Cost of Injury

in the United States

A Report to Congress

1989

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University of California, San Francisco

and

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for

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and

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Preface

Injury is now recognized as a major public health problem in the United States. It is the fourth leading cause of all deaths, but among children and adults under age 45, it is the leading cause of death. Injury is costly to the nation in productive life years lost due to premature death and long term disability; in medical resources used for care, treatment, and rehabilitation of injured persons; and in pain and suffering of the injured persons, their families, and friends.

Background

The present report is the third in a series focusing attention on injury as a critical public health issue. *Injury in America,* the 1985 report from the National Academy of Sciences by the Committee on Trauma Research, the National Research Council, and the Institute of Medicine, launched the series. It found that serious, but remediable, inadequacies exist in the understanding of and approach to injury as a health problem, that current data systems are inadequate for planning and evaluating preventive programs, and that high priority should be given to research on the prevention and treatment of injuries and on the rehabilitation of injured persons. Emphasis was placed on the need for a center for injury control within the federal government and for more adequate resources for research on injury.

Following the publication of *Injury in America*, Congress established a three-year pilot program for the study of injury control at the Centers for Disease Control (CDC). The new Division of Injury Epidemiology and Control began efforts in the following areas: research and data collection, professional training, promotion of health department programs, and coordination at federal, state, and local levels among public health workers and others involved in the field.

In 1988, the National Academy of Sciences published *Injury Control*, the second in the series. This report reviewed the status and progress of the injury control programs at CDC. It commended the accomplishments of CDC activities, but concluded that the full intent of the recommendations made in *Injury in America* had not been met because of the lack of resources and the need for an organizational setting to make the program more widely recognizable as the federal focal point for the conduct and coordination of injury control research.

The present Report to Congress, *Cost of Injury in the United States,* is the third in this series of injury reports. The 1987 Supplemental Appropriation Bill of the House of Representatives (100th Cong., 1st sess.) directed that research be conducted by the joint National Highway

Traffic Safety Administration (NHTSA) and CDC Trauma Research Program to evaluate the impact of injury and associated disability on American society. The report accompanying the legislation states:

> This research should identify the effect of injuries on state and local governments, local communities, families and individuals. Eighteen months following enactment of this Act, a report on the results of this research shall be submitted to the House and Senate Committees on Appropriations. In addition, the report shall provide an estimate of the nation's long-term costs of treatment and rehabilitation of injuries, including motor vehicle injuries, and describe the extent to which existing government and non-government programs cover the economic and non-economic costs. The report shall further provide an estimate of the potential savings to all levels of government that could result from the prevention of injuries, including motor vehicle injuries, and their consequences (U.S. House of Representatives, p. 94).

The present report addresses the purpose and objectives of the mandate. It was conducted under grants from NHTSA and CDC by two research organizations: the Institute for Health & Aging, University of California, San Francisco and the Injury Prevention Center, School of Hygiene and Public Health, The Johns Hopkins University (Grant Nos. DTNH22-88-Z-07145 and DTNH22-88-Z-07144).

Organization of the Report

The report contains five chapters on the incidence and cost of injury, a chapter featuring ten case studies of the long-term impact of injury, and recommendations resulting from the study. Following the Summary and an introduction, Chapters One and Two describe in detail the incidence and lifetime cost of injury. Chapter Three explores the sources of payment for costs incurred following injury and estimates transfer payments from public and private sources to injured persons or their survivors. Estimates of the willingness to pay for the reduction of injury are presented in Chapter Four. Chapter Five assesses potential savings from selected injury prevention programs. Chapter Six consists of ten case studies of injured persons in which personal narratives illustrate the long-term impact of injury on individuals, families, and society. Policy implications emerging from the case studies are presented. The recommendations that follow from the conduct of the study focus on the following issues: injury prevention and control, coding and measurement, data needs, and treatment and rehabilitation.

Acknowledgments

This report on the impact of injuries and their associated disabilities on American society represents a truly collaborative effort of the staff of two universities -- the Institute for Health & Aging, University of California, San Francisco (UCSF), and the Injury Prevention Center, School of Hygiene and Public Health, The Johns Hopkins University (JHU). It is the product of research supported by NHTSA and CDC. The study involved a multidisciplinary approach and many experts, all of whom contributed greatly to the production of this report.

The authors wish to express their appreciation for the invaluable guidance, advice, assistance, support, encouragement and coordination provided throughout the project by Barbara Faigin, Project Officer, NHTSA. Several individuals in NHTSA also provided useful data and expert advice in various aspects of the research including Michael Finkelstein, Steven Luchter, Larry Blincoe, and Louis Lombardo. Mark Rosenberg and Stuart Brown, CDC, also provided invaluable guidance and support.

The principal investigators at UCSF and at JHU gratefully acknowledge the professional expertise and assistance of several colleagues and support staff who had major responsibilities for the various components of the study. At UCSF, Sharon Kaufman, anthropologist, conducted the case studies of injured survivors and their families to measure the long-term impact of injury to themselves, their families, and society. Elizabeth McLoughlin, public health and injury control specialist, provided invaluable expertise in the development of injury incidence categories and the recommendations, writing several sections of the report, and carefully reviewing the entire manuscript. Wendy Max, economist, designed the lifetime cost model and was responsible for the estimation of the direct and indirect costs. The authors gratefully acknowledge the professional assistance of several colleagues at UCSF, including Mitchell P. LaPlante for his guidance in the use of several National Center for Health Statistics public use data tapes; Shubha Fanse for computer assistance; Kristin Jacobson and Norton Twite for word processing. Special recognition is given to the outstanding contribution of Scott Hood in development and layout of the tables and figures and for statistical assistance. We are especially grateful to Ida VSW Red for her special expertise and superior editing of the entire manuscript and for assuming full responsibility for overall design and production of the final report.

At The Johns Hopkins University, Gordon Smith was instrumental in developing the incidence categories and rates. David Salkever, Gregory deLissovoy, and Alison Jones were responsible for estimating the sources of payment. The authors would like especially to acknowledge the contributions of Maureen Fahey, Sharon Edelstein, and Susan Feely. Their expertise in working with large databases and their careful attention to detail was essential in developing the incidence figures and estimates of hospital costs. We are also grateful to Jewel Crum for her assistance in word processing, to Arlene Greenspan for conducting the survey of rehabilitation services administered through state governments, and to Byron Hamilton for providing information from the Uniform Data System for Medical Rehabilitation on source of payment for inpatient rehabilitation.

Two consultants made special contributions to the report. Ted Miller, economist at The Urban Institute, wrote the chapter on willingness to pay and Leon Robertson, Injury Epidemiologist at Nanlee Research and Yale University, wrote the chapter on potential savings from injury prevention.

The authors are indebted to the generosity of the ten participating survivors and their families whose tragedies and triumphs embody the essential subject matter of this report. We thank them for their willingness to share their personal stories. We also thank Joan Leon, Hale Zukos, and Byrd Dunaway from the World Institute on Disability for their assistance in providing background information about government regulations and legal issues in relation to injury and disability, and for preparing a useful annotated bibliography of publications in this area. We appreciate the time spent by health and social service professionals in locating study participants.

We are indebted to several experts in the area of injury prevention and control who carefully reviewed the final manuscript and made important suggestions and comments incorporated in the final report.

Special recognition is given to Professor Susan Baker of the Injury Prevention Research Center, The Johns Hopkins University, and Andrew McGuire of the Trauma Foundation, San Francisco General Hospital. Their leadership in injury epidemiology, prevention, and advocacy, established nationally through decades of work in the field, has guided the development of this report and its recommendations.

We are privileged to have had the opportunity to conduct this important study and to have worked together to produce this report.

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Foreword

Since the end of World War II, more than 6 million U. S. citizens have died from injuries. Such statements remain only numbers unless one can envision over 400 families grieving at a graveside every day of every year. If these injuries could have been prevented, persons who died prematurely would still be alive today. In addition to those who have died from injuries, millions more have been left with severe impairments that will endure for the rest of their lives. Yet this nation has failed to face the extraordinary losses sustained from the problem of injury.

Injury is often viewed as the inevitable price of living in a modern society. This volume provides an estimate of that price as it examines the economic impact resulting from the failure to deal with injury as a major threat to public health. It is only through the systematic examination of the effect of injury on our society that we can fully understand how critical it is to develop a cure for this pervasive killer and crippler.

The researchers reporting in this volume identify, for the first time, the magnitude of the economic effect of injury on the United States. The $158 billion economic cost of injury is compelling, but not nearly as compelling as the case studies. These personal narratives illustrate in human terms the impact of injury on our fellow citizens -- impacts that afflict hundreds of thousands of people each year.

This groundbreaking study makes a number of vital contributions to our appreciation of the scope of the injury problem in this country. For the first time, reliable estimates are presented on the number of fatalities and injuries by cause, an essential step in developing intervention strategies. The information on who pays for injury costs reveals that all sectors of our society are bearing the enormous burden imposed by injury.

The authors also identify strategies that have succeeded in reducing the impact of injury. These strategies have more than paid for themselves and can serve as meaningful examples of how, as a society, we can develop cures for this major public health problem. Failure to fully implement activities with a proven positive savings is a waste of human and financial resources. The savings will accrue to individuals, families, and friends, to all levels of government and the private sector, and to society at large.

The science of injury control requires that competent researchers objectively assemble and analyze data in order to make progress in the prevention of injury and the treatment and rehabilitation of the injured. This major effort to describe the impact of injury in the United States helps to chart a path for a new and rapidly growing field. It is a contribution of major importance. The study provides the tools needed to better understand the impact of injury on our society and to take actions that will reduce the tremendous toll of death and disability in our nation. We need no longer accept injury as an inevitable risk of 20th century life.

William H. Foege, M.D.
Executive Director

The Carter Center
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Summary

In 1987, Congress directed that research be conducted by the joint National Highway Traffic Safety Administration (NHTSA) and the Centers for Disease Control (CDC) trauma research program to evaluate the impact of injury and associated disability on the United States. The Institute for Health & Aging of the University of California and The Injury Prevention Center of the Johns Hopkins University conducted the research and prepared this report to Congress.

This study evaluates the magnitude of the impact of injury on individuals, government programs, and society at large in terms of economic cost and of the effects of injury on people's lives. Comprehensive data on incidence, cause, severity, lifetime cost, life year and productivity losses, and source of funds disaggregated by age and sex are presented. The following topics are addressed:

- Number of people in the United States who are injured and number who die due to injury annually;
- Aggregate lifetime and per person cost to society of injury;
- Long-term cost of treatment and rehabilitation of injuries;
- Years of life lost due to the disabling effects of injury and premature death;
- Age groups most affected by injury;
- Number of persons injured from the major causes of injury and associated cost;
- Number of persons fatally injured, hospitalized, and nonhospitalized and associated cost;
- Burden of injury cost by source of payment;
- Valuing pain and suffering;
- Potential savings from preventive intervention strategies;
- Federal government investment in research on prevention and control of injury relative to research dollars spent for the other leading causes of death;
- Life-long consequences of injury to injured persons and their families; and
- Recommendations emerging from the study for the prevention, control, and further research on the incidence and cost of injury.

Recommendations

Injury Prevention and Control

Recommendation: Direct greater resources to the prevention of injuries and the mitigation of their results through the application of existing knowledge and the development and evaluation of new strategies. Establish and fund a Center for Injury Control within CDC to provide a focal point for national injury prevention activities. Provide additional resources to existing agencies that currently pursue the prevention and control of injury resulting from motor vehicles, fires, consumer products, and occupational hazards.

Recommendation: Conduct research and controlled experiments to evaluate the effectiveness and savings of a wide range of injury control interventions and implement programs shown to be cost effective.

Recommendation: Conduct research to evaluate the societal barriers to the application of injury prevention strategies that have been proven to be effective.

Coding and Measurement Issues

Recommendation: Require the use of both cause and nature or type of injury codes for all hospital discharge data systems and for all data bases having the potential of providing national injury estimates. Require a separate field for the cause of injury code.

Recommendation: Standardize coding of injuries by multiple coding of nature and cause of injury for all data bases intended to provide national estimates of injury. Agency needs for specific information can be met by the addition of customized codes.

Recommendation: Ensure compatibility of International Classification of Diseases (ICD) and Abbreviated Injury Scale (AIS) for classifying anatomic description of injury to permit computerized conversion from ICD to AIS for assigning severity scores on national data bases.

Recommendation: Conduct research on the development and evaluation of a valid and useful classification system for impairments that will meet the needs of researchers, program administrators, and rehabilitation specialists.

Data Needs

Recommendation: Develop a national coordinated program of injury surveillance for the quick identification and control of outbreaks of specific injuries and for epidemiologic research on injuries. For this effort, rely on the integration of uniformly collected data derived from multiple sources at both the national and local levels. To compensate for the time lag inherent in national data bases, states in which the medical examiner and/or hospital discharge data have the necessary quality and currency could monitor their data as an early warning system. Provide resources to achieve these objectives.

Recommendation: Expand core National Health Interview Survey (NHIS) questions relevant to injury to describe the circumstances of injury. In addition, conduct a comprehensive supplement to the NHIS on incidence, medical care, rehabilitation, and disability related to injury. Provide adequate funds for the expansion of the core NHIS questions and for the conduct of a comprehensive injury supplement.

Recommendation: Conduct, with adequate funding, a follow-up survey of respondents to the proposed NHIS Injury Supplement to determine the long-term physical and economic consequences of injury in the general population. Oversample respondents with severe injury resulting in long-term disability.

Recommendation: Develop a series of well-designed, closely coordinated studies of the long-term physical, psychological, and economic consequences of patients treated in several trauma centers throughout the nation.

Recommendation: Conduct, with adequate funding, a national medical expenditure survey periodically, preferably every five years, to provide current expenditure data for the nation.

Recommendation: Implement the recommendations of the National Academy of Sciences Panel on Occupational Safety and Health Statistics of the Committee on National Statistics as soon as possible to provide improved and accurate data on occupational injuries and fatalities.

Recommendation: Require that firearm injuries, in addition to being reportable to the police, be reportable to health departments. Place greater emphasis on coding the type of firearm on the death certificate. Develop a national fatal firearm injury reporting system, comparable to the Fatal Accident Reporting System (FARS), with sufficient data for documenting the firearm problem and designing prevention strategies.

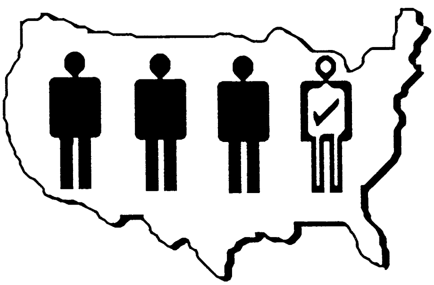
Treatment and Rehabilitation

Recommendation: Conduct collaborative interdisciplinary research to identify and evaluate factors in trauma care that produce optimal results.

Recommendation: Greatly expand research for the development and evaluation of cost-effective model systems of rehabilitation and for the design and production of affordabl.e and reliable assistive devices to serve the needs of people with disabilities. Involve people with disabilities in the decision-making process.

Highlights

How ***many Americans are injured each year?*** About 57 million persons were injured in 1985 -- one in four U.S. residents. Injuries occur to persons of all ages and to both genders, but younger persons and males are most affected.

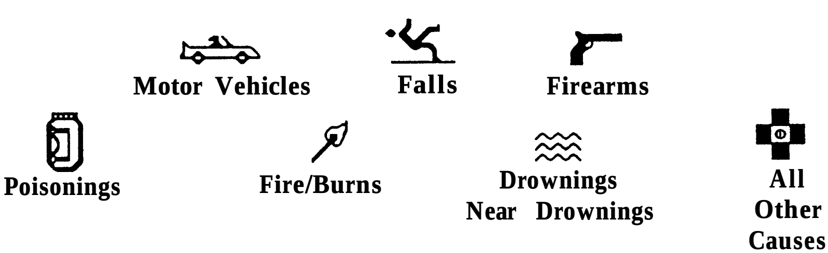


57 Million Persons,
One of Every Four
U.S. Residents,
Injured in 1985

How severe are the injuries? The injury death toll is very high -- 143,000 persons died from injuries in 1985, making injury the fourth leading cause of death in the United States. Hospitalized injuries numbered 2.3 million, and 54 million persons were less severely injured, not requiring hospitalization.

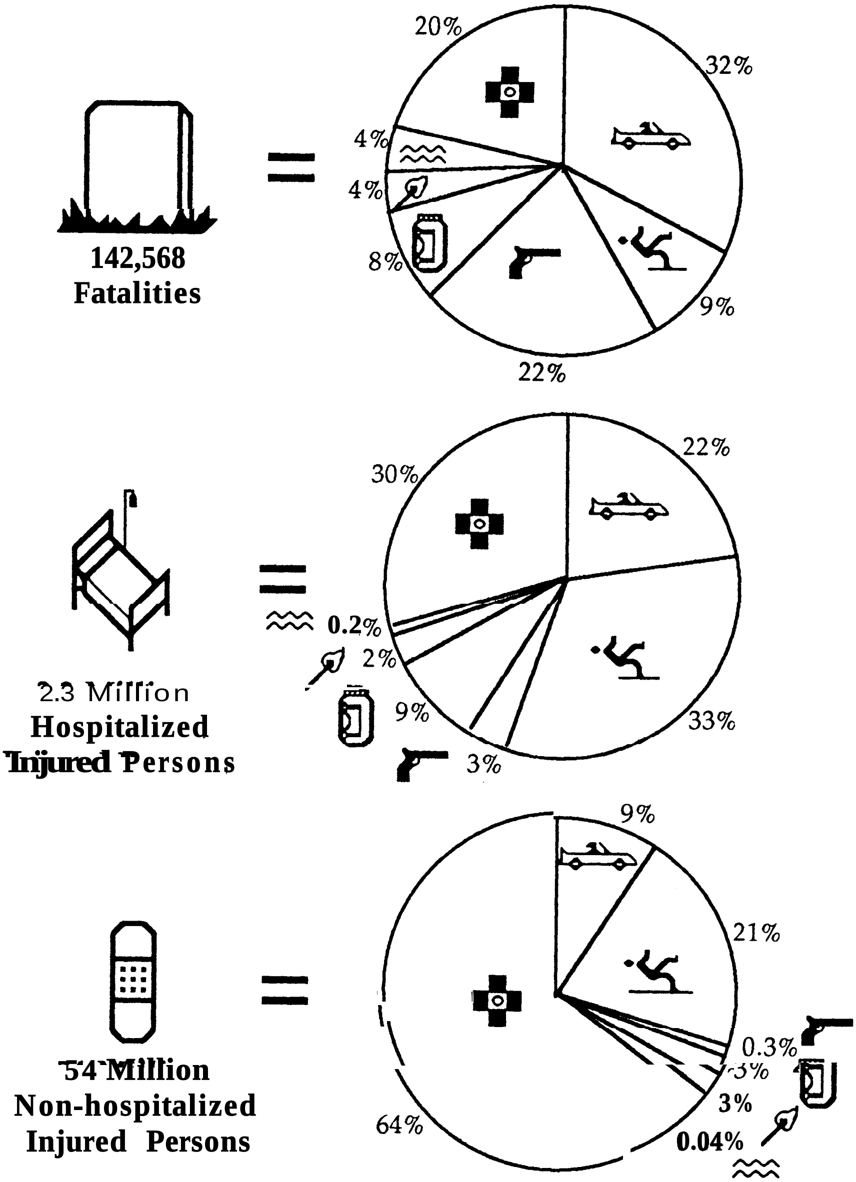
What are the leading injury causes? Falls are the leading cause of injury, accounting for one out of five injuries. Motor vehicle injury, however, is the leading cause of injury death, accounting for one-third of fatal injuries. Falls are the leading cause of nonfatal injury, representing one-third of hospitalized injured persons and one-fifth of nonhospitalized injured persons. All other causes -- injuries due to cutting and piercing instruments or being struck by blunt objects, suffocation, railway and air transportation, etc. -- account for 20 percent of the deaths, 30 percent of hospitalizations, and 64 percent of nonhospitalized injuries.

Leading Causes of Injury



Motor Vehicles the Leading Cause of Injury Death

Falls the Leading Cause of Nonfatal Injury

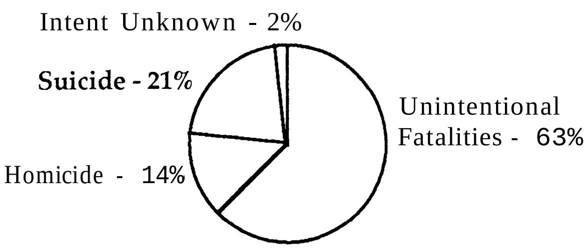


What are the leading causes of hospitalization? Heart disease and injury are the two leading causes of hospitalization (excluding deliveries). During 1987, one of ten discharges and one of six days of care were injury-related.

Who is injured? The young and males are at greatest risk. Four of five injuries are sustained by persons under 45 years of age and the largest number of injuries occurs among those aged 25-44. Three in ten males and one in five females sustain injuries in a year. Males account for 72 percent of injury fatalities, and 56 percent of nonfatal injuries.

How many injury deaths are intentional? More than one-third of all injury deaths result from intentional injuries and, of these, three of five are suicides and two of five, homicides. The remaining two-thirds are due to unintentional causes.

Over One-Third of Injury Deaths Intentional



142,568 Fatalities

What is the total lifetime cost of injury? Injury imposes a $158 billion burden on the U.S. economy. This estimate represents the aggregate lifetime cost for the 57 million persons injured in 1985. The human capital approach is used to estimate the lifetime cost of injury. This method values productivity lost or reduced due to injury. By 1988, the total economic cost of injury sustained in 1985 is estimated at $180 billion.

Total Lifetime Cost of Injury

1985 · $158 billion

1988 · $180 billion

What are the first and later year costs 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. Of the total lifetime cost of $158 billion, almost three-fourths, $116 billion, is for the first year cost and the remaining $41 billion is estimated to be incurred in later years.

Is the economic toll greater for men or women? The risk of injury is highest among males; they sustain 57 percent of the injuries but account for 68 percent of the cost. Almost three in ten males (28%) living in the United States incur injuries in a year. The total lifetime cost of injury for males is more than double that for females -- $108 billion compared with $50 billion. The relatively higher cost for males reflects their higher labor force participation rate, earnings, and fatality rates.

At what age is the economic toll largest? More injuries occur among adults aged 25-44 than in any other age group, and their lifetime cost is highest at $66 billion, 42 percent of the total cost. Injury to persons aged 15-24 ranks second, accounting for 25 percent of total cost.

How much is spent for medical and nonmedical care of injured persons? Expenditures for medical care amount to $45 billion, 29 percent of the total lifetime cost. Included are amounts spent for hospital and nursing home care, physician services, drugs, appliances, and rehabilitation as well as for nonmedical care directly related to the injury.

What is the value of losses in productivity for injured persons? The morbidity loss for persons disabled as a result of injury amount to 5.1 million years of productive output lost, valued at $65 billion, two-fifths of the total economic cost.

What is the death toll? Injury is the leading cause of death for Americans under 45 years of age. About 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. 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 $47.9 billion at a 6 percent discount rate.

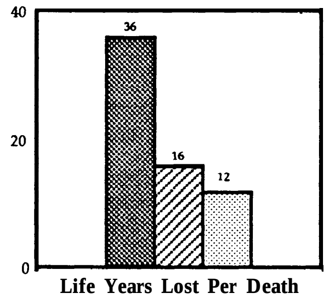
Who pays? Public (federal, state, and local government) funds expended in 1985 amount to $11.6 billion covering 28 percent of the medical expenditure for injury; 72 percent is borne by private sources.

Who bears the burden of disability and survivor benefit payments? These payments, some of which are used for medical care, amount to $53 billion. Of this total, more than one-fourth comes from public programs (Social Security Disability Insurance, Supplemental Security Income, and Veterans Administration).

How much does injury cost the federal government? The federal government pays $8.9 billion for the medical care cost of injured persons, mainly through Medicare and Medicaid. The federal government also pays $13 billion in disability and death benefits under Social Security Disability Insurance, Supplemental Security Income, and the Veterans Administration. Lost tax revenues are excluded.

How does the economic toll of injury compare with that of other leading causes of death? Injury is the fourth leading cause of death, but productivity losses from this cause are far greater than from the three other leading causes of death. Injury deaths represent 36 life years lost per death* and a productivity loss of $334,851 per death. Life years lost per death for the three other leading causes are 12 years for cardiovascular diseases (heart disease and stroke combined) and 16 years for cancer. Cost per death is $51,000 for cardiovascular diseases and $88,000 for cancer.

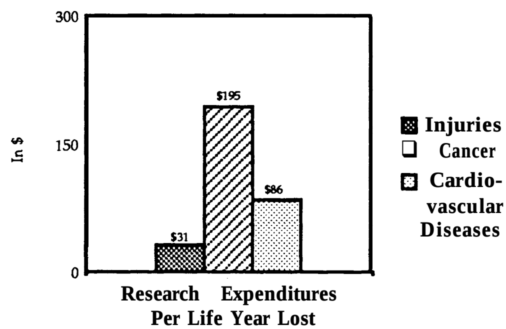
36 Life Years Lost per Injury Death*



"Excludes deaths in later years

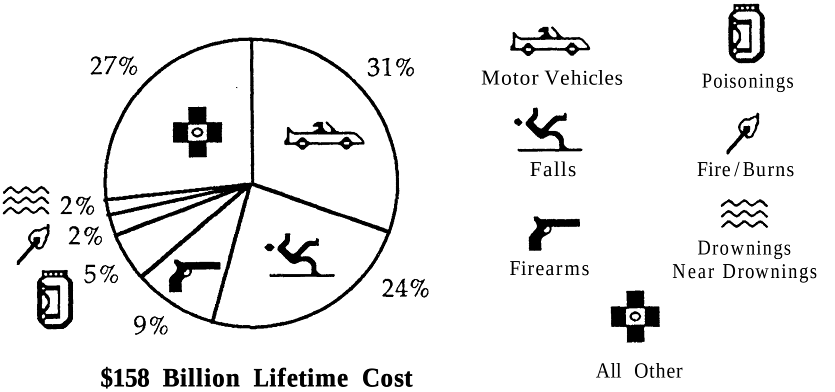
How do injury research expenditures compare with research spending on the other leading causes of death? Comparing federal research expenditures, injury research spending ($160 million) amounts to 11 percent of National Cancer Institute obligations ($1.4 billion) and 17 percent of National Heart, Lung, and Blood Institute obligations ($930 million). A very small amount of research funding is being allocated to injury, a most costly public health problem.

Injury Research Underfunded



Which causes of injury are the most costly ? The greatest economic losses are caused by motor vehicles, accounting for $49 billion, followed by falls ($37 billion), firearms ($14 billion), poisonings ($9 billion), fires and burns ($4 billion), and drownings and near drownings ($2 billion). All other causes of injury total $42 billion altogether.

Motor Vehicle Injuries Most Costly



$158 Billion Lifetime Cost

Can pain and suffering be quantified? The above economic cost, based on the human capital method, does not take into account the cost associated with pain, suffering, and reduced quality of life. An alternative method that incorporates the individual perspective on the value of these aspects of well-being is the willingness-to-pay approach. This method values human life according to the amount individuals spend on injury reduction with potential savings to society. This assessment yields values of $2 million to avoid death. The American public would be willing to pay an estimated $1.1 trillion per year to eliminate all fatal and nonfatal injuries.

Can the economic losses due to injury be reduced? The number of severe injuries could be substantially reduced by greater application of current knowledge. The potential savings, net of the cost of injury control programs, are in the billions of dollars for interventions for which data are available.

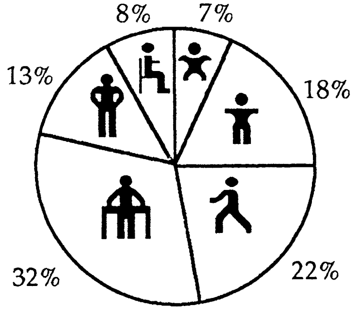
How can the impact of injury on individuals and their families be assessed? An anthropologist interviewed ten people or members of their families about how their lives were changed over a period of **2** to 18 years following severe injury. These case studies describe the struggle to acquire the personal, therapeutic, legal, and financial aid that enables injured people to survive and create lives that are meaningful in terms of work, love, mutual support, recreation, and personal growth.

Findings

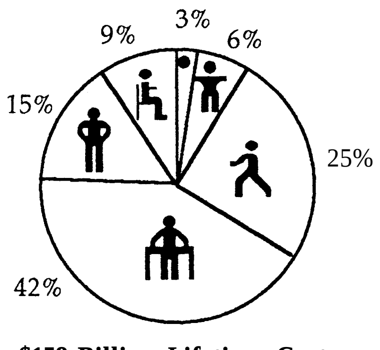
Incidence and Cost

Of the total 56.9 million persons injured in the United States in 1985, almost one-third (18.1 million) are in the 25-44 age group and account for more than two-fifths of the total lifetime cost ($65.8 billion). The second highest number of injuries, more than one-fifth (12.8 million), occurs among persons aged 15-24 and accounts for one-quarter of the total cost ($39.1 billion). About 14 million children under age 15 also suffer from injuries and comprise one-quarter of total injuries and one-tenth of the cost ($13.8 billion). Persons under age 45 sustain almost four-fifths of all injuries and account for three-quarters of the total lifetime cost.

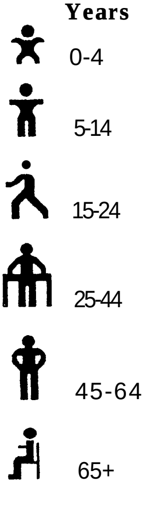
Persons **Aged 25-44 at Highest Risk and Most Costly**



57 Million Injured Persons



$158 Billion Lifetime Cost



Cause of Injury

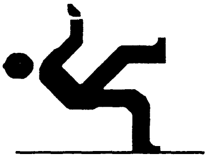
Motor Vehicles

Incidence: Nearly 5.4 million injuries were caused by motor vehicles in 1985. Motor vehicles are the leading cause of injury death (45,923 fatalities) and the second leading cause for hospitalized (523,028) and nonhospitalized (4.8 million) injured persons. The 15-24 age group is at highest risk, and males in this age group are three times more likely to be injured or killed than are females. The elderly rank second in risk of dying of motor vehicle injuries.

Lifetime Cost: Motor vehicle injuries account for 9 percent of total injuries and 31 percent or $48.7 billion in lifetime cost, ranking as the most costly of injury causes. Because of the high number of deaths among young adults, motor vehicle injuries account for over one-third of the mortality cost. Motor vehicle injuries rank second to falls in direct and morbidity costs. About 72 percent of the lifetime cost due to motor vehicles is incurred in the first year after injury.

Per Person Cost: The average lifetime cost per person injured by a motor vehicle is $9,062. The average cost per fatal motor vehicle injury is $352,042, for a hospitalized person, $43,409, and for a person injured but not hospitalized, $1,570.

Falls



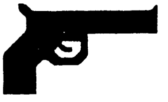
Incidence: Falls are the leading cause of nonfatal injury in the United States, accounting for an estimated 783,000 hospitalizations and **11.5** million persons injured who did not require hospitalization. Falls account for 12,866 deaths. The death rate due to falls among the elderly aged 75 and older is nearly 12 times greater than the rate for all other ages combined, and the risk of hospitalization is nearly seven times as great.

Lifetime Cost: Falls account for $37.3 billion in societal losses due to injury, second to motor vehicle injury. Because of the lengthy hospitalization of elders who fall, direct costs, $14.7 billion, account for 39 percent of the total cost. The mortality cost is relatively low, $1.5

billion, because of the short life expectancy and low earnings of the population at greatest risk. The morbidity cost, $21 billion, is high because falls result in long-term disability, accounting for 57 percent of the total cost.

Per Person Cost: The average lifetime cost per person for a fall injury is $3,033. The average cost per fatal fall is $99,669, the lowest of all causes of injury, reflecting the short life expectancy and low earning power of the elderly population at greatest risk. The average per person cost for hospitalization for a fall injury is $38,174 and for a person injured but not hospitalized, $499.

Firearms



Incidence: Injuries resulting from the use of firearms are the second leading cause of injury death in the United States. In 1985, 31,556 people were shot to death; 39 percent of the deaths were homicide, 56 percent were suicide, and 5 percent were unintentional. The risk of firearm death is highest for the 15-44 age group. Males over age 75, however, have the highest rate of any other age group, due primarily to suicide by firearm. There are an estimated 65,000 hospitalizations for treatment of firearm injuries, and 171,000 persons injured by firearm who did not require hospitalization.

Lifetime Cost: Firearms rank third in the economic toll on society, amounting to $14.4 billion, or 9 percent of the total cost. Firearm injuries account for 5 percent of total injuries, but fatalities at young ages result in a high mortality cost and males are responsible for 86 percent of the cost. Firearm injuries account for $1.4 billion in morbidity cost and 12 billion in mortality cost.

Per Person Cost: The average per person cost of a firearm injury is very high, $53,831, because of the large number of fatal firearm injuries. The average per person cost for a fatality, $373,520, is the highest of any cause of injury. The average cost for hospitalization due to firearm injury is $33,159 and for a person injured but not hospitalized, $458.

Poisonings

Incidence: Poisonings account for 11,894 deaths, 218,500 injured persons hospitalized, and 1.5 million injured persons not requiring hospitalization. Almost all people who die of poisoning are over age 15, and nearly half of all poisoning deaths are ruled as suicide. Males are 1.9 times as likely to die of poisoning as females. For nonfatal poisoning, the elderly, the very young, a.nd adolescents are at greatest risk. Very young children, aged 0-4 years, account for 21 . percent of all nonhospitalized poisonings.

Lifetime Cost: Poisoning accounts for 3 percent of total injuries and 5 percent, or $8.5 billion, of the total lifetime cost of injury, ranking fourth in cost of injury.

Per Person Cost: The average per person cost of fatal poisoning is $372,691, ranking second to the cost of firearm fatality per person because of the large number of poisoning deaths among adolescents and young adults. The average cost per person hospitalized for poisoning is $17,631 and $171 for those not hospitalized.

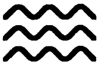
Fires and Burns

Incidence: Fire and bum injuries result in 5,671 deaths, 54,400 hospitalizations, and 1.4 million burns not requiring hospitalization. The very young and the elderly are at highest risk for hospitalization due to burns. Males are slightly more at risk for fire and burn injuries than are females, but the gender differential is not as great as for other injuries.

Lifetime Cost: Fire and burn injuries cost $3.8 billion, accounting for 3 percent of total injuries and 2 percent of the total lifetime cost of injury.

Per Person Cost: The average lifetime per person cost for a fire or burn injury is $2,619. The average cost for a hospitalized bum patient is $35,303, twice that for poisonings. The average fire or burn fatality cost is $249,367 and $347 for a nonhospitalized injured person.

Drownings and Near Drownings



Incidence: In 1985, 6,171 people in the United States drowned. Males are four times as likely to drown as females. Very young children, aged 0-4, are at greatest risk for drownings and hospitalization for near drownings. Young people, aged 15-24, are also at high risk for drownings.

Lifetime Cost: Drownings and near drownings account for $2.5 billion in lifetime cost of injury, less than two percent of the total lifetime cost of injury.

Per Person Cost: Because of the small sample of nonhospitalized injuries due to near drowning and the relatively high proportion of all injuries being fatalities, the average per person cost of near drowning is $64,993. The average fatality cost is $362,292 and for a hospitalized person, $31,408.

Injuries from All Other Causes

Incidence: Injuries from all other causes account for 63 percent of the total number of injuries in the United States in 1985 -- 20 percent of deaths, 30 percent of hospitalizations, and 64 percent of nonhospitalized injuries. Included are injuries due to cutting and piercing instruments or being struck by blunt objects, suffocation, and railway and air transportation (see Appendix A for complete list).

Lifetime Cost: Other injuries account for 27 percent, or $42.4 billion, of the total lifetime cost of injury.

Per ***Person Cost:*** The low average per person cost ($1,187) reflects the large number of persons whose injuries do not require hospitalization, resulting in low medical treatment cost.

Falls, Highest Incidence - Motor Vehicles, Highest Cost

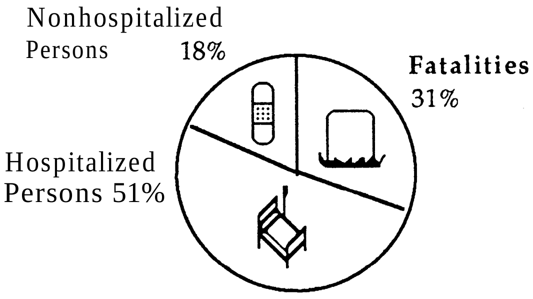
	Injured Persons		cost	
Cause of Injury	Number (000's)	Rate per 100,000	Total (millions)	Per Injured Person
Total	56,859	23,985	$157,615	$2,772
Motor Vehicles	5,372	2,266	48,683	9,062
Falls	12,289	5,184	37,279	3,033
Firearms	268	113	14,410	53,831
Poisonings	1,702	718	8,537	5,015
Fires/ Bums	1,463	617	3,832	2,619
Drownings*	38	16	2,453	64,993
Other	35,726	15,071	42,421	1,187

* Includes Near Drownings

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 injuries sustained in 1985), 2.3 million hospitalized injuries, and 54.4 million nonhospitalized injuries. The distribution of costs by class of injury reflects the severity of the injuries. Of the $158 billion lifetime cost, 31 percent is the cost of fatalities. More than half the cost (51%) is for injuries involving hospitalization and less than one-fifth (18%) for nonhospitalized injured persons.

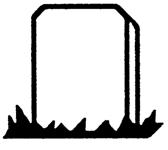
Fatalities Under 1% of All Injuries and 31% of Total Injury Cost



$158 Billion Lifetime Cost

Cost per injured person by class of injury also reflects injury severity. Cost per person fatally injured amounts to $317,189. The cost per injured person hospitalized is $34,116, and per nonhospitalized injured person, the cost is $518.

Fatalities



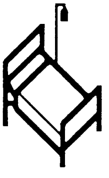
The risk of death from injury is highest among males. Of the total 155,665 injury fatalities occurring in 1985 and in later years, 72 percent are males and 28 percent are females. The lifetime cost for males, however, is significantly higher, 81 percent of the total, reflecting higher labor force participation and higher earnings.

Adults in the 25-44 age group account for 34 percent of the deaths due to injury. Since people who die prematurely in this age group are at the height of their productivity, the present value of future earnings lost is high. Productivity losses for this age group comprise half the total cost of fatalities. The cost per fatality for this age group amounts to $482,583.

By contrast, 21 percent of fatalities are persons aged 65 and over, but less than 2 percent of the lifetime cost of fatality is in this age group. The cost per fatality aged 65 and over amounts to only $25,771 because of short life expectancy and low earnings.

As might be expected, the elderly are at high risk of dying from all diseases, including injury. Thus, the risk of death as a result of injury is highest for adults aged 75 and over. Only 5 percent of the U.S. population is aged 75 and over, but this group accounts for 13 percent of all injuries resulting in death. Adolescents and young adults aged 15-24 rank second in risk of injury severe enough to result in death. Rates are lowest for children aged 5-14.

Hospitalized Injured Persons



About 2.3 million persons sustained injuries severe enough to be hospitalized in 1985 at a total lifetime cost of $80 billion, $34,116 per hospitalized person. Of the 2.3 million hospitalized injured persons, 1.3 million, or 56 percent, are males. The proportion of the total cost for hospitalized injury is higher for males -- 65 percent. Males are apparently involved in more serious injuries that incur higher costs.

Injured persons aged 25-44 are the most costly for hospitalized injuries, comprising 37 percent of the total cost. The 15-24 age group is second costliest for hospitalized injuries. The cost per hospitalized person ranges from $20,661 for the elderly aged 65 and over to $43,169 for adults aged 25-44.

Nonhospitalized Injured Persons

About 54.4 million injured persons, 96 percent of all persons injured in 1985, are not hospitalized. This injury class, although large, involves the least severe injuries. Costs amount to $28.2 billion, 18 percent of the total cost, and $518 per nonhospitalized injured person. Fifty-six percent of the 54.4 million nonhospitalized injured persons are males, and they incur about the same proportion (57%) of the $28.2 billion of nonhospitalized injury.

Nonhospitalized injured adults aged 25-44 are the most costly, comprising 41 percent of the total cost. The 45-64 age group ranks second in cost, accounting for 20 percent of the total. The cost per nonhospitalized injured person, however, is highest for the elderly, amounting to $901 compared to $672 and $791 for those aged 25-44 and 45-64, respectively.

Per Injury Fatality Cost Highest

	Injured	cost	
Class of Injury	Persons (000's)	Total (millions)	Per injured Person
Total	56,859	$157,615	$2,772
Fatalities	143	49,374	317,189 *
Hospitalized	2,347	80,063	34,116
Nonhospitalized	54,369	28,178	518

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

Type of Cost Defined

The lifetime cost of injury includes the amounts spent for medical care and nonmedical services for persons injured in 1985, and the value of losses to society due to premature death or inability to work or to keep house. The lifetime cost takes into account the cost incurred the year in which the injury occurred and the cost incurred in each successive year.

Direct cost includes the amount spent for personal health care for persons injured in 1985, including 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 people. Nonmedical direct costs include expenditures for home modifications, vocational rehabilitation, and overhead and administrative costs for automobile and health insurance. Direct expenditures for medical and nor-medical care amount to $44.8 billion, or 29 percent of the total lifetime cost of injury.

Morbidity cost is the value of goods and services not produced because of injury-related illness and disability. To the degree that injury prevents or deters people from producing goods and services in the marketplace, in the public sector, or in their homes, the value of morbidity losses is a cost borne by the society. 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. Morbidity cost is valued at $64.9 billion, or 41 percent of the total.

Mortality cost is the value of the lifetime earnings lost by all who are fatally injured and die prematurely. This cost is the product of the number of injury deaths and the expected value of future earnings with gender and age taken into account. This method takes into consideration life expectancy at the age of death, changing patterns of earnings at successive ages, varying labor force participation rates, imputed value for housekeeping services, and a six percent discount rate to convert aggregate earnings over a lifetime to present worth. This is the human capital method. Mortality cost amounts to $47.9 billion, or 30 percent of the total.

Type of Cost Distributed

Direct Cost

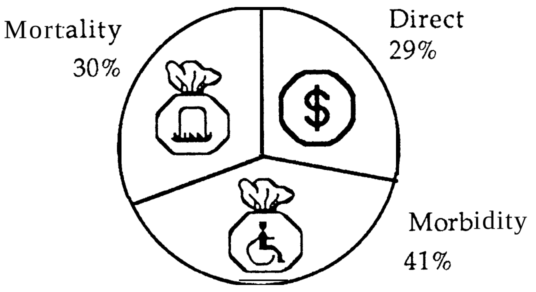
Direct personal medical and nonmedical costs of care for injured persons amount to $44.8 billion. Of this total, $24.5 billion, or 55 percent, is spent for hospital care, including rehabilitation and the cost of professional services provided to hospitalized patients. Physician visits outside of hospitals 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.

Morbidity Cost

Morbidity cost is the value of goods and services not produced because of injury-related illness and disability. Lifetime morbidity cost includes the value of output lost for injured persons who are disabled in later years as a result of injury sustained in 1985. Losses for persons injured and disabled in 1985 amount to 5.1 million life years or 9 life years lost per 100 injured persons. These 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.

The morbidity cost for males is significantly higher than for females, $45 billion compared with $20 billion, respectively. On a per injured person basis, the morbidity cost amounts to $1,407 for males compared with $805 for females, reflecting the higher earnings and higher labor force participation of men.

Disability (Morbidity) Accounts for Two-Fifths of Cost



$158 Billion Lifetime Cost

Mortality Cost

Applying expected lifetime earnings by age and sex to the 155,665 deaths from injury sustained in 1985, including deaths in one or more years after the initial injury, 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. 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, 72 percent of the life years lost, and 82 percent of the productivity losses for 1985.

Most people who die of injuries are relatively young -- one-third of the victims 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 13 percent of productivity lost.

Mortality Cost per Injured Person Highest for 25-44 Age Group

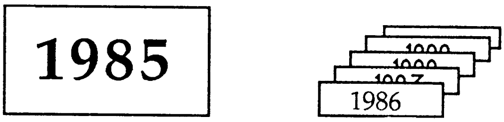
Age and Sex	Cost” (millions)			Cost* per Injured Person		
		Indirect			Indirect	
	Direct	Morbidity	Mortality	Direct	Morbidity	Mortalitv**
Total	$44,807	$64,920	$47,888	$790	$1,145	$307,636
0 4	1,810	1,384	933	445	340	210,403
5-14	4,026	4,067	1,605	395	399	267,864
15-24	8,934	15,725	14,483	702	1,236	427,278
25-44	12,724	28,680	24,418	706	1,592	473,418
45-64	6,757	11,311	5,903	920	1,540	211,936
65+	10,555	3,752	546	2,407	856	17,095

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

First and Later Year Costs

Because many severe injuries result in long-term disability, the lifetime cost of injury takes into account the cost in the first year in which injury occurs as well as the cost incurred in later years. Productivity losses due to premature death are counted as first year costs. Of the total lifetime cost of $158 billion, three-fourths is the first year cost and the remainder is incurred in later years.

Three-Fourths of Lifetime Cost Incurred in First Year



$116 **Billion** **$41 Billion**

Research Investment and Productivity Losses

Injury research expenditures are estimated at $160 million for fiscal year 1987 compared with expenditures for cancer research by the National Cancer Institute of $1.4 billion. The National Heart, Lung and Blood Institute spent $930 million for cardiovascular research in FY 1987. Comparing research investment per life year lost due to these three major causes of death shows that although injury is a large public health problem, it receives a disproportionately small share of research funding. Injury research spending per life year lost is 11 percent of that for cancer and 17 percent of the amount spent for cardiovascular research. Life years lost per injury death (36 years), however, are 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).

Source of Payment

Of the total $44.8 billion direct cost, $41.7 billion is distributed by source of payment. The remainder, $3.1 billion, includes amounts spent for ambulance, helicopter, attendant care, and other expenses for which source of payment data are not available.

About 72 percent of the direct cost is borne by private sources (private health insurance, workers' compensation, uninsured care, and other private sources); public sources (federal, state, and local governments) account for 28 percent. Public sources, mainly Medicare, pay 72 percent of the direct cost for injured persons aged 65 and over. For injured persons under age 65, however, 85 percent of the direct cost comes from private funds, mainly private health insurance.

Of the hospital cost for injured persons, 32 percent comes from public sources, and the remaining 68 percent from private sources, mainly private health insurance. Private sources cover the bulk of expenditures for physician visits, prescription drugs, and physical therapy. For nursing home care, almost one-half of the expenditure comes from public sources, of which 57 percent are federal funds and 43 percent, state and local government funds.

Private Sources Bear the Greatest Injury Burden

	Amount (millions)	Distribution
Total	$41,742	100.0 %
Public	11,598	27.8
Federal	8,860	21.2
State and Local	2,738	6.6.
Private	30,144	72.2
Workers' Compensation	6,997	16.8
Private Insurance	14,162	33.9
Uninsured Care	6,932	16.6
Private	2,053	4.9

Transfer Payments

Transfer payments represent a transfer of funds from one payer to another and do not represent new goods or services produced. Insurance settlements, for example, are funds transferred from the insurance company to the injured individual to pay for medical services that are counted in the direct medical cost. The magnitude of transfer payments due to injury is large, amounting to $52.6 billion for 1985 (lost taxes are excluded). Of this total, $23.3 billion (44 percent) consists of disability payments. Auto insurance pays $22.9 billion, or 44 percent, of all transfer payments. Workers' Compensation programs pay $13.1 billion in disability payments and an additional $1.7 billion in survivor benefits. Social Security pays $4.4 billion in disability payments and $2.9 billion in survivor benefits.

Injury Transfer Payments - $52.6 Billion

Program	Total	Public	Private
Total	$52,578	$13,972	$38,606
Veterans Administration	2,560	2,560	
Social Security Disability Insurance	7,340	7,340	
Supplemental Security Income	1,033	1,033	
Workers' Compensation	14,822	3,039	11,783
Private Insurance	3,898		3,898
Automobile Insurance	22,925		22,925

Of the total $52.6 billion, 27 percent is paid from public funds, including Social Security Disability Insurance, Veterans Administration, and Supplemental Security Income. Private funds, 73 percent of total transfer payments, include private disability and life insurance and Workers' Compensation, a federally administered program primarily financed by employers.

Willingness to Pay

The total cost of injury in 1985 amounts to $158 billion, employing the human capital approach that measures the value of lost output due to reduced productivity of individuals killed, injured, or disabled. Willingness to pay, on the other hand, reflects the value placed on health and life by individuals and measures how much people are willing to pay for safer and healthier lives. It incorporates the value of pain, suffering, and loss in quality of life associated with injury.

Based on a review of 29 studies, willingness to pay to save one life ranges from $1.0 million to $3.1 million, with a mean of $1.95 million. To avoid moderate to critical injuries, willingness-to-pay estimates range from $31,000 to $1.5 million. To avoid severe head injuries involving total impairment, quadriplegia, or very severe burns, willingness-to-pay estimates range from $2.6 million to $3.2 million.

Potential Savings from Injury Prevention

The large number of premature deaths and disabilities due to injury and the high economic cost, including large public sector expenditures, highlight the need to reduce the burden of injury in the United States. The application of current knowledge to implement a variety of injury control interventions can substantially reduce the incidence, severity, and accompanying cost of injury. Examples of successful interventions to prevent injury range from the adoption of automatic braking, signaling and coupling systems for railroads in the nineteenth century to reductions in highway deaths resulting from Federal Motor Vehicle Safety Standards introduced since 1966.

Interventions for which data are available to estimate savings to society are discussed. Many more interventions are identified, but adequate data are not currently available to estimate savings. For the interventions analyzed, the precision of estimates varies depending on research design and generalizability of research findings to the total U.S. population. Although there is some uncertainty in each estimate of injury reduction, there is no doubt that many serious injuries could be prevented or reduced in severity.

Savings for the interventions are estimated on the basis of both the human capital and the willingness-to-pay methods. Employing the two methods shows the range of savings. The human capital method provides the lower level of savings; willingness-to-pay estimates are higher for each intervention.

Air Bag Savings Highest

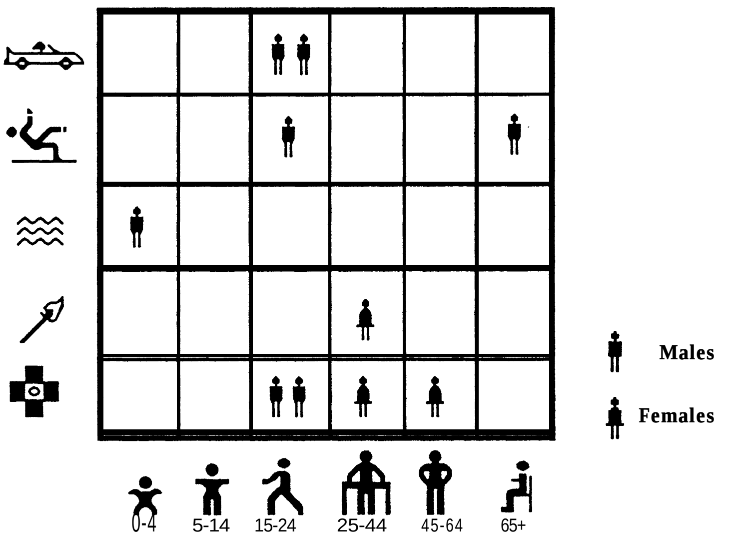
	Savings (millions)	
Intervention	Human Capital	Willingness to Pay
Child pedestrian injury campaign	$58	$180
Bicycle helmet promotion	183	284
Driver education elimination	863	2,230
Minimum licensure at age 37	1,446	4,267
Motorcycle helmet use laws	97	1,200
Reduced ignition of cigarette paper	187	1,100
Air bags	4,650	19,491
Side crash protection	0	1,529
Automatic vehicle lights	0	534

Impact of Injury on Individuals and Families

An anthropological investigation of ten injury survivors and family members defines devastating impacts outside the spectrum of economic cost measurement. Ten case studies describe the struggle to acquire the personal, therapeutic, legal, and financial aid that enables injured persons to survive, meet their basic needs, and create for themselves lives that are meaningful in terms of work, love, mutual support, recreation, and personal growth. Data were collected from five injury survivors, four parents of survivors, one spouse, and one sibling. The subjects present experiences, events, and concerns emerging as central to their lives two to eighteen years after a severe injury occurred. Though small, the California study group represents a range of economic, occupational, and educational backgrounds.

The case studies illustrate the following injuries: automobile crash, motorcycle crash, near drowning, diving into shallow water, contact sport, brutal beating, fall following an illness, fall in the workplace, and crush following malfunctional workplace equipment. The studies represent the following residual disabilities: quadriplegia, ventilator-dependent quadriplegia, brain damage, severe central nervous sys tern damage, facial disfigurement, amputated and deformed fingers, functionless hand and arm, and general weakness and inability to walk.

Ten Personal Narratives



Case Study Findings

Money is central to the well-being of the injured person and family. The cost of severe injury goes far beyond initial medical treatment and includes housing, disability-related equipment, long-term rehabilitation, education, and vocational training. For most individuals, the ability to financially survive a catastrophic injury depends on winning a large legal settlement in addition to having good private insurance coverage. It is realistic to be continually fearful of the cost of potential medical complications, follow-up surgical procedures, and future rehabilitation, housing, education, or job-training requirements. Needs do not stop with medical stabilization; they continue for years or for a lifetime.

Consequences of severe injury have a far-reaching impact that goes beyond economic cost. Profound disability affects all aspects of injured persons' existence for the rest of their lives. Disability disrupts, changes, and dominates family life forever. One family member, usually the mother or spouse, becomes the primary caregiver and devotes her life to the well-being of the injured person, calling on all the personal and community resources of which she is aware.

Government benefits are determined on an either/or basis: disabled or employable, sick or healthy, indigent or ineligible for funds. Such inflexible criteria may not fit individual needs or unusual situations. Federal regulations are insensitive to the fact that many severely disabled people want to work and are capable of doing so. SSI and Medicaid have complex and variable eligibility criteria and are designed to provide benefits to the disabled at or below the poverty level. Services for the disabled are not consistently available across the country.

A severe injury renders individual access to medical and social services, work, and housing questionable. Study subjects needed to negotiate for years with health care, legal, and insurance institutions in order to secure **a** place for themselves in society following injury. Access to long-term rehabilitation, psychological support, appropriate attendant services, housing, medication, equipment, and employment opportunities all had to be negotiated -- indeed, fought for -- within the regulations and policies of particular agencies and institutions.

All individuals interviewed illustrate characteristic American values. In spite of their great need for the resources of society, injured persons exhibit a determination to be self-reliant and independent in the face of profound challenges. Family members maintain responsibilitv toward injured persons with disabilities regardless of the emotional and financial burden of the commitment.

Introduction

The impact of injury on society is enormous in terms of the economic cost, the public and private burden of the cost, and the devastating effect on the lives of injured persons and their families. The cost of years of life lost from premature death due to injury and from productive work losses due to disability is higher than from any other single cause of death, including heart disease and cancer. Expenditures for research on injury causation, prevention, and control nevertheless continue to be dwarfed by research expenditures for other health problems. This report evaluates the magnitude of the impact on individuals, government programs, and society at large in terms of economic cost and of the effects of injury on people's lives. To evaluate these impacts, data are needed on the extent of the problem -- the number, causes, and severity of injuries in the United States -- as a basis for measuring the economic and human toll. Such measurements have been made by other researchers. Nevertheless, comprehensive data on incidence, cost, life years lost, source of funds, cause, and severity disaggregated by age and sex are not available in one document. Likewise, the long-term costs of treatment, rehabilitation, and lost productivity are rarely quantified.

This report documents and evaluates each area presented in a set of statistical tables and figures. The incidence of injury runs into millions of persons, and the cost into billions of dollars. These data are especially valuable when they furnish clues to a more efficient attack on specific aspects of the injury problem. But estimates do not measure the full impact of the injury epidemic in the United States. Nor do they express the personal and economic hardships faced by individuals and their families in the wake of a severe disabling injury. The case studies presented herein provide a measure of that impact.

While it is exceedingly difficult to quantify all aspects of the burden imposed on society by injury, it is important to translate this burden to economic terms in order to facilitate decision-making. The continued rise in health care expenditures and the growing pressures for cost containment may constrain the amount of limited resources available to provide the health care needed by Americans.

The question then arises: just where should health care priorities be placed? The solution is to place priorities where there is likely to be the greatest improvement in welfare or well-being as measured by the magnitude of the economic and social burden of health problems. This means giving priority to the areas placing the greatest burden on society. For example, injury research expenditures by all federal agencies amounted to $160 million in 1987, about one-tenth of the National

Cancer Institute expenditures and one-sixth of the National Heart, Lung, and Blood Institute expenditures. Life years lost per injury death, however, are more than twice the number for cancer (36 years compared with 16 years) and three times those for cardiovascular diseases (12 years). Moreover, the mortality cost per injury death ($335,000) is almost four times the cost for cancer ($88,000) and more than 6 and 1/2 times the cost for cardiovascular diseases ($51,000). There is, therefore, a clear case for allocating significantly increased funds to prevention, treatment, and research on injury in proportion to the burden placed on society.

The economic burden of injury is also used to make program policy decisions, to prepare and deliver testimony, and to support agency budgets. The importance of relieving the severe consequences of injury can be weighed against the need to allocate funds to other social, public health, and medical care problems.

Dimensions of the Injury Problem

Injuries are costly -- in dollars, in pain, in grief, in lives. Substantial resources are used in the care, treatment, and rehabilitation of injured persons. The lives lost are among the young whose productivity is lost to society. The burden on public resources is large. The potential for reducing the number and severity of injuries and thus saving public and private funds is great. Finally, the long-term impact of injury on injured persons and their families is also significant. This study examines and documents all of these dimensions of the problem.

Incidence of Injury *(Chapter 1)*

One of four persons is injured annually in the United States. A total of 57 million persons incurred an injury in 1985. Over 142,000 residents of the United States were fatally injured, occasionally making headlines when several people died at once. More commonly, however, injury deaths, approximately 390 a day, occur in isolation or in pairs, caused by motor vehicle crashes, falls, firearms, poisonings, fires and burns, drownings, and other causes. Injury is the fourth leading cause of death, after heart disease, cancer, and stroke. For children and young adults under age 45, injury is the leading cause of death.

Each year, 2.3 million residents of the United States are hospitalized as a result of injury, and 54 million seek some form of medical care for injuries. Injury is also a leading cause of disability; Americans spent 127 million days in bed due to injuries in 1987.

Nonfatal injuries cause pain and suffering, permanently damage bodies and brains, and affect job opportunities and families. As trauma care systems improve, more severely injured people survive, most frequently with inadequate financial resources to meet enormous needs.

Economic Cost of Injury (Chapter 2)

From the moment -- and it is often merely seconds -- required to sustain an injury, costs accrue. Emergency medical services; hospital, physician and rehabilitation charges; and loss of work and income are the most obvious costs of injuries. The life years lost due to illness, disability, and premature death are also costly to the nation. The life years lost annually add up to more than 10 million.

The total lifetime cost of the 57 million persons injured in 1985 in the United States is enormous, estimated at $158 billion. This estimate is based on the human capital approach to cost-of-illness measurement. This method takes into account all the medical care and related resources used for care, treatment, and rehabilitation of injured persons. Also included is the value of medical care resources used and earnings forgone because of illness, disability, and premature death due to injury. Included is an imputed value for housekeeping services. However, several important injury effects are not measured, such as pain and suffering, reduced productivity of family members and caregivers, and the value of volunteer services. Legal and court costs and property damage are also not included because this report focuses on the cost of injury and excludes the costs associated with the damage caused by the event resulting in injury.

Source of Payment *(Chapter 3)*

The effort to define the range of effects of injury on individuals and society requires information on who bears the cost burden of injury. Much of that burden is due to the large expenditures for medical care paid by various types of payers -- federal, state, and local governments, private insurance, workers' compensation, and individuals. Federal payments for medical care of injured persons amount to $8.9 billion for 1985. In addition, the magnitude of transfer payments is assessed. Transfer payments represent a transfer of funds from public and private sources to injured persons or their survivors. Included are benefit payments made by government programs (e.g., Veterans Administration, Social Security, and Workers' Compensation) and private insurance. In 1985, the federal budget included payments of $12.8 billion for disability and death benefits. These program costs can be saved through reductions in the number and severity of injuries.

Willingness to Pay (Chapter 4)

Another approach to injury loss measurement is the willingness-to-pay method, which bases the value of human life on the amount an individual would be willing to pay for a safer and healthier life by reducing the probability of illness or death. This approach incorporates all aspects of individual well-being including the value of pain and suffering. Although several measurement issues need to be studied further, values estimated by this approach have been used for cost-benefit analysis in several government and private contexts. The value of life estimate using this technique is about $2 million compared to an average injury fatality cost of almost $350,000 using the human capital approach.

Potential Savings from Injury Prevention (Chapter 5)

During the past three decades, there have been reductions in fatalities and injuries, most notably from motor vehicle crashes. The potential exists, however, for even further reduction with appropriate allocation of research funding. This chapter addresses the issue with a view toward estimating potential savings based on specific injury prevention strategies. As with any assessment involving humans interacting with the physical forces of the environment, there are degrees of uncertainty in the reduction impact that would result from implementation of specific intervention actions. An assessment of several programs is presented for the reduction of injuries based on injury costs developed for this study by both human capital and willingness-to-pay methods. The results of this assessment suggest that action can be taken to further reduce injuries. However, more research is needed to better identify the most effective strategies for reducing injuries and their high costs.

Long-Term Impact of Injury on Individuals, Families, and Society (Chapter 6)

The lives of persons injured and their families are significantly affected by severe injuries that result in long-term disability. These impacts are outside the spectrum of economic cost measurement. Although previous case study research has been conducted on the changes that occur in peoples' lives due to debilitating injury, more detailed information, collected in a systematic fashion, is needed before general conclusions can be drawn from the broad array of injury consequences. The approach taken is an anthropological investigation of 10 injury cases to define the range of the debilitating and often devastating outcomes. The case studies describe many barriers that people with disabilities from injury must overcome in order to create meaningful and valuable lives.

Recommendations

The estimated number of persons injured and lifetime cost of injury in the United States are the best estimates based on existing data. The present study utilizes information from numerous sources, but in many cases estimates are necessarily made on the basis of limited data. The recommendations address four major issues.

Injury Prevention and Control: Direct greater resources to the prevention of injury. Conduct research and controlled experiments to evaluate the effectiveness and savings of injury control interventions and to evaluate the societal barriers to application of injury prevention strategies.

Coding and Measurement: Require all hospital discharge data systems to use both cause and nature of injury codes. Standardize the coding of injuries. Make International Classification of Diseases (ICD) and Abbreviated Injury Scale (AIS) systems for classifying injuries compatible. Conduct research to develop a classification system for impairments.

Data Needs: Develop a coordinated national program of injury surveillance and provide sufficient resources to implement it. Expand core National Health Interview Survey (NHIS) injury questions and conduct a comprehensive injury supplement. Conduct longitudinal studies. Periodically conduct a national medical care expenditure survey to obtain injury cost data. Improve data on occupational injuries and fatalities and on firearm injuries.

Treatment and Rehabilitation: Conduct interdisciplinary collaborative studies on trauma care and expand research on model rehabilitation systems.

Chapter 1

Incidence of Injury

Essential to developing estimates of the economic cost of injury are data on incidence by major age, sex, and cause categories. Estimates of numbers and rates of injury are presented in this report for three mutually exclusive classes that reflect severity of injury: 1) injury resulting in death, including those occurring in and outside a hospital or other institution, 2) injury resulting in hospitalization **with survival to** discharge, and 3) injury requiring medical attention without hospitalization or injury resulting in one or more days of self-reported restricted activity without medical attention. Injury not severe enough to result in either medical attention or one or more days of restricted activity is excluded from the definition. Estimates of incidence and economic cost reported herein are for 1985, the most recent year for which reliable data for each class of injury are available.

Within each class of injury (fatal, hospitalized, and nonhospitalized), incidence estimates were developed for each of seven age groups (O-4; 5-14; 15-24; 25-44; 45-64; 65-74; 75 years and over), two sex groups, and seven categories of cause (motor vehicles, falls, firearms, poisonings, fires and burns, drownings and near drownings, and other). Injuries were classified by cause regardless of intent. For example, deaths classified as caused by firearms include those related to both the intentional and the unintentional use of firearms. For deaths and hospitalizations, estimates were also developed by the presumed intent of the injury, categorized as intentional, unintentional, or intent unknown. Sufficient data were not available, however, to produce comparable estimates of nonhospitalized injuries by intent. Specifics regarding the methods used in developing the incidence figures within each class of injury are detailed in the methods section at the end of the chapter.

Overview

In 1985, injuries resulted in 142,568 deaths (plus an additional 13,097 deaths that occurred in later years resulting from injuries sustained in 1985), 2.3 million persons hospitalized, and 54.4 million nonhospitalized injured persons in the United States (Table 1). This translates into **a** total of 56.9 million persons injured or 24 persons injured per year for every 100 U.S. civilian residents (the number of persons in the U.S. is shown by age and sex in Appendix Table C-l). Almost one in four people in this country sustains an injury during a year. Many of these injuries are fatal or serious enough to require hospitalization and are associated with long-term disability.

Table

Number **and Rate of Injured Persons by Sex, Age, and Class of Injury, 1985**

Age and Sex	Total Number (000's)	Total Rate per 100,000 Persons	Fatalities* Number	Fatalities* Rate per 100,000 Persons	Hospitalized Number	Hospitalized Rate per 100,000 Persons	Nonhospitalized Number (000's)	Nonhospitalized Rate per 100,000 Persons
Total	56,859	23,986	142,568	60.1	2,346,735	990.0	54,369	22,936
0-4	4,071	22,621	4,363	24.2	112,434	624.8	3,954	21,972
5-14	10,189	30,039	4,962	14.6	205,047	604.5	9,979	29,420
15-24	12,750	32,892	29,412	75.9	464,078	1,197.2	12,257	31,619
2544	18,063	24,769	47,824	65.6	678,318	930.1	17337	23,773
4564	7,369	16,417	25,601	57.0	376,837	839.5	6,967	15,520
65-74	2,385	14,006	11,877	69.8	179,958	1,056.9	2,193	12,879
75+	2,032	17,616	18,529	160.7	330,062	2,862.0	1,683	14,593
Male	32,116	28,018	102,804	89.7	1321,573	1,152.9	30,692	26,776
04	2,457	26,682	2,570	27.9	65,293	709.1	2,389	25,945
5-14	5,984	34,457	3357	19.3	138,008	794.6	5,843	33,643
15-24	8,027	41,686	23,095	120.0	318,412	1,653.7	7,685	39,912
2544	10,945	30,551	37,612	105.0	454,053	1267.4	10,453	29,178
45-64	3,463	16,166	18,693	87.2	201,620	941 .1	3243	15,138
65-74	711	9,497	7,751	103.7	65,056	869.2	638	8,524
75+	530	13,038	9,726	239.4	79,131	1,947.1	441	10,851
Female	24,742	20,209	39,764	32.5	1,025,162	837.3	23,677	19,339
04	1,614	18,365	1,793	20.4	47,141	536.4	1,565	17,808
5-14	4,205	25,403	1,605	9.7	67,039	405.0	4,136	24,988
15-24	4,723	24,207	6,317	32.4	145,666	746.6	4,571	23,428
2544	7,118	19,186	10,212	27.5	224,265	604.5	6,884	18,554
45-64	3,907	16,650	6,908	29.4	175,217	746.7	3,725	15,874
65-74	1,673	17,533	4,126	43.3	114,902	1,204.1	1,554	16,285
75+	1,502	20,106	8,803	117.9	250,931	3,359.6	1,242	16,629

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

Of the total 56.9 million persons injured in the United States in 1985 almost one-third (18.1 million) occurs in the 25-44 age group. The second highest number of injuries, more than one-fifth (12.8 million), occurs among persons aged 15-24. About 14 million children under age 15 also suffer from injuries and comprise one-quarter of the total injured population. Thus, persons under age 45 sustain almost four-fifths of all the injuries in the United States.

The risk of injury is highest among males; they sustain 56 percent of all injuries. Almost three of ten males (28%) incur injuries. Among females, the risk is lower -- one of five sustains injuries during a year. For both males and females, the largest number of injuries occurs among those aged 25-44. The risk is highest, however, among younger males than for any other sex or age group -- 42 percent of adolescent and young males aged 15-24 sustain injuries during a single year. Motor vehicle injuries are the leading cause of death for both males and females, whereas falls are the leading cause of nonfatal injury. These patterns by age, sex, and cause of injury are described below in more detail by class of injury.

Age and Sex Patterns

The largest number of injuries in each class is among males. Nearly three-quarters (72%) of injury deaths and over one-half (56%) of nonfatal injuries occur among males (Figure 1). Adults in the 25-44 age group account for 34 percent of deaths due to injury; 29 percent of injured persons hospitalized and 32 percent of the less severely injured nonhospitalized persons are in this age group. Adolescents and young adults aged 15-24 rank second in number of injuries for each class of injury. Ranking third in number of fatalities and hospitalizations are persons aged 45 to 64. Children aged 5-14 rank third in number of nonhospitalized injuries (Figure 2). Unlike other leading causes of death and hospitalization (such as cancer and heart disease), nearly 80 percent of the injuries resulting in death or hospitalization occur among persons less than 65 years of age; nearly two-thirds occur among persons less than 45 years of age.

The risk or rate of injury presents a different picture (Figure 3). Although the number of deaths and hospitalizations due to injury for the elderly aged 75 and over are lower than the number in the three younger age groups (15-24, 25-44, and 45-64), the risk of both death and hospitalization as a result of injury is highest for adults aged 75 and older (161 and 2,862 per 100,000 U.S. civilian residents for deaths and hospitalizations, respectively). Their fatality and hospitalization injury rates are nearly three times as high as the rates for all ages combined. The elderly aged 75 and older comprise only 5 percent of the U.S. population but account for 14 percent of all injuries resulting in death or hospitalization. Adolescents and young adults aged 15-24 rank second in risk of injury severe enough to result in death or hospitalization (76 and 1,197 per 100,000, respectively). Rates are lowest for children in the 5-14 age group.

Figure 1

Distribution of Injured Persons by Sex and Class of Injury, 1985

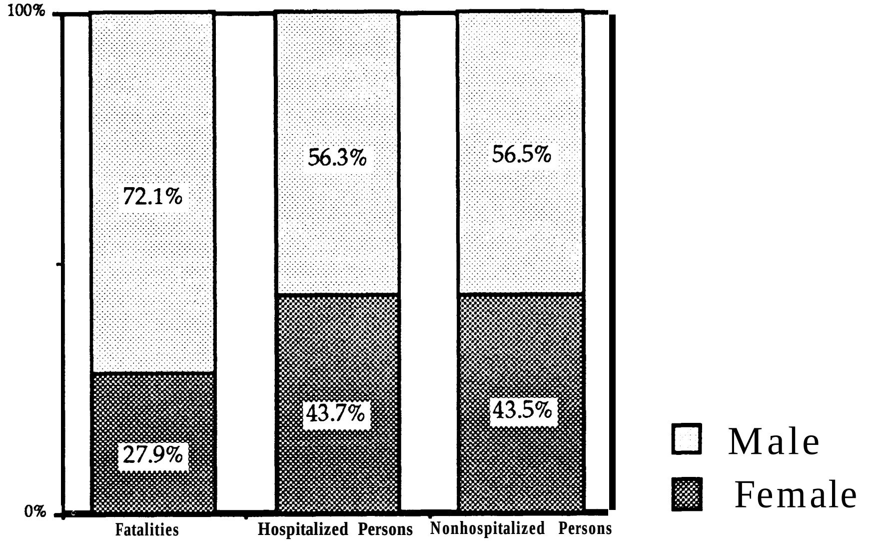
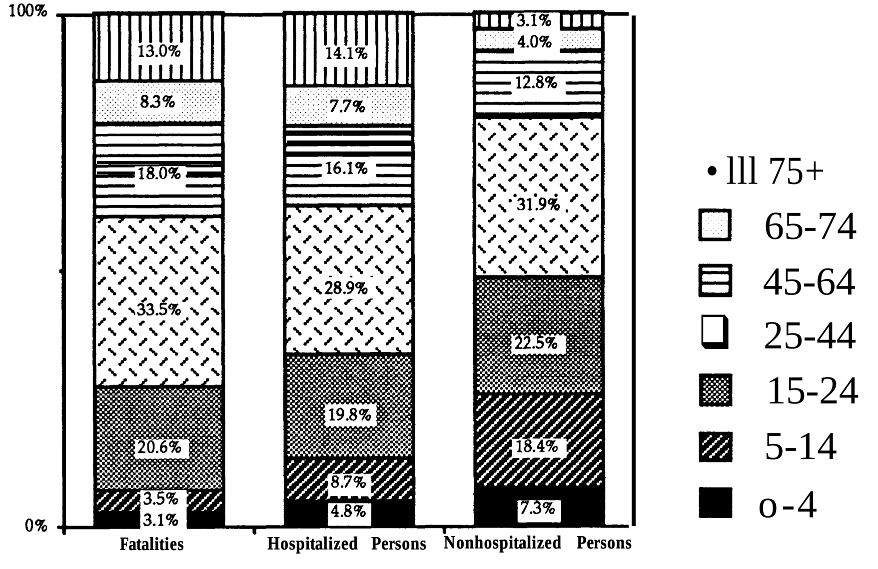


Figure 2

Distribution of Injured Persons by Age and Class of Injury, 1985



Patterns of injury by age are considerably different for less severe injuries not resulting in hospitalization. The elderly aged 75 and older are at a comparatively low risk of minor injury (14,593 per 100,000). Children aged 5-14 and adolescents and young adults aged 15-24 are at the highest risk of minor injury (29,420 and 31,619 per 100,000, respectively).

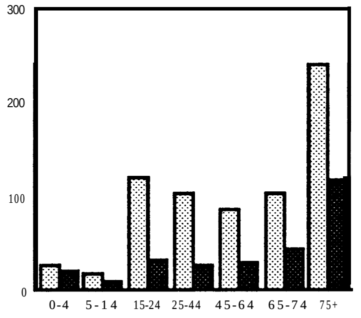
The risk of injury also varies by sex within each class of injury. In every age group except the very young, aged 0-4, the injury death rate for males is more than twice as high as the rate for females. In contrast, males are only 1.4 times as likely as females to sustain a nonfatal injury. Furthermore, among older adults, the risk to females of nonfatal injuries actually exceeds the risk to males. Among adults aged 65 and over, females are one and one-half to two times as likely as males to suffer a nonfatal injury.

Cause of Injury

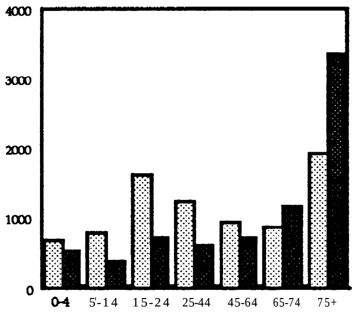
The distributions by cause vary for deaths, hospitalizations, and nonhospitalizations as shown in Table 2 and Figure 4. The number of injuries and rates for each cause of injury are shown in Appendix Tables C-2--C-8. The two leading causes of injury death are related to motor vehicles and firearms. They account for 45,923 and 31,556 deaths, respectively (19.4 and 13.3 per 100,000, respectively). Together, these two leading causes of injury death comprise more than half of the injury deaths. In contrast, the leading cause of nonfatal injury is falls, accounting for 783,357 hospitalizations (331 per 100,000) and 11.5 million nonhospitalized injured persons (4,848 per 100,000). Motor vehicle injuries comprise the second leading cause of nonfatal injury, resulting in 523,028 hospitalizations (221 per 100,000) and 4.8 million nonhospitalized injured persons (2,026 per 100,000). Firearms, on the other hand, account for less than 1 percent of nonfatal injuries. These differences in distribution by cause and class underscore the lethality of injuries involving firearms and motor vehicles.

Injuries categorized as ‘other’ include a variety of causes. For deaths, other causes primarily include stabbings, suffocations from foreign bodies, and hangings and represent 20 percent of all injury deaths. Nonfatal injuries resulting from other causes are primarily those related to being stabbed, hit by an object or person, or injured by a cutting or piercing instrument. Thirty percent of hospitalized injuries are in this category. For less severe nonhospitalized injuries, additional common causes categorized as ‘other’ include animal and insect bites, one-time lifting or exertion, and twisting or stumbling, and they comprise 64 percent of nonhospitalized injuries.

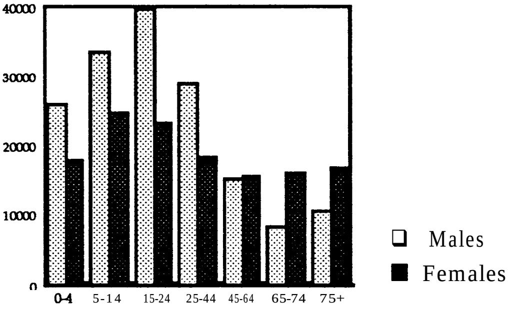
Figure 3
All Causes: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

Table 2

Number and Rate of Injured Persons by Cause and Class of Injury, *1985*

	Total		Fatalities*		Hospitalized		Nonhospitalized	
Cause	Number (000's)	Rate per 100,000 Persons	Number	Rate per 100,000 Persons	Number	Rate per 100,000 Persons	Number (000's)	Rate per 100,000 Persons
Total	**56,859**	**23,985**	**142,568**	60.1	**2,346,735**	**990.0**	**54,369**	**22,935**
Motor Vehicles	**5,372**	**2,266**	**45,923**	19.4	523,028	220.6	4,803	2,026
Falls	**12,289**	5,184	12,866	5.4	783,357	330.5	11,493	4,848
Firearms	**268 ****	113	31,556	13.3	65,129	27.5	171 **	72
Poisonings	**1,702**	718	11,894	5.0	218,554	92.2	1,472	621
Fires/Burns	**1,463**	617	5,671	2.4	54,397	22.9	1,403	592
Drownings	**38 ****	16	6,171	2.6	5,564	2.3	26**	11
Other	**35,726**	15,071	28,487	12.0	696,707	293.9	35,001	14,765
Male	32,116	28,018	**102,804**	89.7	1,321,573	1,152.g	**30,692**	26,776
Motor Vehicles	**2,459**	**2,145**	**32,454**	28.3	311,496	271.7	2115	1,845
Falls	**5,633**	4,914	7,002	6.1	317,980	277.4	5,308	4,631
Firearms	**216 ****	189	26,366	23.0	56,718	49.5	133**	116
Poisonings	**688**	601	7,621	6.6	97,754	85.3	583	**509**
Fires/Burns	**797**	696	3,438	3.0	38,946	34.0	755	659
Drowningst	**35 ****	30	4,951	4.3	3,928	3.4	26 **	23
Other	**22,288**	19,444	20,972	18.3	494,752	431.6	21,772	18,994
Female	24,742	20,209	39,764	32.5	1,025,162	837.3	23,677	19,339
Motor Vehicles	**2,913**	2379	13,469	11.0	211,532	172.8	2,688	2,196
Falls	**6,656**	5,437	5,864	4.8	465,377	380.1	6,185	5,052
Firearms	**52 ****	42	5,190	4.2	8,411	6.9	38 **	31
Poisonings	**1,014**	828	4,273	3.5	120,800	98.7	889	726
Fires/Burns	**666**	**544**	2,233	1.8	15,451	12.6	648	529
Drowningst	**3 ****	2	1,220	1.0	1,636**	1.3		
Other	**13,438**	10,976	7,515	6.1	201,955	165.0	13,229	10,805

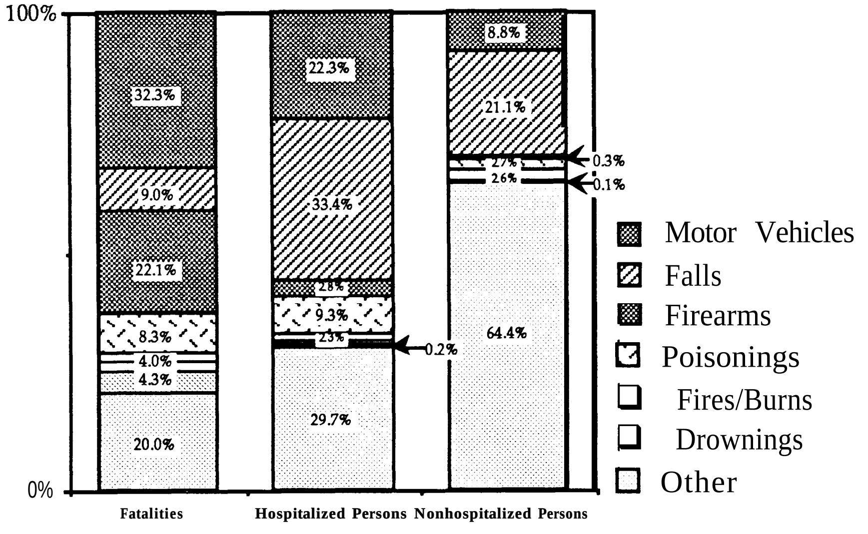
*** Excludes** 13,097 **deaths occuring in later years due to injuries incurred in 1985**
**** Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)**
t Includes Near Drownings

Intent of Injury

Slightly more than one-third of all injury deaths involve intentional injuries (Table 3 and Figure 5). Of 49,276 intentional injury deaths, 40 percent are homicides (19,830) and 60 percent are suicides (29,446). The remaining two-thirds of the deaths are due to unintentional causes -- 51 percent to motor vehicles, 13 percent to falls, and 36 percent to other causes.

Figure 4

Distribution of Injured Persons by Cause and Class of Injury, 1985



Information regarding intent of injuries resulting in hospitalization is less complete than for injury deaths. Intent is not uniformly recorded in the medical record, and if it is, this information often represents conjecture on the part of the physician or nurse completing the narrative description of the injury. To arrive at a rough estimate of the numbers of intentional and unintentional hospitalized injuries, it is assumed that all injuries resulting from motor vehicles, falls, fires, and near drownings are unintentional. The remaining injuries are categorized by intent as reflected in the International Classification of Disease (ICD-9) E-code (Commission on Professional and Hospital Activities, 1980). Using this approach, 84 percent of all hospitalized injuries are classified as the result of unintentional injury, a-nd 11 percent the result of intentional injury, including poisonings (31%), firearms (11%), and other assaultive injuries (58%). The remaining 5 percent can not be classified. Approximately one-half of the hospitalized injuries recorded as intentional are self-inflicted. Sufficient data are unavailable to categorize nonhospitalized injuries by intent.

Table 3

Number and Rate of Injured Persons by Intent and Class of Injury, 1985

	Fatalities*		Hospitalized	
Intent	Number	Rate per 100,000 Persons	Number	Rate per 100,000 Persons
Total	142,568	60.1	2,346,735	990.0
Unintentional	90,469	38.2	1,978,518	834.6
Intentional	49,276	20.8	261,738	110.4
Intent Unknown	2,823	1.2	106,480	44.9
Male	102,804	89.7	1321,573	1,152.g
Unintentional	62,628	54.6	1,096,692	956.8
Intentional	38,156	33.3	169,264	147.7
Intent Unknown	2,020	1..8	55,618	48.5
Female	39,764	32.5	1,025,162	837.3
Unintentional	27,841	22.7	881,826	720.3
Intentional	11,120	9.1	92,474	75.5
Intent Unknown	803	0.7	50,862	41.5

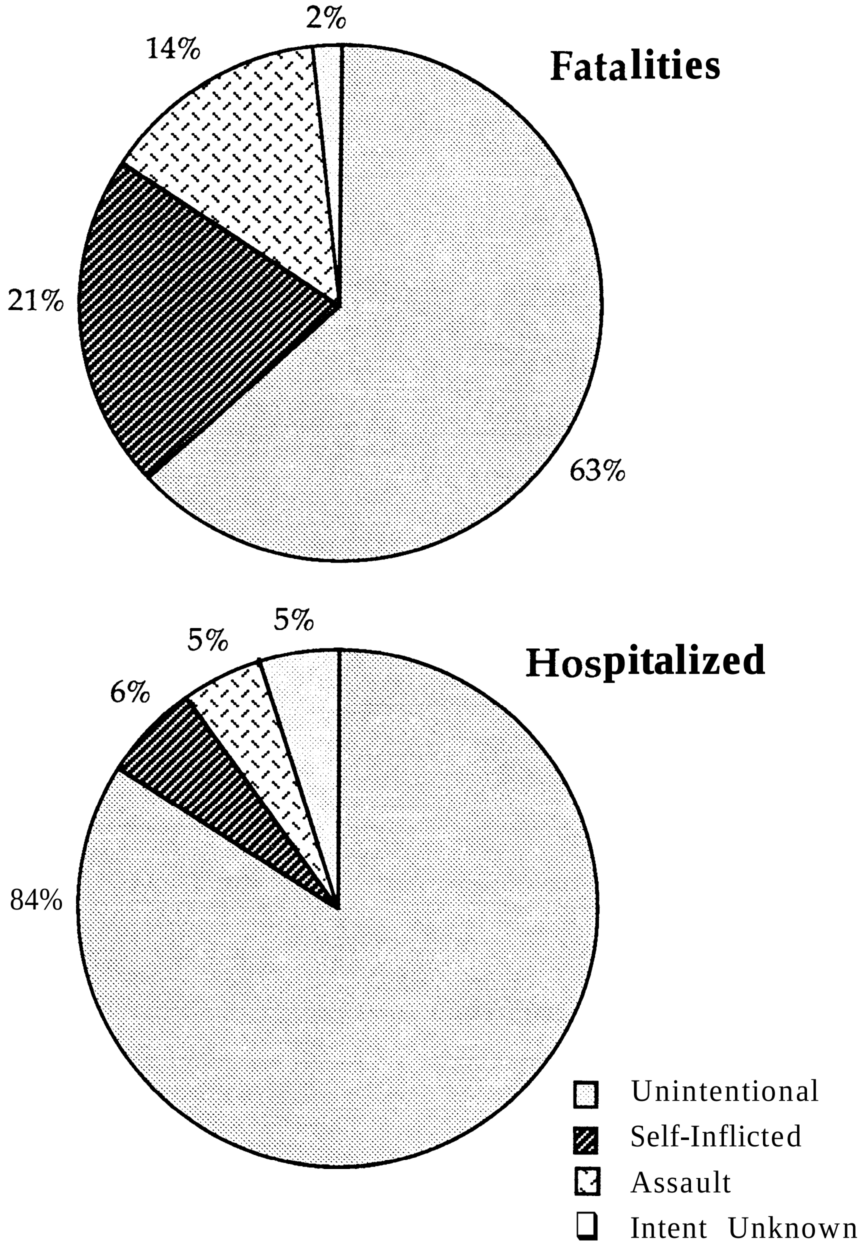
* Excludes 13,097 deaths occurring in later years due to injuries incurred in 1985

Hospitalized Injuries by Nature and Severity

Since hospitalized injuries include a broad spectrum of types and severities, these injuries are further distributed by nature and severity, using the International Classification of Disease/Abbreviated Injury Scale (ICD/AIS) (MacKenzie, Steinwachs, and Shankar, 1989) (Table 4). The AIS is a threat-to-life scale that categorizes injury severity by the nature of damage to different body regions. It ranges from 1 (minor injury) to 6 (maximum injury - virtually unsurvivable) (Committee on Injury Scaling, 1985). Injuries to the upper or lower extremities account

Figure 5

Distribution of Injured Persons by Intent and Class of Injury, 1985



for nearly one million hospitalized persons or 41 percent of the total. Slightly over one-third of these injuries are moderately severe or severe (ICD/AIS 3 or greater). For many of these more severe injuries, recovery can be long and expensive, and even optimal treatment can result in permanent impairment involving chronic pain, loss of motion or contracture of joints, deformity, or loss of limb. The primary cause of hospitalized extremity injury is falls; they account for an estimated 30 percent of upper extremity injuries and 50 to 60 percent of lower extremity injuries. Motor vehicle crashes also contribute significantly to the incidence of extremity injuries, accounting for an additional 15 to 20 percent of all new cases. Another important cause of upper extremity injury relates to injuries involving machinery and tools, which account for approximately 20 percent of all hospitalized upper extremity injuries.

About 300,000 individuals survive a head injury serious enough to result in hospitalization for one or more days. Head injury accounts for 12 percent of all injury hospitalizations. Although the majority (73%) of these injuries are minor, conservative estimates of the number of persons who survive moderate (ICD/AIS 3), severe (ICD/AIS 4), and very severe (ICD/AIS 5) head injury are 45,974, 25,239 and 6,710, respectively. The long-term consequences associated with severe head injury are substantial. Several studies have documented the persistence of significant physical, neuropsychological, and psychosocial deficits following severe head injury. Less is known about the residual effects of minor head injuries, although there is increasing evidence to suggest that they are associated with a multitude of physical symptoms such as persistent headaches, as well as with significant psychosocial and behavioral problems and difficulty in performing one's job. Motor vehicle crashes (including motorcycle, bicycle, and pedestrian) constitute the leading cause of head injury in the United States. They account for one-third to one-half of all head injuries. Falls are the second leading cause of head injury, accounting for an additional 20 to 30 percent of all injured persons. (Frankowski, Annegers, and Whitman, 1985).

Other injuries accounting for more than 5 percent of total hospitalizations include those to the vertebrae (6%); soft tissue injuries to the abdomen, thorax, and neck (6%); and poisonings (9%). Although spinal cord injuries account for a very small proportion of the total (less than l%J, they result in significant physical and psychological changes. Individuals who survive a severe spinal cord injury require extensive long-term medical treatment and rehabilitation. While relatively few in number, these injuries have a substantial impact on the individual and society. Motor vehicles are the major cause of spinal cord injury, accounting for an estimated 30 to 60 percent of all injured persons. Falls

Table 4

Number and Rate of Hospitalized Injured Persons by Principal Diagnosis and Severity of Injury, 1985

Principal Diagnosis	Severity (ICD/AIS)	Number of Live Discharges	Rate per 100,000	Percent Distribution
Total	na	2,346,735	990.0	100.0 %
Head	1-2 *	212,496	89.6	91
	3	45,974	19.4	2.0
	4	25,239	10.6	1.1
	5	6,710	2.8	0.3
Face	l-2 *	83,649	35.3	3.6
	3,4,5	1,629	0.7	0.1
Vertebrae	1-2 *	94,601	39.9	4.0
	3	44,659	18.8	1.9
Spinal Cord	3	6,872	2.9	0.3
	4,5	6,267	2.6	0.3
Abdomen/Thorax/Neck	l-2 *	99,371	41.9	4.2
	3	34,786	14.7	1.5
	4,5	11,805	5.0	0.5
Upper Extremities	l-2 *	271,195	114.4	11.6
	3,4,5	18,332	7.7	0.8
Lower Extremities	l-2 *	364,327	153.7	15.5
	3,4,5	319,217	134.7	13.6
Bums	l-2 *	36,623	15.4	1.6
	3,4,5	2,708	1.1	0.1
	Unknown	26,168	11.0	1.1
Foreign Bodies	na	33,437	14.1	1.4
Near Drownings	na	5,564	2.3	0.2
Poisonings	na	218,554	92.2	9.3
Other Nature	na	376,550	158.8	16.0

* Includes cases of unknown ICD/AIS severity

Note: na = not applicable

constitute the second leading cause; they account for an additional 20 to 30 percent of all spinal cord injuries. Approximately 5 to 10 percent of all spinal cord injuries are due to diving (Kraus, 1985a).

Patterns of Injury by Cause

The categorization of incidence and cost by cause of injury can be particularly useful in designing and targeting preventive strategies. For this reason, a more detailed discussion of the patterns of injury by age, sex, and severity class is presented below for each of the major cause categories.

Motor Vehicles

Motor vehicle crashes are the leading cause of injury death, resulting in 45,923 deaths in 1985. They also comprise the second leading cause of both injury hospitalizations (523,028) and less severe, nonhospitalized injuries (4.8 million). Adolescents and young adults aged 15-24 are at highest risk of both fatal and nonfatal injuries related to motor vehicles. Their rate for each class of injury is approximately twice the rate for all ages (Figure 6 and Appendix Table C-2). The elderly aged 75 and older are also at a relatively high risk of dying from motor vehicle injury. The rate of motor vehicle deaths in this age group is second only to that in the 15-24 age group.

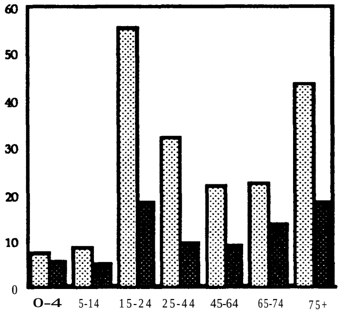
Over age 15, males are more than twice as likely as females to die from a motor vehicle crash, with the largest male to female ratio (over 3-fold) observed in the 15-24 and 25-44 age groups. Males under the age of 45 are also more likely to be hospitalized as a result of a motor vehicle injury, although the sex differential is not as great as for fatalities (male to female risk ratio is 1.7). Males and females 45 years and older, on the other hand, are equally likely to be hospitalized. A somewhat different pattern is observed for minor, nonhospitalized injuries. Over age 15, females are at a slightly higher risk for nonhospitalized injury than are males (female to male risk ratio is 1.2), although among the elderly aged 75 and older, males remain at higher risk.

Major factors contributing to the likelihood of a crash include speed, vehicle instability and braking deficiencies, inadequate road design (e.g., excessive curvature or gradient, inadequate guardrail and shoulders) and alcohol intoxication, which is involved in about half of all fatal crashes. When a crash occurs, important determinants of the likelihood of injury include speed of impact, vehicle crashworthiness, and the use of airbags, safety belts, and motorcycle helmets (Waller, 1985).

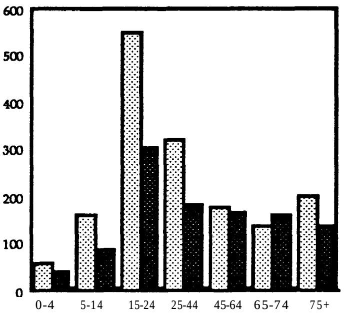
Falls

Falls are the leading cause of nonfatal injury in the United States, accounting for 783,357 hospitalizations and 11.5 million minor injuries that do not result in hospitalization. They also account for 12,866 deaths. The elderly are at highest risk of both dying and being hospitalized as

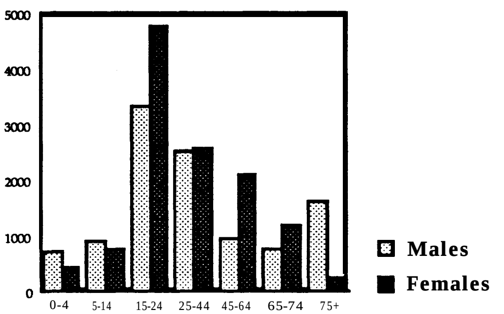
Figure 6
Motor Vehicles: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

the result of a fall (62 per 100,000 and 2,259 per 100,000, respectively) (Figure 7 and Appendix Table C-3). The death rate due to falls among the elderly aged 75 and older is nearly 12 times as great as the rate for all ages combined and the risk of hospitalization nearly 7 times as great. The risk of death or hospitalization-related to falls among children and young adults less than 45 years of age, on the other hand, is very small (less than 1 per 100,000 for deaths and less than 200 per 100,000 for hospitalizations).

A different age pattern is observed for falls resulting in minor, nonhospitalized injuries. The elderly aged 75 and over remain the age group at highest risk; they account for 993,000 injuries or 8,610 per 100,000. However, children less than 15 years of age are also at high risk; they comprise the second and third highest age groups at risk of minor injury due to falls. Falls represent over one-quarter of all minor injuries in this age group.

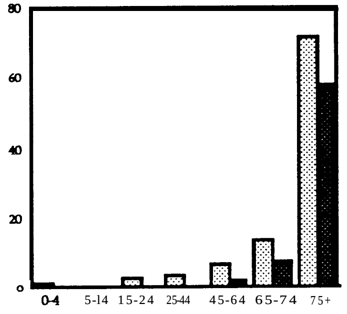
Males at all ages are at higher risk of fall-related deaths than females, although the male to female ratio is considerably less (1.3) than for other causes. Elderly females, however, are at considerably higher risk of nonfatal fall-related injuries than males. Females aged 65 and over are more than twice as likely as males in the same age group to sustain a nonfatal injury resulting from a fall.

Falls among the elderly tend to involve a trip or fall on a level plane. The high risk of death and serious injury resulting from falls among the elderly is due to several factors, including higher rates of osteoporosis and other medical conditions, as well as increased impairment of vision, gait, and balance. The use of medications is also correlated with falls among the elderly (Ray, Griffin, Schaffner, et al., 1987). Elders have a greater risk of complications, even with minor injuries. Falls resulting in hip fractures frequently signal the end of independent living for elderly persons. Falls are a significant risk among residents of nursing homes and chronic care facilities (Baker, O'Neill, and Karpf, 1984). Among younger people, most fatal falls are from a height (e.g., down stairs, out windows) (Gallagher, Guyer, Kotelchuck, et al., 1982). A classic program to install window bars in New York City reduced fall deaths among children (Speigel and Lindeman, 1977), although a more recent study questions whether the effect has been sustained (Bergner, 1982).

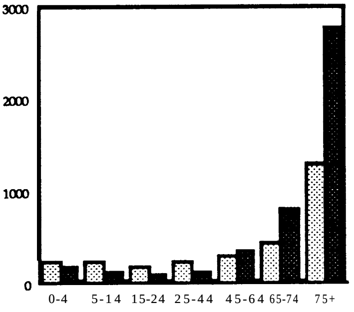
Firearms

Injuries resulting from either the unintentional or intentional use of firearms constitute the second leading cause of death due to injury in the United States. In 1985, 31,556 people died from firearm injuries (13 per 100,000). For all ages, 39 percent of firearm deaths are homicides and 56 percent are suicides. An additional 5 percent of firearm deaths are

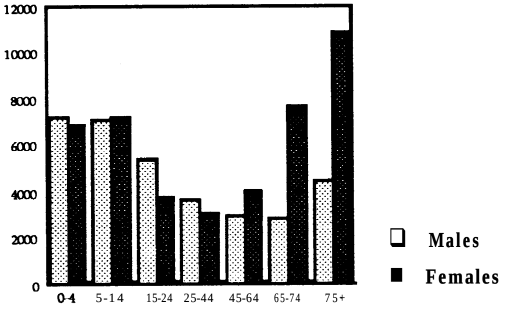
Figure 7
Falls: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

unintentional. The risk of a firearm death is highest for adolescents and young adults aged 15-44 (18 per 100,000) although among males, the elderly aged 75 and over are at higher risk than any other subgroup of the population (42 per 100,000) (Figure 8 and Appendix Table C-4). Their rate is 1.8 times as high as the rate for all males and 1.4 times as high as for males aged 15-44. Firearm injuries resulting in death among elderly males are largely due to suicides; 93 percent of all firearm deaths among males 75 and older are suicides. This is in contrast to firearm deaths among younger males, almost half of which are homicides (48%).

Patterns of incidence by age and sex are considerably different for nonfatal as opposed to fatal firearm injuries. For both hospitalized and nonhospitalized injuries, young adult males are at highest risk with relatively few injuries among females and the elderly.

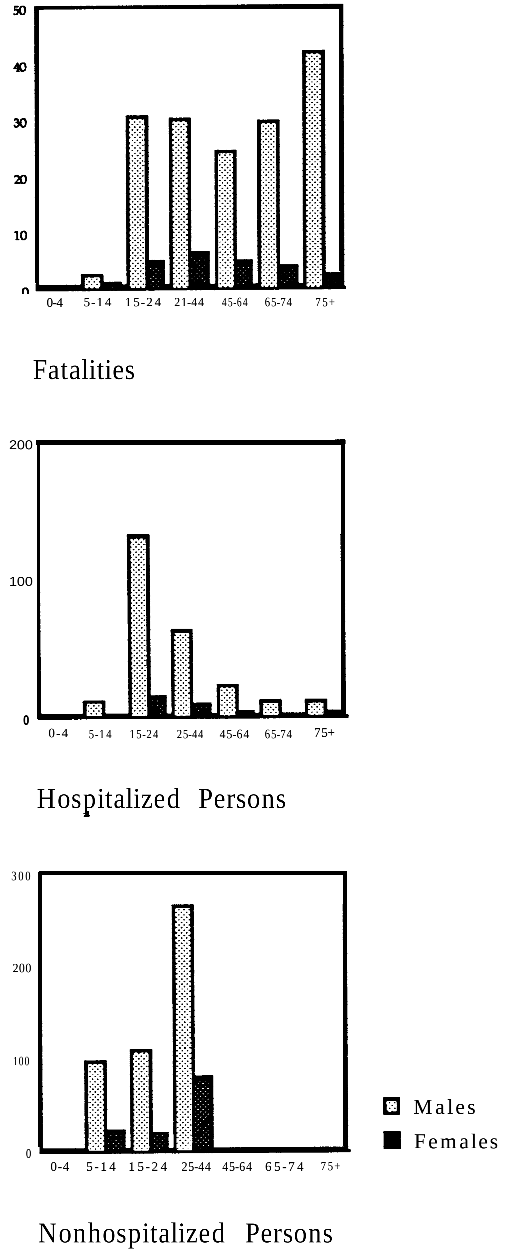
Handguns account for three-fourths of all gun-related homicides (U.S. DOJ, 1986), although recent increases in gang warfare and the adoption of assault weapons by drug traffickers may create different patterns of firearm deaths. Injury deaths caused by handguns are a uniquely American epidemic with a rate over 90 times greater than that of any other country. More than half of all suicides are committed with guns (American Medical Association, 1989). Alcohol has been found at autopsy in 45 percent of firearm-involved homicides (Goodman, Mercy, Loya, et al., 1986). Since the early 1970s, the year-to-year fluctuations in firearm availability has paralleled the numbers of homicides. While firearm retailers market handguns for self-protection, few firearm deaths in the home stem from acts of self-protection. Firearms are unintentionally or intentionally fired at family members, friends, or acquaintances (Kellerman and Reay, 1986).

Poisonings

In 1985, poisonings accounted for 11,894 deaths, 218,554 hospitalizations and 1.5 million minor injuries (Figure 9 and Appendix Table C-5). Almost all poisoning deaths occur among persons over the age of 15. Young adults aged 25-44 are at highest risk of a poisoning death (8 per 100,000). Males are 1.9 times as likely as females to die of a poisoning. Nearly one-half (48 percent) of all poisoning deaths of adults are ruled suicidal. There is evidence to suggest that these statistics may nevertheless underestimate the number of suicidal poisoning deaths because deaths may be classified as unintentional when intent is not immediately obvious (Baker, Fisher, Masemore, et al., 1972).

Patterns of nonfatal poisonings by age and sex are quite different from those resulting in death. Persons at highest risk of a hospitalization associated with poisoning include the elderly aged 75 and older (165 per 100,000), very young children aged 0-4 (139 per 100,000), and adolescents

Figure 8
Firearms: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



and young adults aged 15-24 (130 per 100,000). Females aged 5 and older are at slightly higher risk of hospitalization than males, although the differences are small; for all ages, females are 1.2 times as likely as males to be hospitalized. Little is known about the intent of nonfatal poisonings resulting in hospitalization (42 percent are of unknown intent). Of the hospitalized injuries for which the intent is recorded, however, nearly two-thirds are ruled intentional (over 90 percent are recorded as self-inflicted). The risk of a less serious poisoning resulting in medical attention without hospitalization or in one or more days of restricted activity is highest among very young children aged 0-4 (1,745 per 100,000). They account for 21 percent of all nonhospitalized injuries. Rates among the elderly, on the other hand, are low.

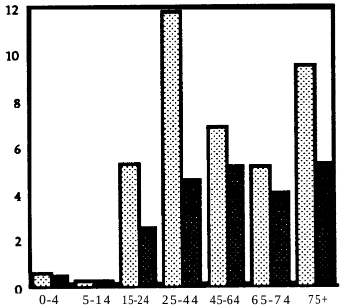
Deaths among adults from poisonings most commonly involve motor vehicle exhaust, other gases or vapors, antidepressants and tranquilizers, barbiturates, alcohol, and opiates. Poisonings among children under age 5 comprise 60 percent of all calls to poison control centers but only 1 percent of fatalities. Poisoning deaths among young children have declined dramatically since 1960 largely because of changes in the formulation and packaging of dangerous drugs (Walton, 1982). However, poisonings remain a major cause of hospitalization and emergency outpatient care. Poison control centers with hot lines provide consultation on appropriate emergency and therapeutic treatment for poisons, drugs, and other toxic substances involved in both unintentional and intentional poisonings (Chafee-Bahamon and Lovejoy, 1983.

Fires and Burns

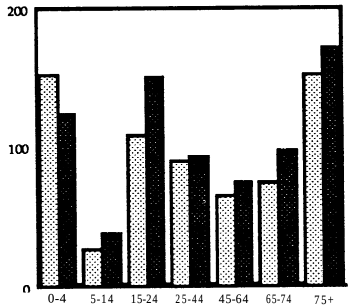
In 1985, fires and burns resulted in 5,671 deaths, 54,397 persons hospitalized and 1.4 million persons with minor injuries. The elderly aged 75 and older are at highest risk of death due to fires and bums (8.6 per 100,000), and young children aged 0-4 are at highest risk of nonfatal burns resulting in hospitalization (66 hospitalizations per 100,000) (Figure 10 and Appendix Table C-6). There is no consistent relationship with age for minor burns. Males are at slightly higher risk of both fatal and nonfatal injuries resulting from fires and burns, although the sex differential is not as great as for other injuries (1.7 for fatalities and 1.3 for nonfatalities).

House fires cause three-fourths of all fire and burn deaths, with smoke inhalation and resulting carbon monoxide poisoning causing two-thirds of these deaths (Birky, Halpin, Caplan, Fisher, McAllister, and Dixon, 1977). The same study reports alcohol involvement in 42 percent of fatal fires. The risk of dying in a housefire is halved in homes with operable smoke detectors. Smoke detectors are now present, but not always operable, in 82 percent of U.S. households (Hall, 1988).

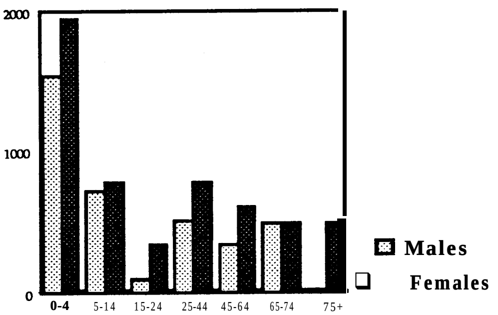
Figure 9
Poisonings: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

Cigarettes, the primary ignition source of fatal fires, can be manufactured to be less likely to ignite furniture (Technical Study Group, 1987). A severe nonfatal burn is among the most devastating injuries a person can survive and may result in permanent scarring. Scalds are the most common burn injury and flame burns tend to be the most severe. Clothing ignition burns are now rare in children but are still a significant problem among the elderly (Tinsworth, 1985).

Drownings **and** Near **Drownings**

Drownings accounted for 6,171 deaths in 1985. There were an additional 31,564 near drownings, of which 5,564 resulted in hospitalization (Appendix Table C-7). Drowning rates are highest among very young children aged 0-4 (4 per 100,000) and among young adolescents and young adults aged 15-24 (4 per 100,000). Males are over four times as likely to drown as are females.

Approximately 11 per 100,000 young children are hospitalized as the result of a near drowning; 145 per 100,000 experience a near drowning that results in outpatient medical treatment or one or more days of restricted activity. Estimates of near drownings are based on a small number of sampled cases. Thus, caution must be exercised in interpreting patterns of incidence by age and sex. The numbers suggest, however, that nearly 90 percent of all near drownings occur among very young children aged 0-4, and that males are over twice as likely as females to be treated as the result of a near drowning.

Most drownings of young children occur in unprotected or unsupervised bodies of water such as swimming pools and can be prevented by adequate fences and self-latching gates around hazards close to home (Pearn and Nixon, 1977). Drownings among adolescents and young adults occur most often during swimming or boating activities, but effective strategies to prevent these drownings have yet to be developed. Alcohol has been detected in the majority of adults who drown while swimming or boating (Dietz and Baker, 1974), although the causal relationship needs further study (Howland and Hingson, 1988).

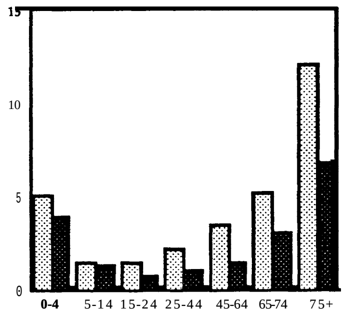
Data Sources and Methods

The major data sources used in estimating numbers of injuries are the National Mortality Detail File (for deaths), the National Hospital Discharge Survey (for live hospital discharges), and the National Health Interview Survey (for less severe, nonhospitalized injuries). Statewide hospital discharge abstract data from Maryland and California are used to supplement the information on cause for hospitalized injuries (Maryland HSCRC, 1988; California OSHPD, 1986). These data sources were chosen because they include population-based information on all

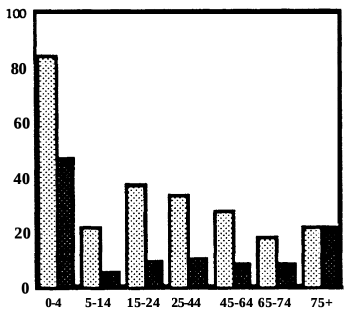
Figure 10

Fires/Burns: Injury Rate by Age and Sex, 1985

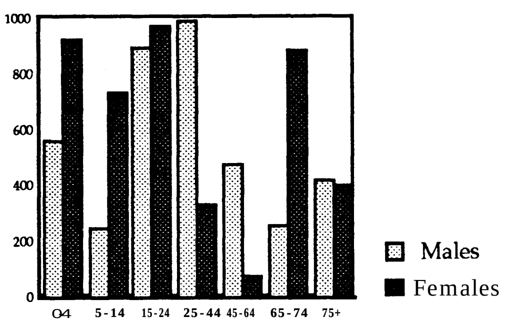
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

injuries regardless of the cause of injury and the age of the injured. Numerous other national population-based data sets exist from which estimates of incidence can be derived for particular types of injury (e.g., motor vehicle injuries (U.S. NHTSA, 1988b; 1988c), injuries related to consumer products (U.S. CPSC, 1983), or occupational injuries (Panel on Occupational Safety and Health Statistics, 1987). Differences in study design and definitions across these studies, however, make it difficult to integrate their results in arriving at uniform figures across all types of injury and subgroups of the population.

Age- and sex-specific intercensal estimates of the 1985 United States civilian population are used in calculating rates of injury per 100,000 (U.S. Bureau of the Census, 1988). The civilian population consists of U.S. residents excluding members of the armed forces. The 1985 population estimates are included in Appendix Table C-1. The definitions and assumptions used in developing estimates for each class of injury are discussed below.

Deaths

The data source for determining the number of injury deaths is the 1985 National Mortality Detail File, a complete record of deaths occurring in the United States, excluding foreign resident deaths. An injury death is defined as any death with an underlying cause of injury as defined by the Ninth Revision of the International Classification of Diseases (ICD-9CM), E-Codes 800-999 excluding E870-E879 (misadventures to patients during surgical and medical care) and E930-E949 (drugs, medical and biological substances causing adverse effects in therapeutic use). This definition includes all traumatic injuries, burns, poisonings, and drownings. Deaths with an injury noted only as a contributing cause and not as the underlying cause are excluded from the definition. Restricting the definition to deaths with an underlying cause of injury underestimates the total number of injury-related deaths, especially among the elderly (Fife and Rappaport, 1987). However, since it is difficult to ascribe the death in these cases to the injury per se, the more conservative definition is used.

The classification of ICD-9 E-codes by cause and intent of injury may be found in Appendix A. The classification by cause defined herein is somewhat different from that often used in national reports of injury mortality by cause because different categories of intent are combined under specific causes of injury. Caution should therefore be exercised in making direct comparisons.

Hospitalizations

The 1984, 1985, and 1986 National Hospital Discharge Survey (NHDS) micro data tapes are used to develop estimates of the number of injuries resulting in hospitalization. The NHDS consists of hospital discharge abstracts uniformly collected for a probability sample of approximately 200,000 patients discharged each year from nearly 600 short-stay, nonfederal hospitals located in the 50 states and the District of Columbia. Three years of NHDS data are used to provide more accurate estimates of incidence by age, sex, and nature of injury. National estimates of the number of hospitalizations are calculated by inflating the sample by the reciprocal of the probability of sample selection, adjusting for nonresponse. Annualized estimates for 1985 are obtained by averaging the estimates over the three years. Estimates of less than 3,000 have a relative standard error that may exceed 30 percent and are generally considered unreliable. These figures are noted in the tables with an asterisk.

Included in the definition of an injury-related hospitalization is any live discharge with a principal diagnosis of an injury as defined by the ICD-9CM N-codes N800-N999, excluding N958 (traumatic complications), N905-N909 (late effects of injuries), N995 (adverse effects), and N996-N999 (complications of surgical and medical care). N-codes are the International Classification of Disease (ICD) codes for the nature of injury and body part affected. For the three years (1984-86), a total of 41,601 live discharges included in the NHDS met these criteria.

Selecting all hospital admissions with a principal diagnosis of trauma overestimates the incidence of injury resulting in hospitalization. This overcount occurs for two reasons. First, transfers from one acute care hospital to another may be counted twice. However, less than 2 percent of injury hospitalizations are transfers (MacKenzie, Steinwachs, and Edelstein, 1988). A second and potentially more important source of overestimation is the inclusion of individuals who are rehospitalized for follow-up care of a previous injury. Hospitalizations classified by principal diagnosis as ‘complications’ or ‘late effects’ of injury, are excluded from the count by definition. Some of these rehospitalizations, however, have a principal diagnosis with a valid injury ICD N-code as defined above. These cases are not readily identifiable in the NHDS. However, several statewide hospital discharge abstract databases indicate whether admissions are elective or not. This classification is used as a surrogate for readmission.

Estimates of the number of hospitalizations obtained from the NHDS are adjusted downward using the percent of live discharges from all Maryland acute care hospitals that were elective. Adjustments are made within 24 injury categories defined by the body region and severity of the principal or most severe injury sustained. Of all injury categories, 12 percent of admissions were elective in Maryland (Maryland HSCRC, 1988), a figure comparable to data from New Zealand in which first admissions and readmissions can be separately identified (New Zealand NHSC, 1989).

Classification by Nature and Severity

All injured persons discharged from the hospital are classified into one of 24 injury categories defined by the body region and severity of the principal or most severe injury sustained. Injury severity is determined using a computerized mapping of ICD-9CM coded discharge diagnoses into Abbreviated Injury Scale (AIS) scores, referred to as ICD/AIS scores (MacKenzie, Steinwachs, and Shanker, 1989). The AIS is the most widely recognized injury severity scoring system based on anatomic descriptors (Committee on Injury Scaling, 1985). The AIS is an ordinal scale ranging from 1 (minor injury) to 6 (maximum injury-virtually unsurvivable).

A drawback to the widespread application of the AIS in large population-based research and evaluation in the past was the need to review the entire medical record for adequate scoring. Development of the ICD-9CM to AIS conversion table has enabled AIS severity scoring when only ICD-9CM coded discharge diagnoses are available. Assumptions used in assigning ICD/AIS scores are generally conservative. Validation studies further show that errors in chart abstracting and ICD coding lead to lower than average AIS values (MacKenzie et al., 1989). Therefore, ICD/AIS scores are slightly lower than AIS scores obtained by reviewing the entire medical record. Thus, the distribution by severity of persons discharged from the hospital is conservative.

For the purpose of classification, all injured persons discharged from the hospital are grouped into 24 categories defined by the body region and AIS score of the principal diagnosis (Table 4).

Classification by Cause

A major limitation of the NHDS for estimating the incidence of hospitalized injuries is the lack of uniform coding of the cause of injury. The percent of cases in the NHDS for which the cause of injury can be identified either by an N-code (for drownings, poisonings, and burns) or by an E-code (for motor vehicles, falls, firearms, and other) is low -- approximately 25 percent. In most statewide discharge abstract databases, on the other hand, the percent of cases with information on cause is somewhat higher (50-60 percent). It has been shown, however, that even in these more complete databases, E-coding is not a random practice within or among hospitals, but is strongly correlated with the age of the patient and the number and severity of injuries sustained (MacKenzie et al., 1988). Given a limited number of fields for recording diagnoses, hospitals are encouraged to record the conditions that influence the reimbursement rate. Thus, patients with multiple injuries and elderly patients who are likely to present with an underlying chronic disease or who develop complications during hospitalization are less likely to be assigned E-codes.

Because of the limitations of both the NHDS and the statewide discharge abstract databases, the following procedures are used to distribute U.S. hospitalized injuries by cause. First, all injuries in the NHDS for which the cause is synonymous with the nature of injury are identified by an ICD-9CM N-code. These injuries include burns, (N940-N949), near drownings (N994.1), poisonings (N960-N969; N970-N989), foreign bodies (N930-N939), and adverse effects (N990-994.0; N994.2-N994.9).

The remaining injuries are distributed by cause using hospital discharge abstract data from Maryland in which cause of injury is known for 59 percent of the cases. Maryland data are used for three reasons: first, a relatively high percent of hospitalized injuries are E-coded in the Maryland database. Second, the demographic distribution of the Maryland population is similar to that of the United States. Third, the distribution of injury deaths by cause occurring in Maryland is very similar to the distribution for the United States (Baker, O'Neill, and Karpf, 1984). As a further check on the suitability of using Maryland data, the distribution by cause for Maryland discharges was compared with distribution by cause for California discharges. Within age and nature of injury categories, the distributions are similar.

Three years (1984-86) of live discharges from the 56 acute care hospitals in Maryland for which E-codes are recorded (N=68,211) are distributed by cause within the seven age groups, the male and female groups, and the 24 categories defining the body region and ICD/AIS severity of the principal injury. Based on the Maryland discharge data, the percent distributions of cause within each age, sex, and nature of injury category are multiplied by the NHDS estimates of the total number of hospitalizations within each group.

Nonhospitalized Injuries

Estimates of the number of minor injuries resulting in medical attention without hospitalization or in one or more days of restricted activity with no medical attention are derived using the National Health Interview Survey (NHIS) for 1984, 1985, and 1986. The NHIS is a continuous survey of a probability sample of households in the United States. Each year, approximately 50,000 households are sampled and information obtained on 122,000 individuals. In 1985, however, only three-quarters of the households were sampled and in 1986, only one-half. Interviews are designed to obtain information about the health characteristics of each civilian noninstitutionalized member of the sampled households. Three years of data are used to provide more accurate estimates of incidence by age, sex, and cause of injury. National estimates are derived by weighting sample estimates by the reciprocal of the probability of selection, adjusted for nonresponse. Annualized estimates for 1985 are obtained by averaging the estimates over the three years. Estimates of less than 312,000 may have a relative standard error that exceeds 30 percent and are considered to have low statistical reliability. These data are marked in the tables.

Included in the definition of nonhospitalized injuries are all acute injuries occurring within two weeks prior to interview, not resulting in hospitalization, but requiring medical attention (including consultation over the phone) or at least one full day of restricted activity. When a person is injured more than once in a two-week period, the injuries are counted separately. An acute injury is defined as any condition with an ICD-9CM N-code of N800-994, excluding N958 (traumatic complications), N905-N909 (late effects of injuries), N995 (adverse effects), and N996-N999 (complications of medical and surgical care).

Nonhospitalized injuries are distributed by cause in the following manner. The NHIS distinguishes between motor vehicle versus non-motor vehicle related injuries. Among the non-motor vehicle injuries, injuries related to fires and burns, poisonings, and near drownings can be further identified by the N-code used in the NHIS to classify the nature of the condition. The remaining injuries are distributed according to the distribution of cause for non-motor vehicle related injuries as reported in the NHIS conducted in 1972, the most recent year for which detailed information on the cause of injury was obtained (U.S. NCHS, 1976).

Data Limitations

The incidence estimates presented in this report are derived from national databases that include a minimum of information on injuries within a certain class regardless of cause or age of the injured persons. At this time, there is no comprehensive source of information on all injuries from which more accurate estimates of incidence by cause, nature, and severity of injury can be derived.

The databases used have limitations, however, and many assumptions and adjustments to the national data are necessary. In general, the estimates are believed to be conservative, both in overall magnitude and in distribution by severity. As noted above, the number of injury deaths is underestimated, especially among the elderly for whom an injury may only be coded as a contributing rather than the underlying cause of death. The number of hospitalized injuries is also likely to represent an undercount since admissions to Veterans Administration and other state or federal hospitals are not included in the NHDS sample. Finally, injuries occurring in institutions such as mental institutions and prisons and not resulting in hospitalization are omitted from the totals since the NHIS collects information only on household members who are not institutionalized at the time of the interview. The NHIS is based on self-reporting, unlike the National Mortality Detail File and the NHDS, which are based on medical records. Therefore, there may be overcounting of injuries to survey respondents and undercounting of injuries to other household members.

Due to limitations of the mapping from ICD-9CM codes to AIS severity scores, the distribution of traumatic injuries by severity is also likely to be conservative -- that is, the number of severe injuries (ICD / AIS 5) is underestimated. Comparison with more comprehensive sources on specific types of injury such as head injuries and spinal cord injuries, however, indicates that the bias is not great (Kraus, 1985a; Frankowski et al., 1985).

In comparing these estimates to those derived from other studies or surveillance systems, the following potential sources of difference may be observed. First, classification by cause is without regard to intent. Also, definitions of specific cause categories may differ from one study to another. Second, estimates of hospitalized injuries exclude inpatient deaths. Thus, for example, the number of severe (ICD / AIS 5) head injuries in Table 4 includes only persons who survive to discharge although studies have shown that an equal number of people are admitted to a hospital with a severe head injury and subsequently die prior to discharge (MacKenzie et al., 1989; Kraus, Black, Hessol, et al., 1984). These hospital deaths are included in the mortality figures. Finally, in comparisons of these estimates to those developed using more accurate information about the incidence of specific types or causes of injury, rates of injury may vary over time and across geographic regions. (Baker et al., 1987; U.S. CDC, 1988)

Conclusion

Incidence data are essential for estimating the cost of injury in the United States. About 56.9 million persons, one in four persons in the nation, are estimated to have been injured in 1985. Of this total number of injured persons, 142,568 died, 2.3 million were hospitalized, and 54.4 million were less severely injured, not requiring, hospitalization. Injury occurs across the age range and to both genders, but younger persons and males are most affected. Four of five injuries occur annually among persons under age 45 and three in ten males sustain injuries in a year. Motor vehicles and firearms are the leading causes of injury death, accounting for more than half of all injury deaths. Falls, however, are the leading cause of nonfatal injury.

The injury incidence data in this chapter represent a major contribution to understanding the full burden of injury in the United States. This is the first attempt to present a comprehensive picture of all injuries by sex, age, severity class, cause, and intent. The estimates are believed to be conservative, undoubtedly understating the overall magnitude of a serious public health problem facing the nation today.

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.

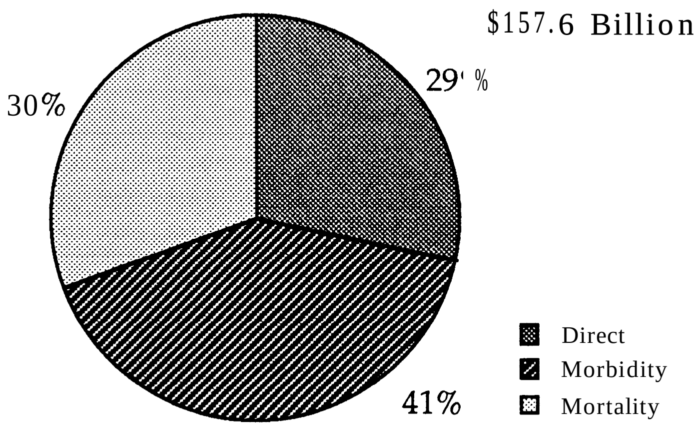
Other losses result from premature injury fatalities. Approximately 143,000 premature deaths from injury occurred in 1985 and an additional 13,000 deaths occurred in later years due to injury sustained in 1985. Premature death due to injury is extremely costly to the nation, amounting to an estimated 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



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
o-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

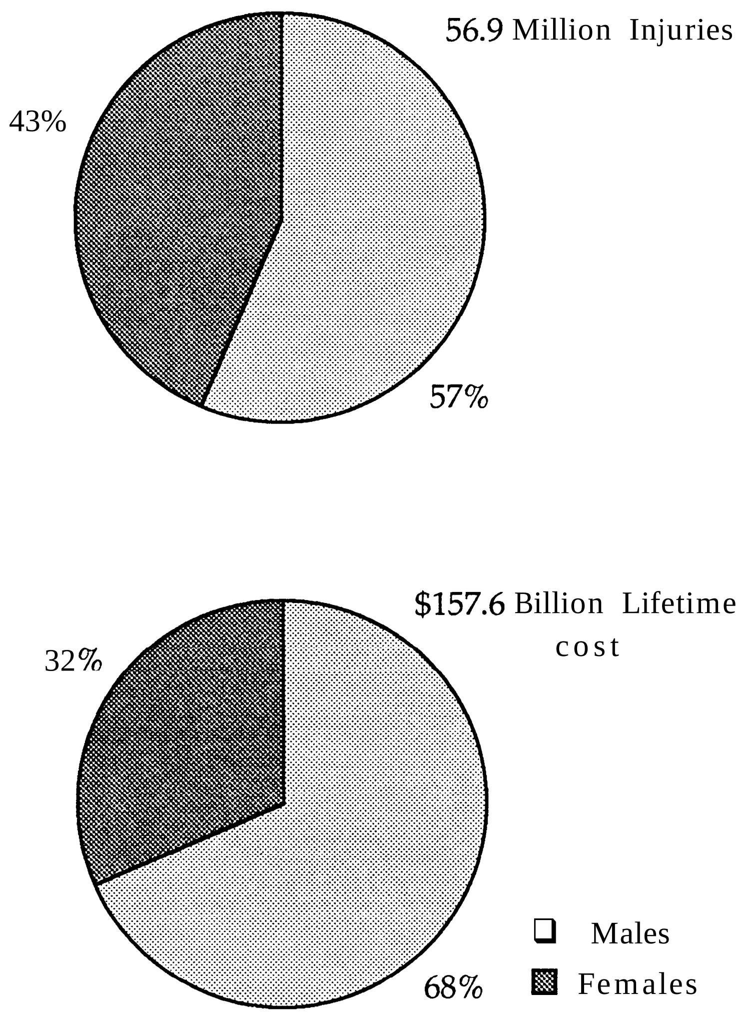
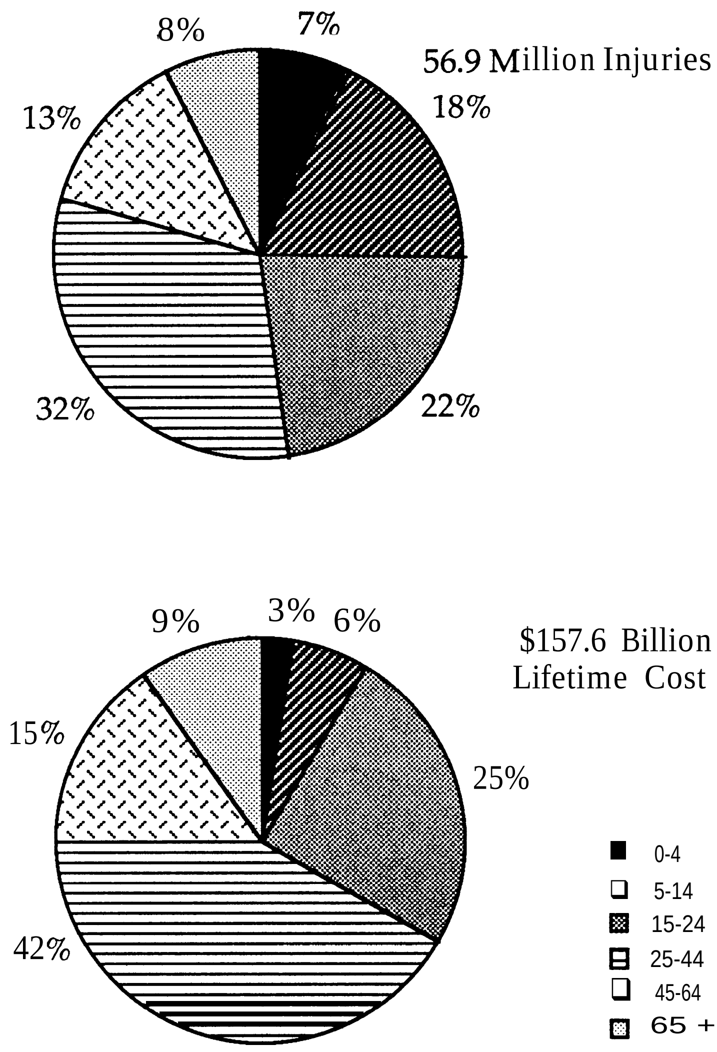


Figure 13

Distribution of Injured Persons and Lifetime Cost by Age, 1985



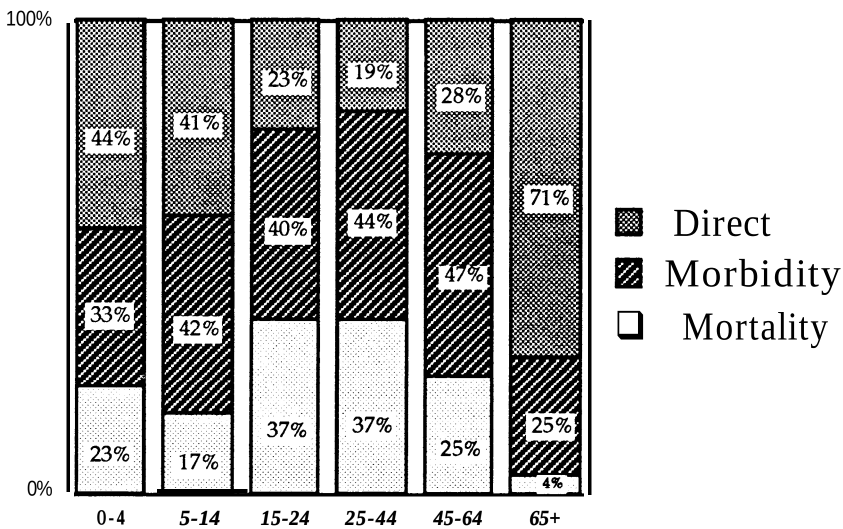
1 percent of the mortality cost because of their short life expectancy, low labor force participation rate, and low earnings.

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

	Cost* (millions)				Cost* per Injured Person			
			Indirect				Indirect	
Cause of Injury	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
0ther	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
0 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

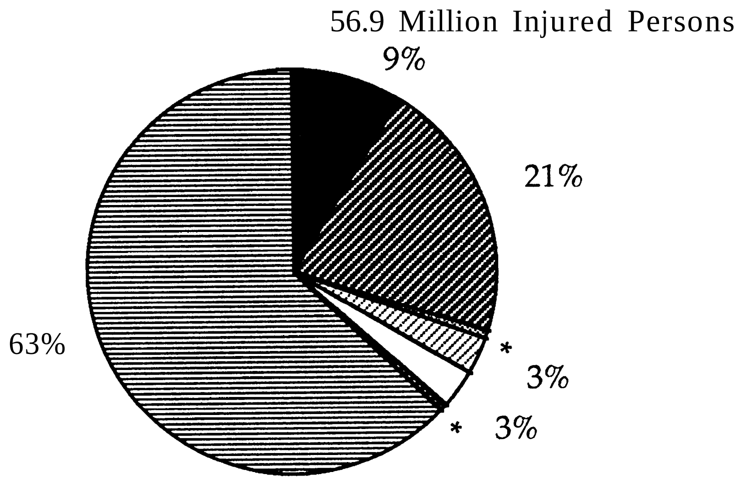
Discounted at 6 percent

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

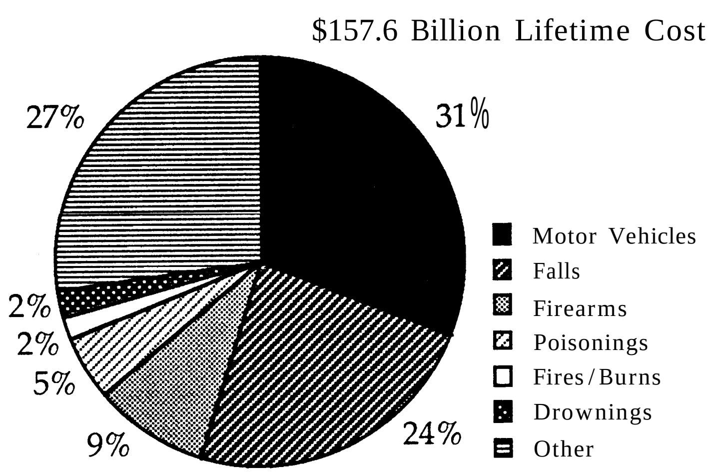
Includes Near Drownings

Figure 15

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



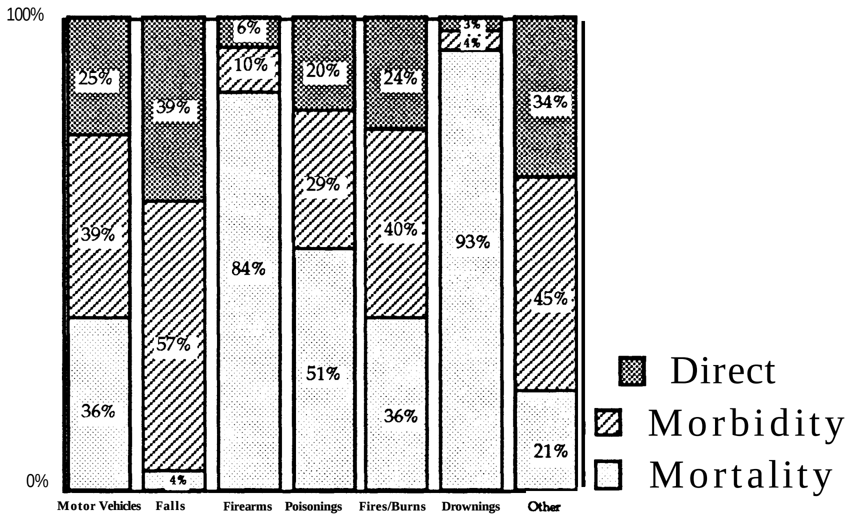
* Injuries due to firearms and drownings each comprise less than .5% of total injuries



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 mortalitv 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

		Cost* (millions)							
		Total		Direct		Morbidity		Mortality'	
Cause	Total	First Year	Later Year	First Year	Later Year	First Year	Later Year	First Year	Later Year
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
Drowningst	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	0 5	100.0	0.0
Fires/Burns	loo.0	80.0	20.0	92.6	7.4	54.9	45.1	100.0	0.0
Dmwningst	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	0 3

* 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
t 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) Total	Fatalities**	Hospitalized	Nonhospitalized	Cost* per Injured Person Total	Fatalitiestt	Hospitalizedt	Nonhospitalizedt
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

tt 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

	Cost* (millions)				Cost* per Injured Person			
Cause	Total	Fatalities**	Hospi-talizedt	Nonhospi-talized†	Total	Fatalitiestt	Hospi-talized†	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	Cost* (millions)							
	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 Insurance††	3,934	3,934	0	0	0	0	0	0
Health Insurance††	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
†† 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: Total (thousands)	Life Years Lost: Per 100 Injured Persons	Morbidity Cost*: Total (millions)	Morbidity Cost*: 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: Total (thousands)	Life Years Lost: Per 100 Injured Persons	Morbidity Cost*: Total (millions)	Morbidity Cost*: 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: Total (thousands)	Life Years Lost: Per Death	Mortality Cost*: Total (millions)	Mortality Cost*: 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

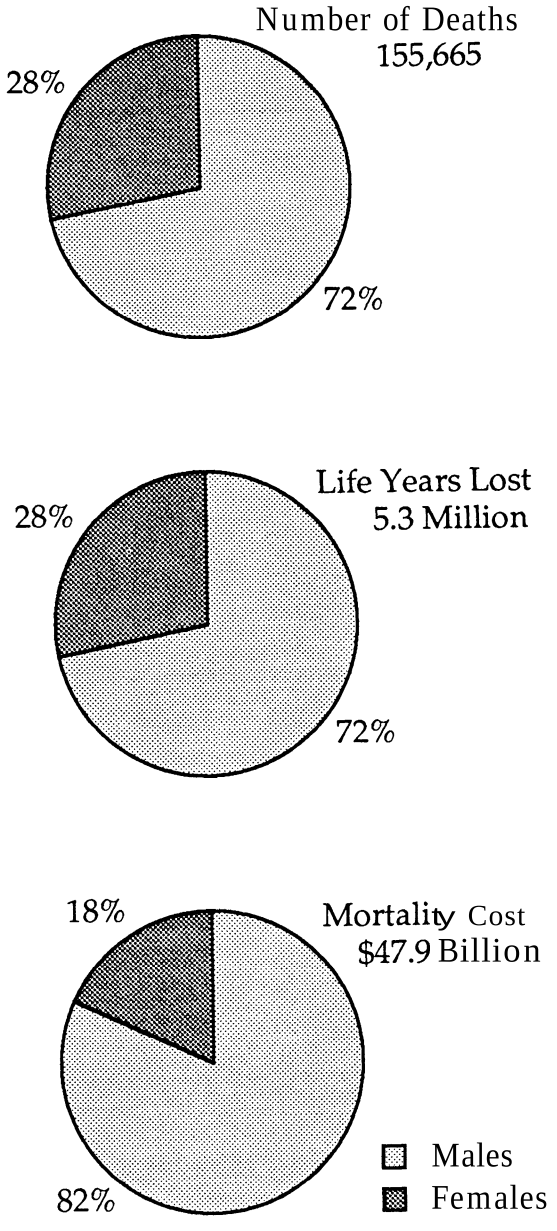
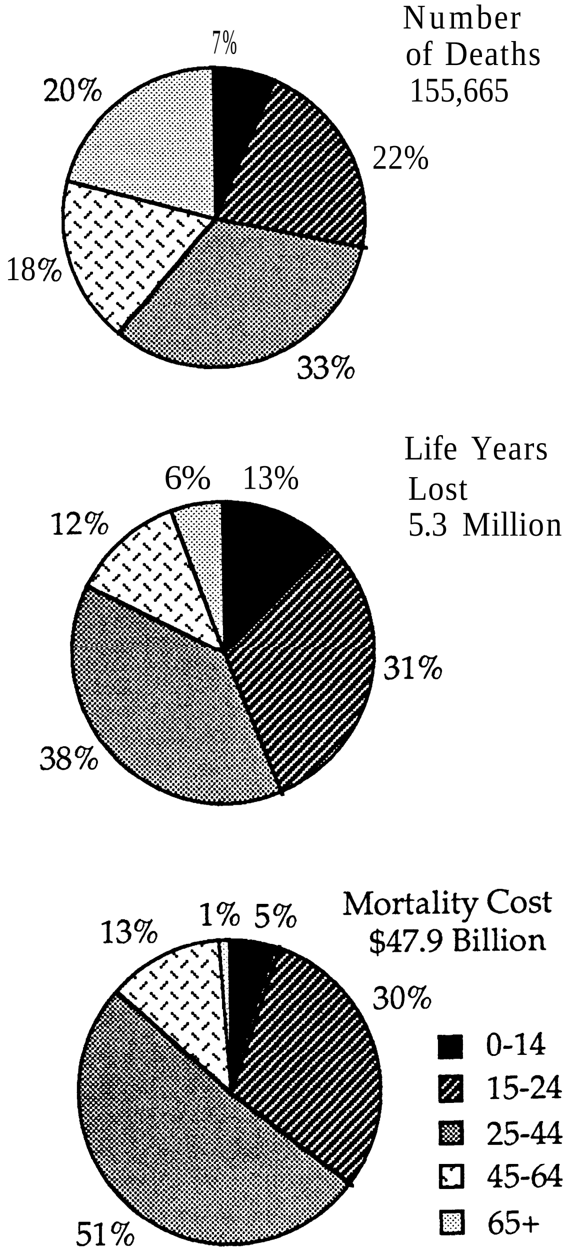


Figure 18

Injury Mortality Losses by Age, 1985



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

		Life Years Lost		Mortality Cost*	
Cause	Number of Deaths**	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

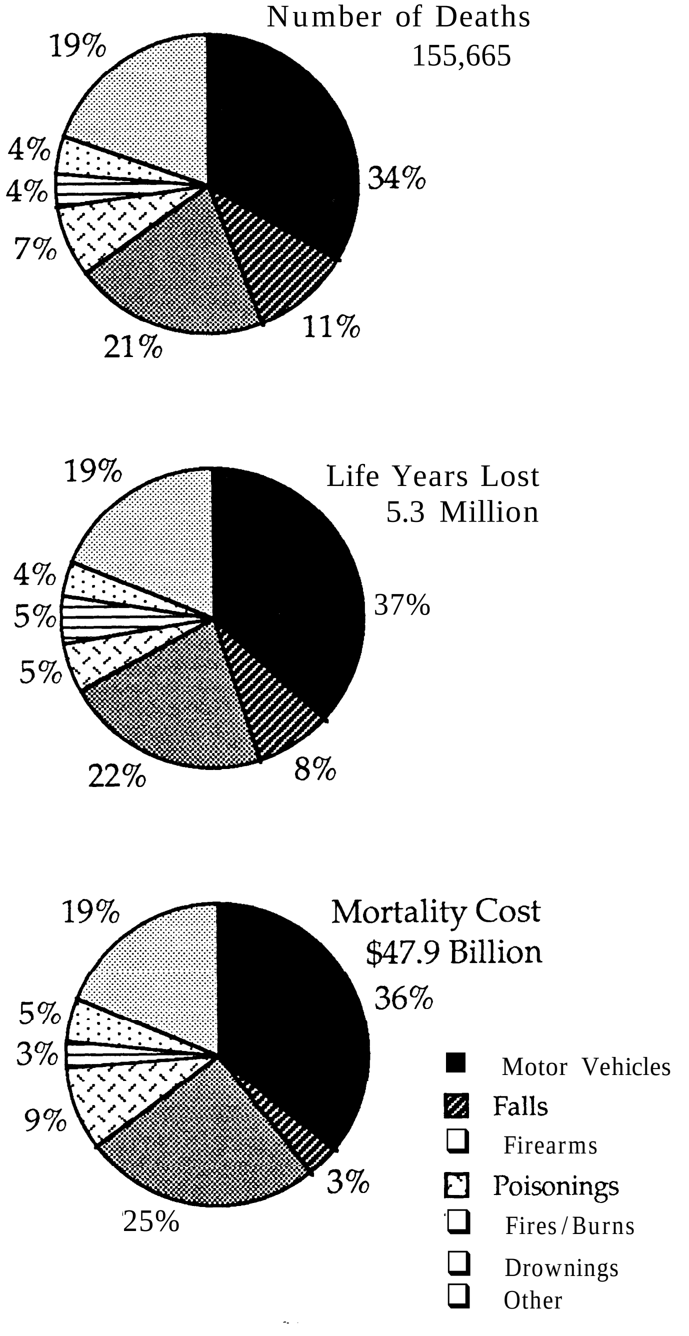


Table 37

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

	All Deaths					Injury Deaths*				
		Life Years Lost		Mortality Cost**			Life Years Lost		Mortality Cost**	
Age and Sex	Number of Deaths	Total (thousands)	Per Death	Total (millions)	Per Death	Number of Deaths	Total (thousands)	Per Death	Total (millions)	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

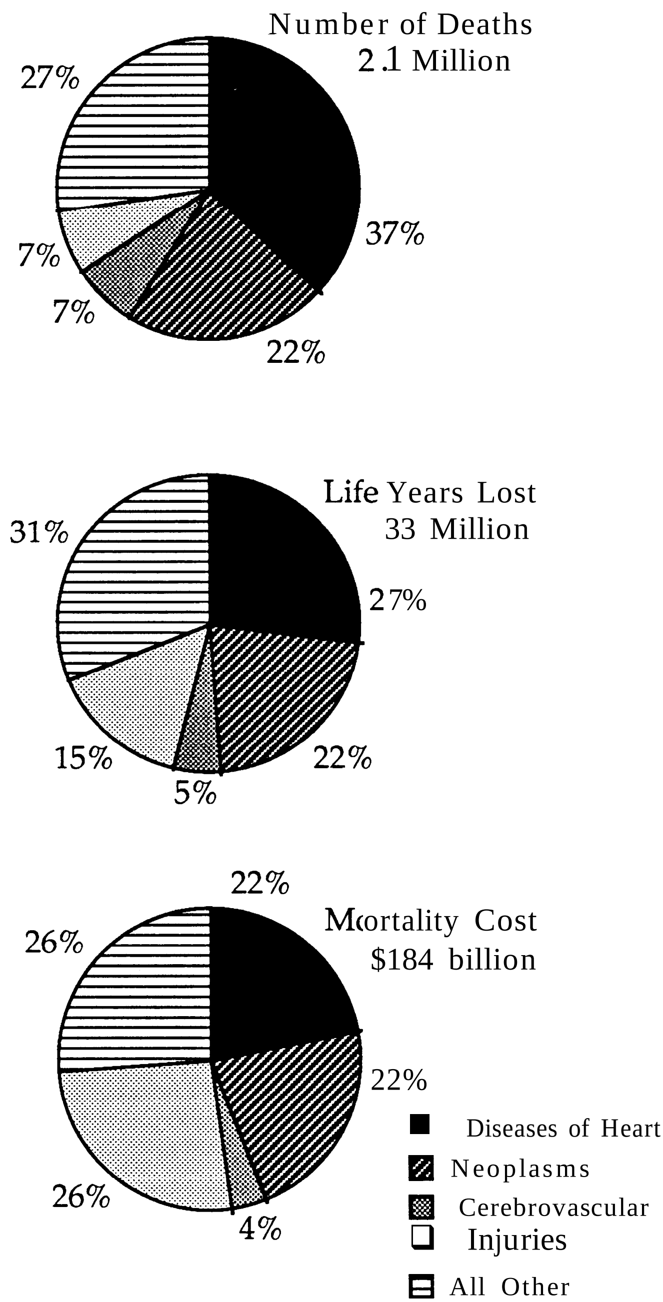
Cause	Number of Deaths	Life Years Lost: Total (thousands)	Life Years Lost: Per Death	Mortality Cost*: Total (millions)	Mortality Cost*: Per Death
Total	2,085,563	33,253	15.9	$183,643	$88,054
Diseases of the Heart	771,169	9,094	11.8	40,982	53,143
Neoplasms	461,563	7,210	15.6	40,786	88,365
Cerebrovascular 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



for research on neoplasms 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).

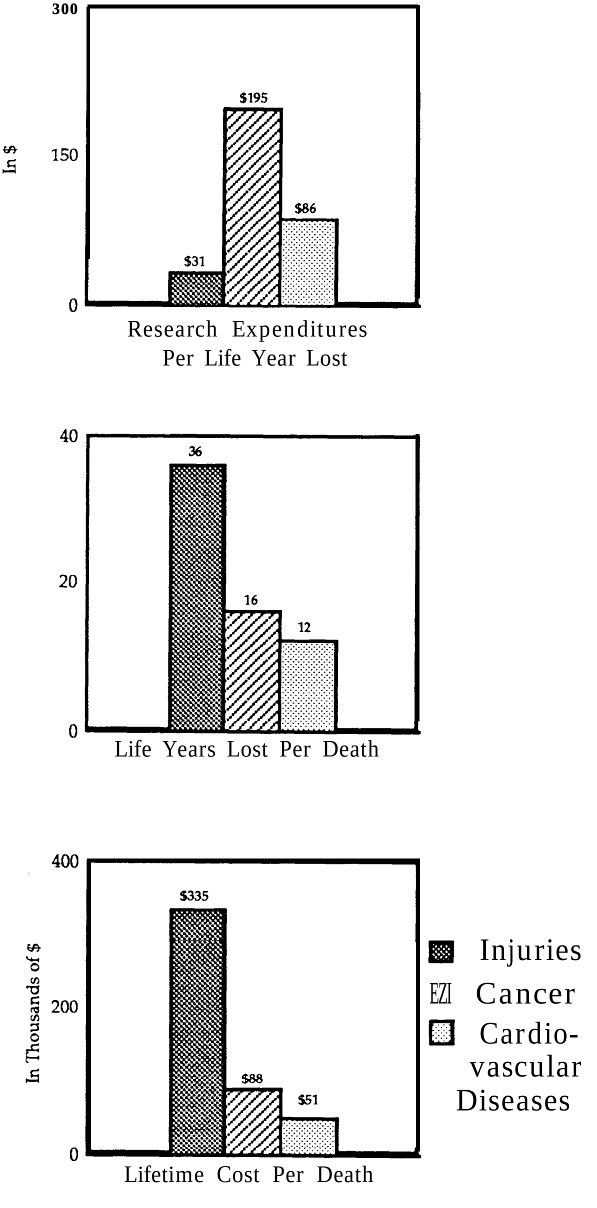
The investigators conclude in *Injury in America* that support for research on injury prevention and control is relatively small, comprising about one-tenth of the expenditures for cancer research and less than one-fifth of cardiovascular disease research expenditures. In terms of life years lost prior 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 Related	Discount Rate	Source
All injuries*	1963 Prevalence	**$11,811**	**$1,703**	**$10,108**	-	**4**	Rice, **1966**
All injuries*	1972 Prevalence	**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 related injuries	1982 Prevalence	**61,025**	**19,278**	**41,746**	-	**6**	Munoz, 1984
Unintentional 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 MacKenzie, 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.

Chapter **3**

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

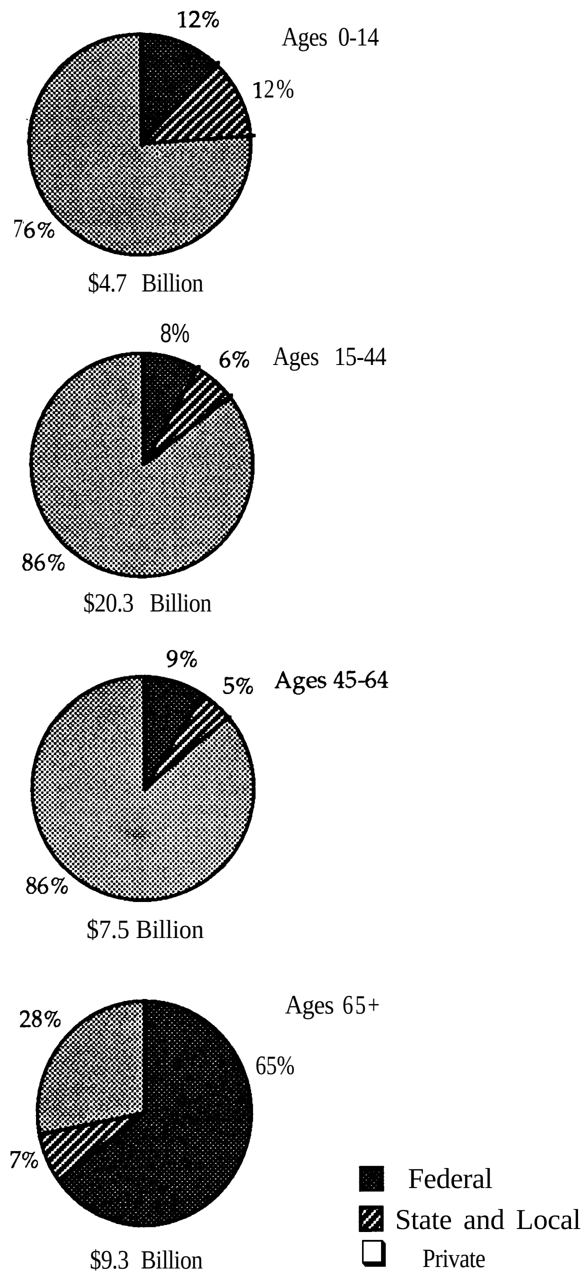
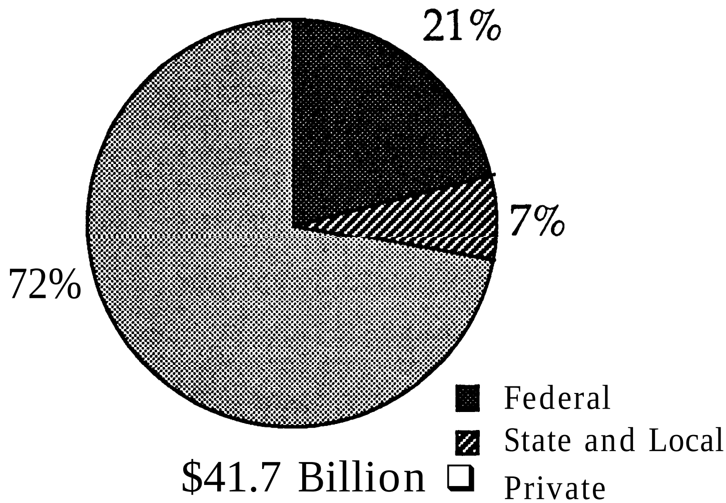


Figure 23

Direct Medical Care Cost by Source of Payment, 1985



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 Pavment	Total	Veterans Admin-istration	Social Security (OASDI)	Supple-mental Security Income	Workers' Compen-sation	Pri-vate Insur-ance	Auto-mobile Insur-ance
				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

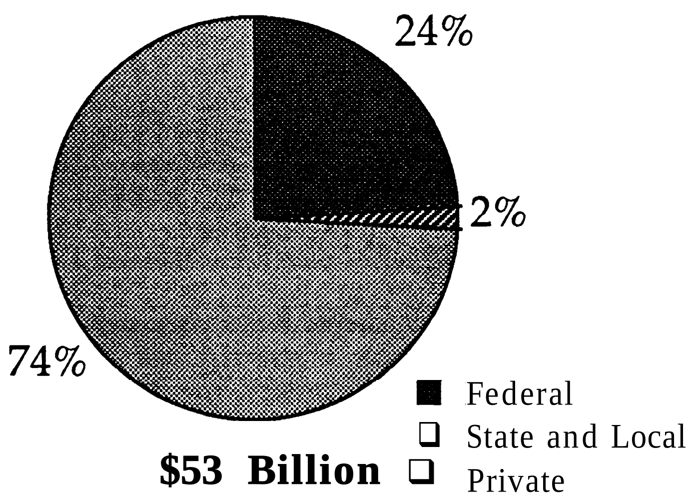
For the distribution of direct medical care expenditure, a variety of data sources is used. The resulting figures represent a best estimate and not an exact accounting.

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



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.

Chapter 4

Willingness to Pay

The willingness-to-pay method of estimating the cost of injury is conceptually different from the human capital approach presented in Chapter 3. Human capital refers to individual worth measured by the production over time of a stream of output estimated at market value. Willingness to pay, on the other hand, reflects the value placed on health and life by individuals. Willingness-to-pay research is an effort to derive social preferences regarding public policy and assess the burden of pain, suffering, and loss in quality of life associated with injury. Thus, the willingness-to-pay method attempts to value life comprehensively.

Societal cost, according to the willingness-to-pay approach, has two components: 1) individual willingness to pay defined as the value a typical person places on health and safety, and 2) the cost the rest of society saves by preventing or controlling an injury. This chapter focuses primarily on the first term, how much people are willing to pay, and actually do pay, for safer and healthier lives. The second term, the savings society gains through injury prevention and control, includes increased tax revenues; reduced transfer payments in Medicare, food stamps, unemployment compensation, etc.; reduced private insurance payments; and reduced costs for administering transfer payment and insurance programs (Miller, Brinkman, and Luchter, 1988; U.S. NHTSA, 1983).

To Reduce Fatal Injury Risk

The literature on individual willingness to pay as a measure of the value of human life has grown in recent years. Some works are theoretical (Cropper and Sussman, 1988; Mishan, 1988; Rosen, 1988; Smith, 1987); some are philosophical (Administrative Conference of the United States, 1988; Gillette and Hopkins, 1988; Menzel, 1986; Merkhofer, 1987; Miller, 1988; Robinson, 1986; Viscusi, 1986; Wenz, 1986); and others are empirical (Blomquist, 1988; Fisher, Chestnut, and Violette, 1989; Garen, 1988; Gerking, de Haan, and Schultze, 1988; Hammitt, 1988; Moore and Viscusi, 1988). Miller (1989) evaluates 49 studies on this issue and concludes that 29 are of reasonably good quality. The most common problems with the remaining studies are: 1) faulty surveys, such as asking about probabilities too small for people to understand, restricting respondents to a few students or professors, or ignoring responses of zero; and 2) use of inaccurate risk variables, such as a variable on risk by industry that ascribes the same risk to the janitor, the secretary, and the machinery operator, or a variable on risk by occupation that was based on only one year of data and involved more occupations than deaths, thus causing most occupations to have equal risks of zero rather than varying, small levels of risk.

The 29 studies of good quality have estimated the values of a reduction in individual risk of fatal injury or illness based on four possible elements:

- Extra wages received for risky jobs;
- Price and demand for products that increase health and safety;
- Personal tradeoffs made between time, money, comfort, and safety; and
- Surveys about individual willingness to invest money to increase health and safety.

Miller converted the estimates from the 29 studies to 1985 after-tax dollars and recomputed those that involved a discount rate or value of time using consistent values for these parameters. Following the Blomquist method (1982),Miller also adjusted the values obtained to assure that behavior be interpreted in terms of perceived, rather than actual, risk levels. Table 24 shows the value of life by type of study.

Across the 29 studies, the individual willingness to pay to save one life ranges from $1.0 million to $3.1 million, with a mean of $1.95 million and a standard deviation of $0.5 million. This level of uncertainty is typical of the effectiveness estimates in most cost-benefit analyses. Furthermore, the emergence of values in a similar range from studies using many different approaches and data sets suggests that the methodological concerns raised by individual studies are not of central importance. For example, existing data appear to underestimate the risk of fatal workplace injury. A comparison across studies implicitly assumes that the willingness to pay to avoid death is the same for slow, painful death as for sudden death, and that the willingness to pay to reduce risk does not vary significantly between unavoidable risks like nuclear disaster and risks like auto crashes, over which the individual has some control. In addition, the choice for some workers may be between a risky job and unemployment rather than a less risky, but lower-paying, job.

To give a simple example of the estimation of the value of human life, a study might estimate that the average person spends $200 on optional auto safety features that reduce the chance of dying prematurely by 1 in 10,000. Dividing $200 by the 1 in 10,000 probability

Table 24

Individual Willingness-to-Pay Estimates of Value of Life by Type of Study, 1985

Type of Study **and** Sources	**Amount (millions*)**
Average of 29 Studies	$ 1.95
Extra Wages for Risky Jobs (15 studies)	1 .00-3.00
Demand and Price	
Safer cars (Winston & Mannering, 1984)	1.90
Smoke detectors (Dardis, 1980)	1.00- 1.80
Houses in polluted areas (Smith & Gilbert, 1984)	2.30
Life insurance (Landefeld & Seskin, 1982)	1.10
Behavior	
Pedestrian tunnel use (Melinek, 1974)	1.80
Safety belt use (Blomquist, 1979; 1988)	1.30-3.10
Speed choice (Jondrow, Bowes, & Levy, 1983)	1.30-1.60
Driver's travel time (Miller, 1989)	1.00- 1.20
Surveys	
Cancer (Landefeld, 1979)	2.40
Safer bus (Jones-Lee, Hammerton, & Phillips, 1985)	2.60
Safer job (Gegax, 1984)	2.00
Auto safety (Viscusi, Magat, & Huber, 1989)	2.20

Source: All estimates from Miller, 1989a; references in parentheses show primary sources prior to adjustment or value extraction from behavioral models

* After-tax dollars

suggests that the average person is willing to spend $2 million to assure a safe and healthy life. This value estimation does not imply that most people would actually be able to pay $2 million to avoid dying prematurely. The estimate is based on the small amounts people regularly pay – in dollars, time, discomfort, and inconvenience -- to reduce health risks. The aggregate expenditure of $2 million on health and safety, by ten thousand people, prevents one anonymous, statistical individual from dying. That is the price average Americans pay for safety.

To Reduce Nonfatal Injury Risk

The $1.95 million value per life is based on the behavior of people who have an average of roughly 40 years to live. If the net present value of 40 future life years is $1.95 million, the implied value per life year is roughly $120,000, based on a 6 percent discount rate. Willingness to pay to prevent a nonfatal injury can be estimated by multiplying this value times the years of functioning lost to injury, discounted to present value.

The percentage of functioning lost to different types of moderate and severe injuries has been estimated by a small number of physician experts (His et al., 1983). The ratings cover three time periods: the year after the injury, the second through fifth years, and thereafter. They examine six aspects of functioning: physical dependency, mobility, pain, and cognitive, cosmetic, and sensory functioning. Subsequently, the ratings were extended to a more comprehensive range of injuries (Carsten, 1986). Aided by the *Guides to the Evaluation of Permanent Impairment* (AMA, 1984), developed by physician panels of the American Medical Association, Carsten also developed a method for combining the ratings by functional aspect into a summary impairment rating. Luchter (1987) used the physician ratings to compute average impairment by injury severity, based on the relative incidence by severity of different injuries in auto crashes.

Table 25 shows estimates by injury severity of individual and societal willingness to pay to prevent nonfatal injuries. The societal amounts range from $30,000 for prevention of an injury of moderate severity to $1.5 million to prevent a critical injury. To prevent a fatal injury, the societal amount is estimated at $2 million. Thus, the willingness-to-pay estimates for reduction in critical nonfatal injuries and fatal injuries are roughly 4.5 to 6 times the cost per death caused by injury -- $317,187, estimated by the human capital approach.

To Avoid Specific and Minor Injuries

Arthur (1981) presents a theoretical model of willingness to pay that is readily extended to nonfatal events. The model indicates that willingness to pay to reduce the incidence of an injury equals willingness to pay for life times the relative loss associated with the injury and

Table 25

Individual and Societal Willingness-to-Pay Estimates for Reduction of Nonfatal Injury by Severity, 1985

Injury Severity	Individual (thousands*)	Societal (thousands*)
Nonfatal Injury		
Moderate	$25	$30
Serious	100	115
Severe	260	375
Critical	1,225	1,525
Fatal Injury	1,950	2,000

Source: Miller, Brinkman, and Luchter, 1988

* After-tax dollars

with death. The extended model was used to determine willingness to pay to prevent selected injuries and to assess the reasonableness of the values obtained from the physician ratings.

The medical decision-making literature is rich in scales that score the relative loss associated with different levels of health status. Some articles focus on chronic conditions -- for example, the loss due to a heart attack, hearing impairment, or kidney failure. Others create functional ability indexes or scales and score the relative loss at each point on the scale. The scores indicate total loss, including family loss in quality of life and pain and suffering, as well as financial loss.

Selected injuries were scored on several scales of reasonable quality, and the median loss across scales was used to estimate willingness to pay. On all the scales, the loss score for death was one, while the score for perfect health was zero. Scores were estimated for three groups of injuries: fates worse than death, serious injuries preferable to death, and minor injuries.

Fates Worse Than Death

Severe head injury, severe burns, and quadriplegia are examples of fates many people consider worse than death. Indications that people feel some fates are worse than death are easy to find. American slang is filled with such phrases as "He'd be better off dead," or "I'd rather die." Mercy killing is a hotly debated issue. The suicide rate soars for people **with** central nervous system disorders or AIDS (Marzuk et al., 1988). The largest jury awards have been primarily for severe injury, rather than death. The question of whether death or paralysis from the neck down is worse generally yields split, but emphatic, opinions.

Guilt, regret, stress, loneliness, bereavement, and pain can be much worse than death. The stressful uncertainty faced by the loved ones of a permanently unconscious person can exact a terrible cost. Three studies outlined below provide adequate information to assess the loss associated with fates generally considered worse than death.

Through sample surveys in Canada, Torrance (1982) developed scores according to status on four dimensions of functioning (mobility and physical activity, self-care and role function, emotional well-being and social activity, and health problems). He obtained further insight into fates worse than death by asking parents whether it would be better to bear a disabled baby or experience a still birth. One weakness of the health problems scale used by Torrance is that it has only one moderate level each for pain and disfigurement. Green and Brown (1978) surveyed British students about the relative severity of death and a variety of injuries.

Kind, Rosser, and Williams (1982) estimated scores on a two-dimensional health status scale. One dimension measures disability, with 1 representing full mobility and 8, unconsciousness. The second dimension measures distress, with 1 being none and 4, severe. Median scores were computed from the noneconomic component of British jury awards, which follow an informal schedule.

The loss scores for quaciriplegia and head injury resulting in long-term unconsciousness or total permanent disability were taken directly from the studies. Quadriplegia scores averaged about a 10 percent greater loss than death, while totally disabling head injury scores averaged about a 15 percent greater loss.

An important caution about these loss scores is that values vary widely among individuals. For example, Torrance (personal communication, 1988) found that partial and complete quadriplegics who adjust to their injury perceive their loss as 65 percent, while quadriplegics who sue for the right to starve to death clearly perceive a loss exceeding 100 percent. The 110 percent loss estimate for complete quadriplegia is an average loss score based on a survey of people with differing expectations about their ability to adjust.

The losses associated with severe burns were computed from the functional scales based on the impairment ratings reported by His and associates (1983). The physician ratings suggest that severely burned people over 45 generally would need an attendant for the rest of their lives, be confined to bed, and experience some mental impairment, as well as substantial disfigurement and pain. Severe burns are essentially the worst fate possible, with a loss almost 40 percent greater than the loss associated with death. It is little wonder that the debate over death with dignity is becoming more heated as the survivability of persons with these injuries and other severe health conditions increases.

Severe Injuries Preferable to Death

Functional scales were applied to paraplegia and partially disabling head injury, as was a scale developed by Kaplan (1982). Based on sample surveys in the U.S., this scale assumes no fate is worse than death. The scale has three dimensions (mobility, physical activity, and social activity) and adjustments for a diversity of symptom-problem complexes. It includes adjustments for pain by body part (at a single severity level) and for information related to disfigurement.

On average, complete paraplegia is associated with about a 60 percent loss, incomplete paraplegia about a 50 percent loss, and incomplete quadriplegia about a 90 percent loss. Torrance (personal communication, March 1988) reports that paraplegics who have adjusted well to the condition rate their loss at about 45 percent. Partially disabling head injuries are associated with losses ranging from 15 to 62 percent, depending on the severity of long-term consequences.

Miller and associates (1988) used the loss scores for serious burns, head injuries, and spinal cord injuries to validate selected willingness-to-pay estimates. They estimated individual willingness to pay to avoid critical injury at 1.1 million, which is on the same order of magnitude as the 1.2 million computed in Table 25 from the Carsten (1986) estimates of impairment and life years lost. The estimated willingness to pay to avoid a severe injury is $310,000, compared to the $260,000 computed from the impairment estimates.

Table 26 shows the estimated societal willingness to pay to avoid selected injuries. The highest amounts result from severe nonfatal injuries, rather than fatalities. Included is an estimated $3.6 million to avoid a severe burn, $2.9 to $3.2 million to avoid a totally disabling head injury, and $2.2 to $2.6 million to avoid injury resulting in quadriplegia. The estimate exceeds $1.3 million to avert an injury resulting in complete or partial paraplegia.

Minor Injuries

Physician ratings of functional impairment were not available for minor injuries. Data from the National Highway Traffic Safety

Table 26

Societal Willingness-to-Pay Estimates to Avoid Selected Injuries by Nature of Injury, 1985

Nature of Injury	Amount (thousands*)
Severe Head Injury	
Total impairment	$2,900-3,200
Partial impairment	550-1,500
Quadriplegia	
Complete	2,600
Partial	2,200
Paraplegia	
Complete	1,800
Partial	1,350
Very Severe Burn	3,600
Minor Injury	4
Death	2,000

Source: Miller, Brinkman, and Luchter, 1988
* After-tax dollars

Administrations National Accident Sampling System (NASS) indicated that an average of 2 days were spent in the hospital and another 2.8 days of ability to perform work or housework were lost (Miller et al., 1988) Perhaps another 4.8 days of progressively less severe activity limitation and mild pain might follow. The three impairment scales described above suggest an average functional loss of 37 percent for 9.6 days, or a total of .01 life years lost. The societal willingness-to-pay amount to avoid a minor injury is estimated at $4,000.

Conclusion

Much of this report discusses the cost of injury to society. This chapter focuses on a methodology that combines individuals' assessment of the amount they are willing to spend on injury risk reduction with the potential savings to society. This assessment yields values of $2 million to avoid death. To avoid moderate to critical injuries, the estimates range from $30,000 to $1.5 million. To avoid severe head injuries involving total impairment, quadriplegia, or very severe burns, willingness-to-pay estimates range from $2.6 million to $3.2 million.

There is support in the economics profession for employing the willingness-to-pay method rather than the human capital approach when a dollar value is placed on health and safety benefits in cost-benefit analyses or resource allocation models (Bailey, 1980; Menzel, 1986; Mishan, 1988; National Safety Council, 1987; Thompson, 1980). Regulatory analyses performed by several federal agencies have employed the willingness-to-pay approach. Included are the Consumer Product Safety Commission, Occupational Safety and Health Administration, Federal Highway Administration, Coast Guard, Federal Aviation Administration, Nuclear Regulatory Commission, and Environmental Protection Agency. The Department of Agriculture has also used the approach in cost-benefit analysis.

The American public would be willing to invest $300 billion a year to prevent all injury deaths and $800 billion to prevent all nonfatal injuries, for a total of $1.1 trillion. It is clear that the human capital approach yields significantly lower estimated values of human life than does the willingness-to-pay method. Both sets of estimates are presented in this report to provide the reader with the best and most current estimates available employing each approach.

Chapter 5

Potential Savings from Injury Prevention

The premature deaths, disabilities, and costs resulting from injury, including large public sector expenditures, highlight the need to reduce the burden of injury in the United States. The application of current knowledge can substantially reduce the incidence or severity, and accompanying cost, of injury. This chapter provides examples of estimated savings to society of selected injury control interventions for which reasonable estimates of effectiveness and cost can be made. When effects of an intervention are known, but data are insufficient on cost or current extent of implementation, the missing data are noted.

The precision of the estimates varies depending on research design and the generalizability of research findings. Scientists often disagree on these issues. However, in cases with large effects, or small effects based on large samples, it is unlikely that additional research would reverse the conclusion that a given intervention did or did not produce savings. In many cases, better data would increase the precision of the estimates.

Background

Some progress has been made in reducing injuries in the United States. Automobile occupant fatalities per million miles driven were reduced about 40 percent by the Federal Motor Vehicle Safety Standards authorized by the Motor Vehicle Safety Act of 1966 (Robertson, 1984). In New York City, where most children's deaths from falls result from crawling out of windows in multistoried buildings, health department initiated programs and regulations helped reduce such fatal falls of children from about 50 per year in the 1960s (Bergner, Mayer, and Harris, 1971) to about 4 per year in the 1980s (Bergner, 1982).

Numerous interventions to reduce the incidence and severity of injury have been identified (e.g., Haddon, 1970; Dietz and Baker, 1974; Robertson, 1983; Baker, O'Neill and Karpf, 1984; Waller, 1985), but many have yet to be implemented. Delay in the application of interventions known to be effective has a long history. In the 19th century, railroad workers had a very high injury mortality rate because of dependence on time tables to avoid the collision of trains on the same track, lack of uniform braking of all cars, and use of flexible chains to join cars. Despite the availability of automatic signaling systems, automatic braking systems, and automatic coupling systems in the 1870s (Adams, 1879), most railroads did not adopt the technology until it was required by Congress near the turn of the century (Robertson, 1983). Fatalities per thousand rail workers were reduced 80 percent from 1890 to 1920 (Swain, 1980).

In recent years, argument over the cost of applying interventions has been a major factor in delay of implementation. Determination of the net savings to society if any one intervention were implemented depends on estimates of level of incidence reduced, the cost of injury severity reduced, the estimated cost of implementing or increasing the intervention, and the extent to which the intervention would be applied. Unfortunately, for most interventions that have been suggested or implemented to some degree, data on all these elements are unavailable.

Savings Estimation Method

The current review of the literature on injury control interventions suggests that, most often, the cost of the intervention is not known or reported. Researchers who evaluate the effects of interventions seldom include cost estimates of the interventions.

It is also difficult to find data on the extent of implementation of many interventions. For example, a controlled experiment in which parents in an experimental group were counseled regarding infant falls from tables, beds, etc. suggests that these falls can be reduced about 41 percent by physician warnings and counseling (Kravitz, 1973). To estimate the savings that could be realized' from expanding such counseling, however, data is needed on the current extent of counseling by physicians. No survey of physicians to determine the extent of such counseling and its cost is known.

The following data are necessary to calculate savings:

a. Number of injuries of given severity to which an intervention applies;
b. Cost of injuries by severity;
c. Proportion of each severity level reduced by the intervention;
d. Reduced costs = Sum of $a_i \times b_i \times c_i$ where i = each severity level;
e. Cost of applying or incrementing the intervention; and
f. Net savings = d - e.

It should be noted that this is not cost-benefit analysis. Certain costs and benefits that are not translatable into dollars are not included. On the cost side, for example, some interventions include alteration in transportation of teenage children that changes the daily routine of families. On the benefit side, for example, the human capital approach does not include reduced pain and suffering, and on the cost side, substitution of economic productivity with caregiving by family members. The willingness-to-pay approach includes the assumptions that people perceive risks accurately and evaluate them in economic terms. Even were the latter true, the public's assessment of many risks is at variance with reality (Slovic, Fischhoff, and Lichtenstein, 1987). Nevertheless, with assumptions explicit, application of a particular method to a variety of interventions sheds light on the relative merits of the interventions in economic terms.

Table 27 presents savings estimated for several interventions by the human capital and willingness-to-pay methods, separately, using data from Chapters 2 and 4. Although some of the uncertainties and ranges of estimates are discussed in this chapter, the literature cited should be consulted for a more complete view of the strengths and limitations of the studies relative to their use here. More detail on the methodology is found in Appendix B.

Table 27

Estimated Cost and Savings of Interventions to Reduce Injury and Severity

	Cost (millions)			Savings (millions)	
Intervention	**Human Capital**	**Willingness to Pay**	**Program**	**Human Capital**	**Willingness to Pay**
Child pedestrian injury campaign	**$112**	**$234**	**$54**	**$58**	**$180**
Bicycle helmet promotion	**255**	**356**	**72**	**183**	**284**
Driver education elimination	**-700 ***	**-2,067 +**	**-163 ***	**863 ** **	**2,230 ** **
License age 17	**1,446**	**4,267**	**0**	**1,446 ** **	**4,267 ** **
Motorcycle helmet use laws	**393**	**1,500**	**296**	**97**	**1,200**
Reduced ignition of cigarette paper	**187**	**1,100**	**0**	**187 ** **	**1,100 ** **
Air bags	**8,650**	**23,491**	**4,000**	**4,650**	**19,491**
Side crash protection	**916**	**3,529**	**2,000**	**0**	**1,529**
Automatic vehicle lights	**391**	**1,154**	**620**	**0 ** **	**534 ** **

* **Represents reduced cost**

** **Excludes savings in property** damage

Implementation Strategies

Implementation strategies can be categorized into four general approaches:

- Persuade individuals to reduce risky behavior or protect themselves and others;
- Require that people refrain from risky behaviors or increase protection by administrative rule or law;
- Change vehicles or environments to increase automatic protection (that is, the individual at immediate risk does not have to be changed to be protected); and
- Improve post-injury emergency and rehabilitative treatment services.

Generally, automatic protection is most successful and persuasion least successful, particularly if the persons at risk must take very frequent action for protection, such as the use of child restraints and safety belts in cars (Robertson, 1975). There seems to be a preference for education and other behavior-change approaches without resort to law, probably because they are thought to be less controversial or less costly, but such assumptions are subject to challenge by research. Laws may reduce risk if sufficiently enforced, but several nonlegal factors are related to both compliance with law and degree of enforcement (Robertson, 1983). The success of automatic approaches requires technical competence in design and quality control in implementation, after political, social, and economic barriers are overcome.

Persuaded Behavior Change

The research on three attempts at behavior change by persuasion is complete enough to allow a savings estimate – a campaign against child-pedestrian injuries tested in three cities, a bicycle helmet promotion tested on a large scale in Australia, and high school driver education, which has been the subject of numerous studies.

Campaign Against Child-Pedestrian Injuries

Based on research regarding child 'dart-out' behavior resulting in pedestrian injuries, a campaign using an animated character, "Willy Whistle," in schools and on television was studied in three cities. The researchers estimate a 20 percent reduction in dart-out injuries to pedestrians under age 15 and a 12 percent reduction in all child-pedestrian injuries. The one-time developmental and research cost of the campaign was $472,000. The success of the campaign is dependent on use in school classrooms and on television. The television time (e.g., 380 showings in Los Angeles valued at $150,000) was contributed by local stations as a public service (Blomberg, Preusser, Hale, and Leaf, 1983).

Apparently only Miami, Florida has used the program consistently. The Miami schools spend $95,000 per year to implement the program in 135 elementary schools, about $704 per school. If that cost is generalizable to the 76,000 elementary schools in the U.S., the annual cost of full implementation would be about $53.5 million per year, excluding any contributed television time. Limiting the use of the program to schools in neighborhoods that have a history of child-pedestrian injuries would reduce the cost. Since the effect of the program used only in schools without any television may be less than in the original experiment, the savings may be less with only school use.

There were 978 deaths to pedestrians under age 14 in 1985. Using ratios of deaths and hospitalizations to incidence of medically treated child-pedestrian injuries from a large regional study (Barancik, Chatterjee, Greene-Cradden, et al., 1986), investigators estimate the medically treated incidence and hospital admissions per fatality. A **12** percent reduction in child-pedestrian injuries would result in about 117 fewer fatal injuries, 1,413 fewer hospitalizations, and 2,289 fewer medically treated and released cases.

The cost of these injuries in human capital terms would be about $112 million, and by willingness-to-pay estimates, $234 million for fatal injuries alone. The human capital savings exceed the estimated cost of the program by about $58 million. Savings employing willingness-to-pay estimates less the cost of the program, would be about $180 million. The latter approach excludes nonfatal cases, for which the cost was not comparably calculated.

A film entitled “And Keep on Looking,” dealing with a wider range of child-pedestrian situations for 9-12 year olds, has been field tested and a 20 percent reduction in injuries estimated (Pruesser and Lund, 1988). A videotape combining the “Willy Whistle” and the new film is being considered for distribution to urban and suburban schools by the National Highway Traffic Safety Administration. If these tapes are used, they may provide substantial results at less cost per school than the Miami program, but the cost per school has not been established.

Bicycle Helmet Promotion

Head injuries to bicyclists can be reduced substantially by helmet use (Thompson, Rivara, and Thompson, 1989). A promotional campaign to increase use of bicycle helmets in Victoria, Australia during 1982-85 resulted in a 20 percent reduction in head injury to bicyclists (Wood and Milne, 1988). The campaign included:

- 1,000 helmets sold through the schools at two-thirds retail cost;
- Required helmet wearing while cycling in school activities;
- Poster distribution to all schools, physicians, and helmet retail outlets;
- Distribution of promotional materials to cycling clubs;
- A television and radio campaign that cost $A160,000 (Australian dollars); and
- Government rebates of $A225,000 to purchasers of about 25,000 helmets.

Although the total cost of this effort is not calculable, a reasonable estimate of the program cost, given the identified cost, is $A500,000. The cost to consumers of helmet purchases must be added to that amount. The helmets known to have been sold through the rebate program cost consumers about $A900,000 after subtracting the rebates. The total cost, not counting unrebated helmet purchases, was about $A1.4 million in a population of 3.9 million. To implement the program in the U.S. population of about 245 million, converting Australian dollars to U.S. dollars at the 1985 conversion rate, 1.208, would cost about $72 million, assuming comparable rates of bicycle use.

The total incidence and severity of head injuries to bicyclists is unknown. Head injuries have ranged from 49 percent to 67 percent of hospital admissions of bicyclists in three studies (summarized in Friede, Azzara, Gallagher, and Guyer, 1985). Assuming that these estimates are reasonably accurate, and applying the ratios of hospitalizations and deaths to incidence from a large regional study (Barancik et al., 1986), a 20 percent reduction in bicyclist head injuries would result in 178 fewer fatalities, 2,463 fewer hospitalized injuries, and 16,602 fewer injuries treated and released. Deducting the $72 million cost of the program, the savings of the Australian bicycle helmet program in the U.S. would be about $183 million in human capital terms or at least $284 million by willingness-to-pay estimates. The latter estimate is for fatality reduction alone since the nonfatal injury cost was not calculated in a way usable here. The validity of these estimates depends on the extent to which cultural differences affect public acceptance of such programs and on the extent to which the direct conversion of Australian and U.S. dollars distorts differential effects of incentives in countries with different wage structures.

Driver Education

One of the most widespread attempts to educate people to reduce injury by altering behavior is driver education in the public schools. According to the latest survey (1982-83), 998,363 students were enrolled. Costs per pupil varied widely among the states, but the median was $163 (National Safety Council, 1985). Therefore, high school driver education cost approximately $162.7 million in that year, not counting time diverted from academic subjects. The 1985 cost was probably not very different from the 1982-83 cost since any decline in numbers taking the course in the two years after the most recent survey would be at least partly offset by inflation in cost per pupil.

Unfortunately, the scientific evidence indicates that expenditures on driver education in the public schools had an adverse rather than an ameliorative effect on injury rates. Al though carefully controlled experiments find that driver education has little or no effect on individual risk in the aggregate (Shaoul, 1975; Lund, Williams, and Zador, 1986), it results in a large increase in licensure in an age group that has a very high crash rate (Shaoul, 1975). An increase of 8 licensed 16- and 17-year-olds per 10 students was found in a 27-state study (Robertson and Zador, 1978). In Connecticut, when driver education was eliminated from the public schools in nine school districts, there was a 75 percent decline in licensure of 16 and 17-year-old drivers of those taking high school driver education compared to comparable districts that retained the course (Robertson, 1980).

A 75 percent reduction in licensure of the 998,363 students enrolled nationally in 1982-83 would reduce the number of fatal crashes by about 595 per year based on the national rate of 7.95 fatal crashes per 10,000 licensed drivers aged 16-17. There were 1.64 deaths per fatal crash of 16-year-old drivers, so about 976 deaths can be attributed to early licensure due to driver education.

Since 16-year-old drivers have a fatal crash rate per mile about 11.4 times that of drivers aged 35-39 (Robertson, 1983), near the average age of their parents, there would be about 91 percent fewer deaths if parents drove their children the same number of miles that the children drive themselves. Therefore, adjusted for substitution of parental driving, the reduction from eliminating driver education would be approximately 0.91 x .75 x 976 or 666 deaths per year. If the distribution of nonfatal injury severity relative to deaths is similar to the distribution for all crashes, severity of injuries reduced would be distributed by the Abbreviation Injury Scale (AIS) as follows: AIS 1 - 69,657, AIS 2 - 5,974, AIS 3 - 1,325, AIS 4 - 213, AIS 5 - 71, fatal - 666.

The estimated savings of crash injuries prevented would be approximately $700 million in human capital terms or $2.1 billion by willingness-to-pay estimates had there been no driver education in public schools. Adding the savings from eliminating the program, the total savings would be about $863 million per year in human capital terms or $2.2 billion by willingness-to-pay estimates, not counting property damage.

Laws Addressing Individual Behavior

Estimates of savings from the effects of laws on individual behavior are not possible for many laws because the cost of enforcement is unknown. Estimates are attempted below for two cases -- legal driving age and motorcycle helmet use, for which the cost of enforcement is considered to be minimal.

Legal Driving Age

Driver education would have no adverse effect if the legal minimum driving age were raised to 18 (Robertson and Zador, 1978). Since no state has a minimum licensing age of 18, the exact effect of such a policy cannot be estimated. Research comparing fatal crash involvement of 16-year-old drivers in New Jersey with a licensing age of 17 (except for an agricultural license at age 16) and Connecticut with a licensing age of 16 indicates that about a 65-85 percent reduction in fatalities involving 16-year-old drivers would ensue from a minimum licensing age of 17 (Williams, Karpf, and Zador, 1983). Although the study found that the fatal crash rate involving 17-year-old drivers in New Jersey was slightly higher than in Connecticut, the fatal crash rate of drivers in the combined 17-29 age group was comparable among the states. Also, there were no offsetting rates of 16-year-olds killed as pedestrians or bicyclists.

In 1985, 2,014 people in the United States were killed in crashes involving 16-year-old drivers. Applying the same adjustments for parent substitution for 16-year-old drivers as in the case of driver education, about 1,375 deaths (0.91 x 0.75 x 2,014) would have been avoided if the legal driving age had been 17 in 1985. Assuming that the ratio of nonfatal to fatal injury distribution when these drivers are involved is similar to that for drivers in all age groups, the reduction in injury distribution of a 75 percent decrease in crashes by drivers less than 17 years old would be approximately as follows: AIS 1 - 143,808, AIS 2 - 12,344, AIS 3 - 2,736, AIS 4 - 440, AIS 5 - 146, fatal - 1,375. Since it is unlikely that every trip of a 16-year-old driver would be substituted by a parent or other adult, this is a conservative estimate.

A total savings of $1.4 billion in human capital terms or $4.3 billion by willingness-to-pay estimates would result from a minimum licensing age of 17. This does not account for time spent by parents or others transporting teenagers under age 17 or the savings in property damage. A survey of teenagers in Michigan, New Jersey, and New York, with very different rates of licensure, found very little effect of licensure on lifestyle. The increase in percent of teenagers with jobs, comparing employment at age 15 and 16, was highest in New Jersey, where licensure at 16 was prohibited except in agriculture (Preusser, Williams, and Lund, 1985).

Law enforcement expenditure would probably not have to be increased much, if any, to achieve the reduction. Most law enforcement would be achieved by parents who are unlikely to allow unlicensed drivers to use family vehicles.

Motorcyclist Helmet Use Laws

Laws requiring motorcyclists to use helmets reduce motorcyclist deaths by about 24-30 percent (Robertson, 1976; Watson, Zador, and Wilks, 1980; Hartunian, Smart, Willemain, and Zador, 1983). Data on nonfatal head injuries are sparse, but one study indicates that the increase in such injuries after repeal of a helmet law paralleled the increase in deaths (McSwain and Lummis, 1980). The nonfatal head injury to death ratio was 3:l.

The number of motorcyclist fatalities in states without helmet laws in 1985 was 2,714. Therefore, based on a 24 percent reduction from the law, it is estimated that 651 fewer deaths and 1,953 fewer head injuries would have occurred had these states had helmet use laws. The reduction in injuries and deaths multiplied times their cost, results in an estimated cost reduction of $393 million in human capital terms or $1.5 billion by willingness-to-pay estimates.

Such a reduction is particularly significant because it would disproportionately reduce public expenditures. A detailed analysis of the cost of treatment and rehabilitative care of motorcyclists in a major trauma center found that 63 percent of the costs were borne by the taxpayers, mainly through Medicaid (Rivara, Dicker, Bergman, Dacey, and Herman, 1988). This is in contrast to all motor vehicle injuries, for which about 19 percent of treatment and rehabilitative costs are paid by Medicare and Medicaid (U.S. National Highway Traffic Safety Administration, 1983).

Helmet use rates in states without laws range from 42 to 59 percent (Williams, Ginsburg, and Burchman, 1979). Assuming that about 50 percent of the owners of registered motorcycles in the states without laws would have to purchase a helmet, the cost of the helmets would be approximately $296 million (based on a median price per helmet of $170 in 1989, although some were available for less than $100). Assuming that the helmet would be used in subsequent years, the annualized cost would be a fraction of that amount. Since virtually all motorcyclists use helmets in states where there are laws, the increment in law enforcement cost is considered nil. Therefore, if motorcyclist helmet use were required in states without such laws, the savings, subtracting the cost of the helmets, would be about $97 million in human capital terms or $1.2 billion by willingness-to-pay estimates in the first year. Savings would increase in subsequent years because helmets would not have to be repurchased each year by most riders.

An earlier analysis of the net human capital losses from motorcycle helmet repeal, using more detailed age distributions but a lower estimate of helmet costs, put the net cost of repeal of helmet laws at $160 million in 1980 (Hartunian et al., 1983).

Product Design and Environmental Changes

Numerous potential changes in product design and environments have been studied. For many, the cost and effectiveness varies by degree since various levels of protection are possible. The examples below -- cigarette design; automobile air bags, side crash protection, and automatic lights and head restraints; and offshore drilling equipment -- are analyzed briefly at one specified level of protection each.

Reduced Ignition Potential of Cigarettes

The most frequent cause of housefires is a cigarette dropped on bedding or upholstered furniture where it smolders and later produces a killing smoke or fire, often after occupants of the household are asleep. In response to The Cigarette Safety Act of 1984, a Technical Study Group on Cigarette and Little Cigar Safety produced a report on the feasibility and the cost of modifying cigarette design to reduce the likelihood of ignition by dropped cigarettes (Technical Study Group, 1987).

Experimental cigarettes manufactured on equipment now used by the industry were tested on fabric, standardized as to padding and geometry. The numbers of ignitions in 20 tests varied from 0 to 20 for cigarettes with 41 combinations of type of tobacco, tobacco density, paper porosity, citrate added, circumference, and second paper wrapping. Lower ignitions were associated with low tobacco density, lower circumference, lower paper porosity, and no citrate added.

Subsequent tests on commercially available furniture with fabric and substrate similar to the standardized mockup produced an exceptionally strong correlation (r=0.86) to results with the mockup. Although the Technical Study Group cautiously called for more work to establish performance criteria, the results of these studies indicate that reliable tests of cigarettes for potential ignition are feasible and standards for cigarette manufacture could be based on performance in such tests.

Various costs and savings related to the modification of identified characteristics of cigarettes were estimated by a group at the National Bureau of Standards for the Technical Study Group (Ruegg, Weber, Lippiatt, and Fuller, 1987). A combination of modifications to cigarettes could achieve up to a 75 percent reduction in cigarette-related fire injuries, but several would result in increased cost of manufacture and lost revenues to farmers and in taxes. Reduced paper porosity, a modification that was assumed to generate no cost, produced a 30 percent reduction in ignitions. A 30 percent reduction in cigarette-ignited fires in 1985 would have avoided about 450 deaths and 2,100 injuries as well as millions of dollars in property damage. The cost of these deaths and injuries is estimated to be $187 million in human capital terms or $1.1 billion by willingness-to-pay estimates (excluding reduced property damage cost).

Air Bags

After 20 years of regulatory battles and court decisions, a federal standard now specifies limits for forces on the head, chest, and legs in frontal crashes of automobiles at 30 miles per hour into a barrier. The standard is being phased in during the 1987-1990 model years. Manufacturers have indicated that, to comply with the standard, some vehicles will have driver-side airbags and safety belts in the right-front seat. Others will have the automatic safety belts in driver and right-front passenger positions. Automatic safety belts vary in effectiveness depending on design and ease of detachability (Graham and Henrion, 1988; O'Neill, 1988).

Estimates of the effect and cost of various forms of compliance with an automatic restraint standard have been the subject of controversy for two decades. The official regulatory analysis indicates fatality reductions of 40-50 percent for fully used lap-shoulder belts, 35-50 percent for fully used automatic belts, and 45-55 percent for air bags with full lap shoulder belt use (U.S. National Highway Traffic Safety Administration, 1984). Since full belt use will not be accomplished, even with belt use laws and automatic belts, the actual effectiveness depends on projections of belt use generally and particularly among people at high risk. The effect on fatalities of increased use as the result of safety belt use laws is not nearly as high as predicted by estimated effectiveness of belts (Williams and Lund, 1988).

Eventually, as the relative effectiveness of the various technologies in actual use becomes known, the use of air bags will likely increase. Use of full front-seat air bags, assuming no belt use, is estimated to reduce deaths by about 6,190 (range -- 3,780-8,630); AIS 1 injuries, by about 255,770 (no range indicated); and AIS 2-5 injuries, by about 110,360 (range -- 73,660-147,560) (U.S. NHTSA, 1984). Since the midpoint of the range is the best estimate, it is used to estimate savings of approximately $8.7 billion in human capital terms or $23.5 billion by willingness-to-pay estimates.

Increased belt use would reduce these estimates to the extent that there is overlap in the injuries reduced by air bags and those reduced by belts. Belt use laws have increased belt use from 10-20 percent to 40-60 percent with an accompanying reduction in deaths of 5-15 percent (Williams and Lund, 1988). Some of that reduction is in side crashes and ejections that would not overlap with the effect of airbags.

Since about 10 percent of the U.S. fleet is replaced with new vehicles each year, the savings from a modification of vehicles over their average lo-year use is about the same as the cost of injuries in a given year minus the cost of modifying a cohort of new vehicles of a given model year. The charges for air bags by manufacturers have varied from $300 per car for full-front-seat air bags as an option by General Motors in the mid 1970s to $800 per car for driver-side air bags in certain recent models of several manufacturers. Like all vehicle components, the cost per unit is greatly reduced as a function of the number manufactured. The National Highway Traffic Safety Administration estimated $364 per car for full-front air bags, including lifetime energy costs of the added weight of the vehicle (U.S. NHTSA, 1984). Multiplied times the number of new cars sold in 1985 (11.04 million), the cost of full-front air bags on all cars would be about $4 billion. Thus, subtracting the cost of the air bags, full-front airbags in each model year would save about $4.7 billion in human capital terms or more than $19.5 billion by willingness-to-pay estimates.

Side Crash Protection

The National Highway Traffic Safety Administration is presently receiving comments on a proposed rule to increase protection to occupants of passenger cars hit from the side, which accounted for 32 percent of car occupant fatalities in 1985 (U.S. NHTSA, 1988d).The NHTSA analysis presents effects and costs of various degrees of protection. At the highest level of proposed protection, estimated injury reduction would be approximately: AIS 3-5 - 4,735, fatal - 1,200.

Since NHTSA did not estimate any benefits for reduction in AIS 1 and AIS 2 injuries, the savings of $916 million in human capital terms or $3.5 billion by willingness-to-pay estimates are conservative. The ‘worst case’ cost estimate of the proposed side protection is $185 per car, including lifetime fuel costs, or a total cost, if applied to new cars sold in

1985, of about $2 billion. Therefore, while it seems there would be no net savings in human capital terms at that level of protection, the savings by willingness-to-pay estimates, less the cost of increased side protection at the specified level, would be approximately $1.5 billion.

Automatic Vehicle Lights

Increased conspicuity of motor vehicles has been found an important factor in multiple-vehicle crash rates. Evaluations of the effects of the daytime use of headlamps, parking lamps, or redesigned systems have produced estimates of reductions in daytime, multiple-vehicle crashes of 7-38 percent (Stein, 1985). Sweden experienced a 11-13 percent reduction in such crashes when daytime headlamp use was required by law, despite the fact that 50 percent of drivers were using headlamps in daytime before the law (Transport Canada, 1986).

While crash reductions can be largely accomplished by requiring the driver to turn the lights on by law as was done in Sweden, there is substantial potential for adverse reaction from people whose batteries die when they forget to turn the lights off at the end of a trip. An automatic relay that turns the lights off when the ignition is turned off would alleviate this problem.

Although the current use of headlamps in daylight in the U.S. is unknown, it is unlikely to exceed 5 percent. Therefore, even considering the differences in weather and hours of daylight year-round between Sweden and the United States, the 11-13 percent reduction in crashes in Sweden, given a 50 percent prelaw headlamp use, seems a minimum to expect from automatic use were such a policy adopted in the United States.

Assuming that the nonfatal severity to death ratio in daytime multiple-vehicle crashes is similar to all crashes, a 12 percent reduction in daytime multiple-vehicle collisions in 1985 would reduce injuries approximately as follows: AIS 1 - 38,907, AIS 2 - 3,337, AIS 3 - 740, AIS 4 - 119, AIS 5 - 40, fatal - 372. This amounts to $391 million in human capital terms or $1.2 billion by willingness-to-pay estimates, excluding property damage and pedestrian injuries that might be avoided by greater vehicle conspicuity.

Transport Canada estimates the lifetime cost per vehicle of automatic reduced intensity highbeams at $40 for cars and light trucks, including increased fuel use. Applied to the 15.5 million cars, light trucks, and vans sold in 1985, the lifetime cost of the lights would be about $620 million. Since the lifetime use of a given model year is about equal to that of the full fleet in one year, automatic lights on all new vehicles in a given model year, if only 12 percent effective, would produce no savings in human capital terms but would save about $534 million by willingness-to-pay estimates, after subtracting the cost of the lights. Using a human-capital cost method and including savings in property damage excluded here, Transport Canada concludes that the savings from automatic headlamps would be greater than the costs (Transport Canada, 1986).

Automatic Head Restraints

The federal standard for head restraints can be met by adjustable restraints or by high seat backs that automatically reduce neck injury in rear-end crashes. Despite the fact that high seat backs are probably less expensive and certainly more effective in reducing neck injuries, about 70 percent of new cars are equipped with adjustable restraints. High seat backs were found to reduce injuries by 17 percent compared to 10 percent for adjustable restraints and were said to cost $28 less per car (Kahane, 1982). Recently, the National Highway Traffic Safety Administration has revised its cost estimate, indicating little difference in the cost of the two types of restraints on average, but the cost is said to vary from $20 to $40 for adjustable restraints and $20 to $37 for high seat backs depending on materials used (U.S. NHTSA, 1988c).

A reduction of about 64,000 neck injuries in rear-end motor vehicle collisions occurred annually with a mix of 70 percent adjustable restraints and 30 percent high seat backs. If there were 100 percent high seat backs, the reduction would be about 85,000, a difference of 21,000. In 1981, neck injuries were estimated to cost about $670 per case, not counting pain and suffering (Kahane, 1982). Therefore, 100 percent installation of high seat backs would save approximately $14 million per year in injury cost, assuming no difference in the cost of the two types of seat on average.

Power Makeup Equipment in Offshore Drilling

In oil drilling, pipes are connected and disconnected by large tongs that work similarly to wrenches. Workers who handle the tongs experience a variety of injuries. Worker proximity to the mechanical energy in such operations can be altered by the use of ‘power makeup equipment.’ Comparison of sites with such equipment to those without, both before and after the installation of the equipment, indicates a reduction of 42 percent in related worker injuries per hours worked. The reduced cost of the injuries would pay for the equipment in 6 years (Mohr and Clemmer, in press).

Since the extent of such equipment use throughout the industry is unknown, the total savings to society if the equipment were installed at all offshore drilling sites cannot be estimated. Nevertheless, the case illustrates the principle that injury reducing equipment in industry can pay for itself in reduced injury costs and should be considered an investment rather than a cost.

Data Needed for Estimation of Savings

A list of some interventions for which data on effects have been estimated, but data on other aspects of savings analysis are unknown, is presented in Table 28. Many of the references for this section are in the table and are not repeated in the text. Although a large-scale literature review was conducted to find examples of interventions with known effectiveness, some may have been missed.

Missing Implementation and Cost Data

Counseling by physicians has been found to promote injury-reducing behaviors such as child restraint use and purchase of smoke detectors. In the study of pediatric counseling regarding infant falls from tables, beds, etc., counseling was associated with a 41 percent reduction in such falls compared to a control group that did not receive counseling. The extent and cost of the counseling and the severity and cost of the injuries are unknown.

Drownings associated with children wandering into unsupervised swimming pools occurred 65 percent less frequently in Honolulu, where pool fencing is required, than in Brisbane, Australia which had no such requirement. The cities have similar weather and pool to household ratios. While the cost per pool of fencing can be easily obtained, the extent of installed fencing of pools in the U.S. is unknown as is the distribution and cost of drownings and near drownings associated with the lack of fencing.

Motor vehicle fatalities and other health problems related to alcohol are lower in correlation with increased alcohol taxes, but taxes have not been raised to keep pace with inflation. Restoring the 1950 taxes on alcohol adjusted for inflation would increase the revenues generated by $20 billion per year (Hacker, 1987). Since both the severity distribution of injuries attributable to alcohol and the cost of administering the taxes are unknown, an estimate of the savings from increased alcohol taxes is not attempted here.

Although relatively nonsevere injuries must occur in substantial numbers to equal the cost of one very severe injury, such seemingly mundane injuries as fractures and other injuries from sliding into bases while playing softball are not without significant cost. A recent study estimated a cost of $1,223 per sliding injury. Use of breakaway bases reduced such injuries by 95 percent at a cost of $48 per base (Janda, Wojtys, Hankin, and Benedict, 1988). Without an estimate of the extent of the injuries and the use of breakaway bases nationally, however, savings from the universal use of breakaway bases cannot be calculated.

Administration and Enforcement Costs

Motor vehicle occupant deaths of infants (per 100,000 population in that age group) declined 37 percent from 1980 to 1984 in association with the enactment of child-restraint use laws. The reduction in 1980-84 for children aged 14 was 25 percent and for children aged 5-9, 11 percent (Robertson, 1987). Head injuries to children less than 4 years old in one emergency room declined 26 percent from before to after the child-restraint-use law in California; changes in less severe injuries were statistically insignificant (Agran, Dunkle, and Winn, 1987).

Motor vehicle occupant deaths of young children (per 100,000 population in that age group) declined about 30 percent from 1968 to 1979 (Baker et al., 1984) in association with motor vehicle safety standards and the 55 mile-per-hour speed limit. This trend should not have continued into the 1980s because the effects of those policies were fully realized by 1980. Child-restraint laws no doubt account for some of the reductions in child occupant deaths in the 1980s. One analyst attributes 153 fewer child deaths in 1985 to the laws (Partyka, 1989). The reductions were found despite numerous exemptions in state laws. An analysis of state laws requiring child-restraint use found that 39 percent of the children O-5 years old killed in the year preceding the law were not covered by the law because of age or other exemptions (Teret, Jones, Williams, and Wells, 1986). If the exemptions had not retarded restraint use, an estimated additional 98 children ((153/0.61)-153) would not have died in 1985.

It is not possible to estimate savings from eliminating the exceptions in child-restraint laws because data on the number of child seats that would have to be purchased and the cost of law enforcement are unknown. Many areas have child-seat loan programs that allow reuse of seats, but the extent of reduction in cost attributable to these programs is unknown.

The cost of the administration of laws has seldom been studied. The cost of police enforcement varies depending on whether police are reassigned from other duties that are more or less beneficial or whether the police force is expanded. Certain laws such as administrative license suspension for driving while intoxicated (DWI), mandatory jail sentences for DWI, and required use of safety belts have been found to have some effect on fatalities. Administrative license suspension for DWI expanded to the 75 percent of states without such a policy would save $1.7-$4.6 billion, less the cost of administration. Mandatory jail sentences

Table 28
Examples of Injury Control Countermeasures with Known Effectiveness: Data Needed for Savings Analysis

Intervention	Effect (% reduction)	Percent Unapplied*	Severity Distribution	cost of Injuries	Cost of Intervention
Pediatric counseling on infant falls (Kravitz, 1973)	41% of treated falls	Unknown	Unknown	Unknown	Unknown
Fenced swimming pools (Pearn et al., 1979)	65% child pool drownings	Unknown	Unknown	Unknown	Unknown
Alcohol taxes (Cook, 1981)	7% auto fatals per 10% increase in liquor price	Varies by state	Unknown	Unknown	Unknown
Breakawav bases for softball (Janda et al., *1988)*	95% sliding injuries	Unknown	see ref.	$1,223 per injury	$48 extra per base
Administrative license suspension for DWI (Zador et al., 1988)	5% of all fatals	75%	Estimated by ratio per death	$1.7-$4.6 billion	Unknown
First offense mandatory jail sentence for DWI Zador et al., 1988)	2% of all motor-vehicle fatals	76%	Estimated by ratio per death	$700-$1,857 million	Unknown
Belt use laws (Williams and Lund, 1988)	7% front occupant fatals	20%	Estimated by ratio per death	$342-$906 million	Unknown
Gun registration and waiting period (Medoff and Magaddino, 1983)	24% suicides	Unknown	Unknown	Unknown	Unknown
Repeal right-turn-on-red laws (Zador et al., 1982)	57% pedestrian injuries at such sites	Unknown	Unknown	Unknown	Unknown
Required smoke detectors in homes (McLoughlin et al., 1985)	25% fatal	Unknown	Unknown	Unknown	Unknown

Table 28 (Cont.)

Intervention	*Effect* (% reduction)	Percent Unapplied'	Severity Distribution	cost of Injuries	cost of Intervention
Window barriers in high-rise buildings (Bergner, 1982)	90%	Unknown	Unknown	Unknown	Need updated figures
Amber timing at intersections (Zador et al.,1984)	Potential 12-70% all such crashes	Optimally unknown	Derivable from NASS	Derivable	Unknown
Flashing lights at rural stop signs (Hagenauer et al, 1982)	80% fatal	Unknown	Unknown	Unknown	Unknown
Pedestrian-friendly vehicle front ends (Ashton, 1982)	30% fatal	Unknown	Derivable from NASS	Derivable	Unknown
Reflective tape on outline of large trucks (Burger et al., 1986)	18% night- time car into truck crashes	Unknown	Unknown	Unknown	Unknown
Breakaway utility poles near roads (McFarland et al., 1979)	30% fatal of such crashes	Unknown	Derivable from NASS	Unknown	Need updated figures per pole
Remove u tilitv poles from roads (McFarland et al.,) 1979)	38% fatal of such crashes	Unknown	Derivable from NASS	Unknown	Need updated figures per pole
Remove trees from roadsides (McFarland et al., 1979)	50% fatal of such crashes	Unknown	Derivable from NASS	Unknown	Need updated figures per tree
Impact attenuators at fixed objects (McFarland et al., 1979)	50-75% fatal of such crashes	Unknown	Derivable from NASS	Unknown	Varies by type
Breakaway signs (McFarland et al., 1979)	40-70% fatal of such crashes	Unknown	Derivable from NASS	Unknown	Varies by type
Improve guardrail ends (McFarland et al., 1979)	55% fatal of such crashes	Unknown	Unknown	Unknown	Varies by type

Table 28 (Cont.)

Intervention	Effect (% reduction)	Percent Unapplied+	Severity Distribution	cost of In juries	cost of Intervention
Transition guard-rail at bridge ends (McFarland et al., 1979)	55% fatal of such crashes	Unknown	Unknown	Unknown	Varies by type
Upgrade substandard guardrail McFarland et al., 1979)	15% fatal of such crashes	Unknown	Unknown	Unknown	Varies by type
Concrete median barrier McFarland et al., 1979)	85-90% fatal crossover head-on	Unknown	Derivable from NASS	Unknown	Need updated figures
Widen bridges (McFarland et al., 1979)	50% fatal of such crashes	Unknown	Unknown	Unknown	Varies by type
Improve curve delineation (McFarland et al., 1979)	16% fatal of such crashes	Unknown	Unknown	Unknown	Need updated figures
Channel left turns (McFarland et al., 1979)	42% fatal of such crashes	Unknown	Unknown	Unknown	Need updated figures
Lighting freeways (McFarland et al., 1979)	50% fatal of such crashes	Unknown	Derivable from NASS	Unknown	Need updated figures
Flashing lights and gates at rail-high-way crossings (Pinnell et al., 1982)	60-80% fatal	Unknown	Unknown	Unknown	Unknown
Limited access to businesses on rural roads (Stover et al., 1982)	33% fatal at appropriate sites	Unknown	Unknown	Unknown	Unknown
One-way urban streets (Parsonson et al., 1982)	10-50% pedestrian injuries	Unknown	Unknown	Unknown	Unknown

* Percent of population for which interventions have not been implemented

for DWI in the states without it would save $342-$906 million, but the unknown cost of administration and keeping prisoners would substantially offset those savings. Mandatory belt use in the states without it would save $700-$1,858 million, less the cost of enforcement and administration.

The lack of data on administrative and enforcement costs, as well as arguments over the effectiveness of laws such as gun control laws, also impedes savings analysis. More than half the suicides and homicides in the United States are committed with firearms. Controlling for age, income, religion, region, and occupational status, laws that require a license or waiting period for purchase of a firearm are associated with a reduction in suicides of 3 per 100,000 population (Medoff and Magaddino, 1983).

Such laws have generally been found more effective than laws that prohibit carrying concealed weapons, presumably because they are more enforceable (Lester and Murrell, 1982). Another study estimated that if New Jersey's law had been applied in all states in the 1960s, some 4,200-6,400 fewer deaths would have occurred annually from suicide, homicide, and unintentional firearm injuries (Geisel, Roll, and Wettick, 1969). The New Jersey law included licensure of dealers and purchasers; delay between purchase and acquisition; maintenance of records of sales; restrictions on sales to felons, drug addicts, alcoholics, mentally ill persons, and minors; and restrictions on carrying handguns in motor vehicles or as concealed weapons. The results of that study have been questioned because the correlation was reduced when controls for region of the country were introduced in the analysis (Magaddino and Medoff, 1984).

Recent research compared assaults and homicides in Seattle and Vancouver, the latter with stricter rules regarding gun ownership. Gun ownership is not allowed for 'self-protection' in Vancouver but is allowed in Seattle. The two cities, 140 miles apart, have similar weather, unemployment, education, household income, and burglary and robbery rates. Although aggravated assaults and homicide rates, excluding those in which guns were involved, were similar in the two cities, the firearm assault rate in Seattle was 7.7 times that in Vancouver and the firearm homicide rate was 5.1 times higher (Sloan, Kellerman, Reay, et al., 1988).

Since the lack of uniformly strict state laws regarding gun licensure and waiting periods allows for interstate transportation of guns by unqualified owners from less to more strict states, it is likely that a uniform policy would have more effect than has thus far been demonstrated by comparing the experience of states with different laws.

Research on the effect of allowing drivers to turn right on red at signalized intersections indicates an overall 57 percent increase in pedestrian collisions in states where the law allowed right turns compared to states with no change in the law during the same period. Studies of all intersection crashes attribute only about 1 percent to right-turn-on-red (Hagenauer,Upchurch, Warren, and Rosenbaum, 1982), but the studies include dubious assumptions regarding the validity of police reports on the color of lights at the time of the crashes before the officer arrived. If the right-turn-on-red laws were repealed, the number of intersections where the signs would have to be changed and the cost of such changes is unknown.

Comparison of a county with a law requiring smoke detectors in homes to a county without that requirement suggests that the requirement is associated with a 25 percent reduction in deaths from housefires. About 67 percent of U.S. households had smoke detectors in 1982 (U.S. Fire Administration, 1983), but the extent of coverage of smoke-detector legislation is unknown.

Fatal falls of children crawling out windows of multistoried buildings were reduced 90 percent in New York City in association with programs promoting the use of window barriers and regulations requiring such barriers. The number of barriers needed in other cities is unknown.

Motor Vehicle Environments

The length of the yellow phase of traffic control lights among signalized intersections is associated with a substantial difference in crash rates, the degree depending on the length of the lights (Zabor, Stein, Shapiro, and Tarnoff, 1984). A review of other studies suggests less effect in before-after comparisons when lights are changed (Hagenauer et al., 1982). The lack of use of control groups of intersections without light changes does not allow estimation of changes in crash rates that would have occurred without the light changes. An all-red interval after a green in either direction at intersections has also been associated with reduced crash rates (Hagenauer et al., 1982). The distribution of the timing of yellow lights and the use of all-red phases is not known, nor is there a good estimate of the range of injury severity affected.

Use of flashing lights at approaches to stop signs at rural intersections is associated with substantially reduced crash rates. One study found a 51 percent reduction in injuries and an 80 percent reduction in deaths at installation sites (Hagenauer et al., 1982). Better controlled research and a census of relevant sites are needed to assess the savings potential of the use of warning flashers.

Comparison of injuries to pedestrians struck by the frontends of vehicles in England suggests that a 30 percent reduction in pedestrian fatalities could be achieved if all vehicles were designed to reduce the energy exchanges from points, edges, and characteristics related to the kinematics of the event. Since some of these changes would result in less use of materials, such as elimination of sharp points on the front corners of several large American cars, there could possibly be a lower cost of at least some vehicles as well as savings in injury costs. The extent of all the changes needed in U.S. vehicles has apparently not been studied in sufficient detail for savings analysis.

Comparison of large trucks with reflective tape defining the outline of the trucks and trucks without the tape indicates a 15 percent reduction of car-into-truck crashes associated with reflectorization. The extent of use of this approach is unknown, but trucks with striping are rarely seen on the roads.

Fatal crashes that occur when vehicles cross into the paths of oncoming vehicles are reduced 85-90 percent by concrete barriers that are flared at the bottom to guide an errant vehicle back into its lane. While the cost of such installations per mile can be obtained, the number of miles of road at high-risk sites is unknown.

Crash rates related to bridge width are a function of both bridge width and the width of the approaching road (Bissell, Pilkington, Mason, and Woods, 1982). Widening of bridges is associated with an average 50 percent reduction in fatal crashes related to bridge width. Modifications of the road approach, such as diagonal shoulder markings, continuous guardrail tapered before the bridge structure and post-mounted delineators behind the guardrail, have also been demonstrated to reduce bridge crashes substantially. The number of bridges that could be widened or approach roads modified to achieve the maximum reduction in injury is unknown.

As noted previously, motor vehicle crashes occur disproportionately on or near curves. Better delineation of curves (edge and center stripes, roadside and center reflectors, and the like) is associated with about 16 percent reduction in fatal crashes on modified roads. The miles of road curvature lacking such delineation is unknown. Curved road sections with low or absent cross slopes are particularly hazardous when wet. At one such section on the Washington, DC beltway, Congressional staff on rainy days filmed cars spinning and some that had spun off the road, going over embankments or striking bridge abutments (Kelley, 1972). One study found an average 25 percent difference in crashes per mile between sites that had no cross slope and a 0.025 ft. downward slope per foot of road in an area with an average rainfall of 60 inches per year (Dart and Mann, 1970). The extent of the problem nationally and the injury reduction that would be realized from modification of cross slopes is unknown.

Pavement grooving has also been found to be effective in reducing crashes on wet roads, but the estimates vary widely among studies -- 27 percent reduction in Louisiana, 69 percent in California, and 62 percent in Baltimore. One study in Ohio indicated increased crashes on grooved sections in dry weather, but the other studies did not find a significant effect on dry-pavement crashes (reviewed in Gallaway, Benson, Mounce, Bissell, and Rosenbaum, 1982). The injury severity distributions in these crashes and extent of surfaces that would produce benefits from grooving are unknown.

At intersections, lanes that channel left-turning vehicles out of the path of through traffic are associated with a 42 percent reduction in fatal crashes compared to intersections without this feature. Channeling is more effective at unsignalized intersections (54% injury reduction) than at signalized intersections (36% injury reduction), (Hagenauer et al., 1982). Identification of the numbers of high-risk intersections that would produce a savings from channeling has apparently not been done.

About 50 percent fewer fatal crashes occur on lighted sections of urban freeways compared to unlighted sections. Studies of lighting on several major routes indicate that lighting less than 0.4 horizontal foot candles is ineffective at best and may increase crashes (Schwab, Walton, Mounce, and Rosenbaum, 1982). Also, the placement of light poles near the road may increase the crash rate and, if they do not break away on impact, the severity.

Intersection crash rates at night are substantially lower at lighted compared to nonlighted intersections, 25 to 86 percent lower depending on such elements as type of intersection, type of crash, and number of lanes (Hagenauer et al., 1982), but data on relative severity and numbers of intersections involved by type are inadequate for estimation of savings.

Studies of sight distance impaired by hedges, fences, and the like at intersections indicate substantial reduction of crash rates associated with greater sight distance (Hagenauer et al., 1982). However, the relative severity of associated injuries and the extent of the problem have not been adequately studied for savings estimates.

Crashes of motor vehicles and trains at intersections of roadways and train tracks are often very severe. The effectiveness of warning devices such as flashing lights and gates has been estimated at 64 to 80 percent reduction in severe and fatal injuries in such crashes (Pinnell, Mason, Berg, Coleman, and Rosenbaum, 1982). Separation of motor vehicle and rail traffic by overpasses is obviously even more effective. In 1973, the Highway Safety Act authorized federal assistance for improvements at railroad crossings. About $1.2 billion was expended to eliminate or modify 5,600 railroad crossings in the ensuing decade. The numbers of motor vehicle fatalities at such crossings declined from 1,128 in 1974 to 542 in 1984 although exposure increased 4 percent (Dempsey, 1985). If the deaths had continued at the 1974 rate, about 2,500 more people would have died and nonfatal injuries of unspecified severity would have declined 28 percent. The reduced deaths alone resulted in a savings of about $1 billion in human capital terms or approximately $5 billion by willingness-to-pay estimates, the latter several times the expenditure for the improvements. Since the installations will continue to produce savings, the total return will be larger.

Crashes per mile on rural highways are strongly correlated to number of business accesses per mile. Often in a string of adjacent businesses, each has its own parking lot and entrance. The parking lots could be joined and the in-and-out traffic channeled to a single entrance. The data suggest that an average 33 percent reduction of fatalities could be achieved on roads with no access control if they were changed to partial access control (Stover, Tignor, and Rosenbaum, 1982). The number of road sections that would produce benefits from partially limited access is unknown.

In urban areas, changing traffic flow on a street from two-way to one-way traffic frequently results in reduced crashes and pedestrian injuries, although the variation is wide, 10 to 50 percent. Efficiency of traffic flow is also usually a benefit (Parsonson, Nehmad, and Rosenbaum, 1982). To specify the savings involved, more research is needed on the types of streets that would produce benefits, their numbers, and the distribution of crash severities.

In 1985, almost 12,000 motor vehicle fatalities occurred in collisions with fixed objects near roadsides -- trees or shrubbery (2,967), utility poles or signs (2,221), guardrails (1,129), and other objects (5,477). Research indicates that 50 to 75 percent of these fatalities could be prevented by removal of trees from roadsides, impact attenuators, breakaway poles and signs, and improved guardrails. The current cost of such modifications per modification can be obtained, but the number of sites that need modifying is unknown.

Targeting Interventions

As noted above, the cost of applying many interventions is dependent on the extent to which they are targeted to high-risk populations or sites. For example, research comparing sites of fatal crashes into fixed objects with sites one mile in the direction from which the vehicles traveled indicates the high-risk sites can be substantially identified by road characteristics. Twenty-five percent of the crash sites were within 500 feet of curves greater than 6 degrees with downhill grades greater than 2 percent. Only 8 percent of the comparison sites had such characteristics. There was no difference in number of objects along the road at the fatal and comparison sites (Wright and Robertson, 1976). Use of such epidemiologic studies to set priorities would decrease the cost of many interventions relative to the cost of associated injuries.

An example of one such successfully targeted intervention occurred on Queens Boulevard in New York City. Spot maps of pedestrian severe and fatal injuries during 1980-84 revealed clusters on this widest street in the city. Eighty-five percent of the persons injured were aged 65 and older suggesting that interventions related to walking speed and vision, as well as speed control and education, might be effective (Retting, 1988). In 1985, several countermeasures were introduced at a total cost of about $150,000: 1) timing of lights was changed to increase pedestrian crossing time; 2) pedestrian signals were placed on median islands; 3) roadway markings were increased to identify pedestrian walkways and traffic flow; 4) size of speed limit signs was increased and speed enforcement increased; and 5) presentations on pedestrian safety were given at senior citizen centers. The deaths and severe injuries in the targeted area were 3 per year in the two years after these measures were introduced compared to 8 per year in the five years before.

Feasibility

Effectiveness and savings analysis ignores feasibility of implementation because of ideological factors and concentrated interests that may oppose certain interventions. Policies such as government subsidization of bicycle helmet purchases, while acceptable in Australia, may be difficult to implement in the U.S. Although the majority of motorcyclists are in favor of helmet use laws, a vocal minority have been successful in gaining repeal in many states (Baker, 1980). Seemingly overwhelming ideological opposition or lobbying power is not always as solid as it appears, however. No one familiar with Tennessee politics would have expected that state to be the first to enact a child-restraint use law, but it did, and other states followed. The gun lobby spent $6 million in an attempt to defeat Maryland's new gun control legislation but was overwhelmingly defeated in a referendum in the 1988 election.

The incremental approach discussed here also neglects the question of the circumstances under which the injurious consequences of certain products are so severe relative to whatever uses they have that they should be banned. In the 1960s, about 700 people per year in the U.S. died on motorcycles. As a result of massive advertising of motorcycles aimed at a broad spectrum of the population (Sakiya, 1982), sales soared and motorcycle registrations increased from about 500,000 in the 1960s to 5.6 million by 1984. Deaths on motorcycles rose from 700 to 4,600 per year. In the 1980s, racing motorcycles capable of speeds of 160 miles per hour were introduced for street use. These racing motorcycles have death rates about twice those of other motorcycles (Kraus, Zador, Arzemanian, Anderson, and Harrington, 1988).

A marketing effort similar to that for motorcycles, but directed to children as well, led to a large increase in sales of so-called 'all-terrain vehicles' (ATVs) and an accompanying increase in deaths. In this case, however, the government acted while the deaths were in the hundreds, rather than the thousands, per year. The industry has agreed to stop marketing 3-wheeled ATVs, but the Consumer Product Safety

Commission allowed continued marketing of 4-wheeled ATVs in a compromise to avoid extensive litigation, although 4-wheeled ATVs may be as unstable as 3-wheelers (Kitzes, 1989). The government has refused to act on numerous other product-related hazards (Berger and Rivara, 1980; Christoffel and Christoffel, 1989; Robertson, 1989).

Conclusion

There is some uncertainty in each of the estimates of potential for injury reduction because of variation in sampling error and the lack, in some cases, of good experimental design. There is, however, no doubt that a substantial proportion of severe injuries could be reduced by a greater application of current knowledge. The potential savings, net of the cost of injury control programs, is in the billions of dollars for the interventions for which data are available. Usually, savings estimates are far more sensitive to differences caused by using the human capital or the willingness-to-pay method than to variation in estimates of effectiveness of a given intervention. For example, there is nearly a four-fold difference in savings from air bags estimated by the human capital method compared to the willingness-to-pay method. There is, however, no such variation in estimated effectiveness of air bags.

Savings in the billions of dollars were found for air bags ($5-$19 billion), a minimum licensing age of 17 ($1.4-$4.3 billion), and the elimination of driver education from the public schools ($0.8-$2.2 billion). Tens of millions would be saved by reduced cigarette paper porosity ($187-$1,100 million), high seat backs in cars ($14 million), motorcycle helmet laws in states without them ($97-$1,200 million), bicycle helmet use promotion ($183-$284 million), and child-pedestrian programs ($58-$180 million). Estimated by the willingness-to-pay method, the savings from automatic headlamps on cars and light trucks ($534 million) and increased side crash protection for cars ($1.5 billion) are large. Because of the exclusion of the cost of property damage, the estimated savings for eliminating high school driver education, increased licensing age, reduced cigarette ignition, and automatic headlamps are substantially understated.

As noted in the discussion above of the estimates for driver education and licensing age, the savings from some programs or policies, if implemented, would reduce the savings from others. Several of the programs and policies mentioned are independent of one another, but there is overlap in those related to injuries in or by motor vehicles. For example, air bags would reduce some of the injuries that would also be reduced by changes to the road environment, and these changes would contribute to a part of the reduction in motorcycle and bicycle injuries, which would also be reduced by increased helmet use.

Although complete information needed to calculate the precise savings that would result from implementing numerous approaches is missing, the cost of preventable injuries is so large that implementation would have to be enormously expensive to contraindicate action. Cost could be reduced substantially by collection and use of better data on the clustering of injuries geographically in some cases and in particular populations in others. Better data on the extent of current implementation and cost of implementation would contribute to more rational choices among programs and policies.

Chapter 6

Long-Term Impact of Injury on Individuals, Families, and Society

Personal Narratives and Policy Implications

Every injury resulting in severe disability causes profound personal, familial, and social impacts over the long term. An injury episode is not only physical and physiological, but is a deeply personal event occurring in an extended interpersonal and social context. What happens to severely injured individuals in the United States is a result not only of the physical trauma itself and the quality and extent of the medical care that follows, but also of the long-term support available from a variety of sources: family, friends, community groups, health care and social service delivery systems, and legal, insurance, and political institutions. The ability of severely injured people to attain maximum physical recovery, to survive financially, and to reorganize their lives within new limitations is dependent on a society with laws and policies that constrain or enable secure, productive lives regardless of inhibited functional status.

The case studies below illustrate what happens to people with severe disabilities in the various contexts that impinge directly upon their well-being in the months and years following an injury. Together, these case studies tell a story of the struggle to acquire the personal, therapeutic, legal, and financial aid that enables injured persons to survive, have basic needs met, and create for themselves lives that are meaningful in terms of work, love, mutual support, recreation, and personal growth. A major disability resulting from injury shatters an individual's world. Basic routines and activities of daily living can no longer be taken for granted. One's place and role in family, community, and society are no longer the same. One never returns to previous conceptions of 'normal.' Perhaps most importantly, following an injury, one's entitlement to society's resources such as jobs, housing, education, and transportation is no longer automatic. Severely injured people have a 'betwixt and between' or undefined social status regarding their roles as productive participants in community life and as autonomous, decision-making beings. "They are neither ill nor well, neither socially alive and active nor socially expunged and removed" (Murphy, Scheer, Murphy, and Mack, 1988). A sudden disability renders an individual's access to medical and social services, work, and housing questionable. A negotiation process over access begins immediately following the injury and continues sometimes for years.

The most comprehensive finding of the present study is that all participants needed to negotiate with health care, legal, and insurance institutions in order to secure a place for themselves in society following an injury. Access to long-term rehabilitation, psychological support, appropriate attendant services, housing, medication, equipment, and employment opportunities all had to be negotiated, or even fought for, within the regulations and policies of particular agencies and institutions. Thus, documenting the personal, noneconomic costs resulting from an individual's or family member's injury involves discussion of the social institutions in which their lives are embedded, the solutions those institutions are able to provide, and the problems they sometimes create.

Methods and Subjects

The following pages describe what happened to ten individuals and some of their family members over a period of two to eighteen years following a severe injury. Interviewees were selected from health care and social service professional referrals. Only mentally alert, expressive, articulate individuals were selected as subjects for this study in order to gather detailed information on the full range of the injury's ramifications. Thus, the ability to express oneself was the first criteria for subjects chosen. Second, subjects chosen had mechanisms of injury typical of those occurring in the U.S., and common residual disabilities as well. Third, the personal stories of the ten individuals, though unique and idiosyncratic, are similar to thousands of other injury and disability stories. Thus, the case studies were carefully chosen to be widely representative of injury and its aftermath. Moreover, study participants were ordinary citizens. None were wealthy or famous. All were forced to make difficult choices under tragic circumstances. Their stories illustrate the financial, social, and institutional constraints that influence the decisions and give shape to the opportunities of injured persons. The stories are a testament to the strength of the human spirit under great adversity.

The case studies illustrate the following injury-causing episodes: automobile crash, motorcycle crash, near drowning, diving into shallow water, contact sport, brutal beating, fall following an illness, fall in the workplace, and crush following malfunctioning workplace equipment. The studies represent the following residual disabilities: quadriplegia, ventilator-dependent quadriplegia, both mild and severe brain damage, severe central nervous system damage, facial disfigurement, amputated and deformed fingers, functionless hand and arm, and general weakness and inability to walk. The names used are pseudonyms and identifying information has been eliminated in order to preserve anonymity. The case studies portray events and responses from the point of view of the injured person or a family member who was the major caregiver of the injured person. The studies are entirely subjective (see Appendix B for a full description of methods).

Data were collected from five injury survivors, four parents of survivors, one spouse, and one sibling. The small study group does not adequately represent the ethnic diversity of the U.S. population or of the greater San Francisco Bay Area, the location of all the interviews. The study group, however, represents a range of economic, occupational, and educational backgrounds. The California study group possibly had more services available than in other places in the country.

'Invisible' Survivors

There are thousands of severely disabled individuals in the San Francisco Bay Area. Yet finding injury survivors or family members who fulfilled the study eligibility criteria and who would share their experiences with an empathetic researcher proved to be exceedingly difficult. Many scholars have noted how the disenfranchised and alienated are 'invisible' members of American society (e.g., Harrington, 1962; Sheehan, 1976). In spite of the growing lobbying strength and visibility of the disability rights movement over the past decade, the disabled, as individuals, have muted voices. People with disabilities seldom seek publicity. Potential subjects and their families were difficult to locate, even with the help of informed, energetic professional contacts. Members of ethnic minorities with disabilities and their families were even harder to find and thus are under-represented. Appropriate subjects who had suffered from firearm injuries were not located. Most injured people known to medical or allied health personnel had moved numerous times since their acute care or rehabilitation hospitalizations, and providers did not know where to find them. The fact that locating expressive individuals (especially ethnic minorities) with disabilities was so challenging is an important finding in itself. If representatives of the disabled population cannot easily be found to share their personal experiences, it will continue to be difficult for their collective needs to be articulated to policymakers at the local, state, and federal levels.

The goal of presenting a small number of case studies is to illustrate how survivors and their families interpreted what happened to them in the days, months, and years following a severely disabling injury. The subjects presented experiences, events, and concerns that have emerged as central to their lives two to eighteen years after the injury occurred. The aim is to present a range of injuries, disabilities, family dynamics, economic situations, and concerns about health, work, productivity, and dependence. Health care, social service, government, and insurance industry professionals would, of course, have different stories to tell.

Defining Disability

Criteria used to define disability vary widely in the literature. Krause (1972) distinguishes among three kinds of disability: biopsychosocial, social role, and legal disability. Social role disability, the definition employed in this chapter, refers to health-related limitations in performing the social roles expected of an individual, such as going to school, performing work at a job, or doing housework (Nagi, 1979; Rice and LaPlante, 1988). Similarly, the World Health Organization defines disability as "any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner, or in the range, considered normal" (WHO, 1984).

Biopsychosocial definitions are made by physicians and others qualified to judge physical and mental functioning by generally accepted standards. The legal definition of disability is used to determine an individual's entitlement to benefits from government programs, especially Supplemental Security Income (SSI) and Social Security Disability Insurance (SSDI). The definition for SSDI is relatively stringent: "Persons awarded benefits must have been judged to be unable to engage in any substantial gainful activity in the national economy, not merely in their own usual occupation, by reason of a physical or mental impairment. . . . The impairment is medically determined and must be expected to last a year or to result in death' (U.S. SSA, 1987b). The legal definition of disability is much more restrictive than the social role definition.

Ability and Desire to Work

Regulations, Access, Disincentives

In a recent book about the personal, cultural, and social dimensions of disability, Robert Murphy states: "Most disabled people would prefer to work, even at low-paying jobs, rather than live on the Social Security rolls, but if their earned income exceeds a very low limit, they lose both their pension and their government health insurance. This is a critical matter, as their medical expenses usually are much higher than those of ordinary people. Even if they are accepted by an employer's private plan, these generally do not pay for attendants and certain costly equipment. In this classic bind, many disabled people cannot afford to be employed! . . . The system itself promotes dependency" (Murphy, 1987, pp. 159-160).

Social Security Disability Insurance (SSDI) provides benefits to eligible disabled persons (and their dependents) who have worked under and contributed to the Social Security system (2 million recipients in 1986). The amount of the benefit is directly related to the amount of time worked and money paid into the system. The maximum benefit available from SSDI in 1988 was $800 a month. Supplemental Security Income (SSI) is intended for eligible disabled persons who fall below a certain income/assets level (3.9 million recipients in 1986). The monthly SSI benefit in 1988 was $354. Many states supplement the SSI benefit; the California supplement in 1988 was $221 a month. In order to be determined disabled under Social Security law, individuals must have a physical or mental impairment expected to last for at least a year, which prevents them from doing any substantial gainful work. Partial disabilities, which are recognized in many benefit programs, are not sufficient to qualify one for SSDI or SSI. Social Security's medical requirements are strict and only about one-fourth of the initial claims received each year are allowed. Persons considered severely disabled may be denied benefits if they are capable of substantial gainful work.

Since 1972, Medicare coverage has been extended to disabled persons. Hospital insurance protection and optional supplementary medical insurance is provided to disabled individuals who have been entitled to SSDI benefits for at least 24 months. Most SSI recipients are also covered by Medicaid. In fiscal year 1985, nearly 3 million (2,936,000) individuals with permanent and total disabilities received Medicaid benefits (U.S. SSA, 1987a). The following case study illustrates the ramifications of the employment bind in which many people with disabilities find themselves.

Alan Bensen -- Eighteen Years of Quadriplegia

Approximately 200,000 people in this country live with paralysis as a result of spinal cord injuries. Each year it is estimated that there are approximately 2,500 new cases of paraplegia and 1,050 new cases of quadriplegia. About 56 percent of the injuries resulting in these disabilities are caused by motor vehicle crashes, 20 percent by falls, 12 percent by firearms, 7 percent by sports and recreational activities, and 6 percent by other sources (DeVivo, Fine, Maetz, and Stores, 1980 and extrapolated from Kraus, Franti, Riggins, Richards, and Borhani, 1975).

In 1969, at the age of 18, Alan Bensen dove into a lake and broke his neck when he hit the bottom. He was instantly and permanently paralyzed below his collarbone, but maintained arm function. His friends pulled him out of the water and got him to a hospital. He spent a few weeks in intensive care at an acute care hospital and then was transferred to a rehabilitation hospital. He was hospitalized a total of nine months. Mr. Bensen had graduated from high school the year before his injury and had spent the preceding year working in a factory, saving money, and deciding what to do next. Both of his parents were working in factories at the time of his injury. From the hospital, Mr. Bensen moved home with his parents. They worked different shifts and one of them was always at home to care for their son. Mr. Bensen lived at home for about a year, learning to function. His parents were his primary caregivers. They initiated a lawsuit against the owner of the lake property shortly after the injury. They lost the suit but owed no legal fees. The case ended in 1972.

For seven years following the injury, Mr. Bensen had many hospitalizations and surgeries for various injury- and quadriplegia-related medical problems. He recalled a period when he was hospitalized every few months. His problems were those common to quadriplegics – urinary tract infections and upper respiratory infections, including pneumonia. In 1971, he had an ileal diversion, the removal of his bladder. He also had surgery three times on his right arm and hand to allow the thumb to function so he could write and hold objects securely. Both types of surgery were elective. All his medical bills -- acute care, rehabilitation, outpatient, successive surgeries -- and his related costs -- attendant care, a wheelchair-accessible van, and medical supplies – were covered by medical insurance. His initial acute care and rehabilitation costs were covered by his mother’s employee insurance policy. By the time she retired, Medicare was covering Mr. Bensen’s total health care costs. Medicare payments began for Mr. Bensen in 1973.

Education and Job Discrimination

Mr. Bensen attended the state university as a full-time student from 1973 to 1977, graduating with a B.A. degree. He lived in an apartment with an attendant and a roommate during most of his undergraduate education. Friends drove him to and from school and transferred him in and out of the car. While he was a student, he spent three to five hours a week at the university gym doing rehabilitation therapies and learning how to do more things independently. One of the therapists at the university taught him to drive. He began with hand controls in a borrowed car. Then he bought his own car and had hand controls installed. This was of limited value, he recalled, because he could not get himself in and out of the car and could not go anywhere unless transfers were arranged at both ends. A free van with a lift acquired from the Midwest state vocational rehabilitation department during his senior year enabled him to become independently mobile. He was fortunate that the department had a surplus in the budget and was eager to spend the extra money.

Mr. Bensen stayed out of school for the next three years while he considered options and applied to law schools. He drove in his van, with a friend, around the country to look at a few law schools. He eventually decided to come home and apply to the state university law school, which accepted him. He began there in 1980 and finished in 1983. He applied for many more jobs than his peers and was aware of discrimination because he was in a wheelchair (see Murphy, 1987 and Vash, 1981 for a discussion of job discrimination experienced by the disabled). He finally got a job in a small town (pop. 750) in another state. He went there for seven months in 1984. He recalls that there was absolutely nothing to do there aside from his work, and in addition, no public buildings were accessible to him. He decided to move to the San Francisco area and live with a friend.

Mr. Bensen contacted all the county offices around San Francisco to learn about subsidized housing for the disabled. He moved into the suburban apartment in which the interview was conducted early in 1985. He studied for the California bar exam and passed on the first attempt, in the summer of 1985. Again, he spent a long time looking for a job. First, he had a half-time job for a few months. Then he got the public sector law job he held at the time of the interview. For two years he worked at that job full-time.

Increasing Medical Vulnerability

Mr. Bensen said that he had recently cut his work schedule back to four days a week, taking Wednesdays off because he was getting physically sick working ten hours a day, five days in a row. He simply did not have the physical stamina to continue at that pace. At age 38, Mr. Bensen had recently become aware of his increasing vulnerability to a variety of health problems. The scoliosis in his lower back was getting worse, and he felt he would eventually need to have his lower spine fused. He would probably go back to the Midwest for the surgery because he does not have a doctor in California and he knows and trusts the doctors back home.

Attendant Services That Work

Mr. Bensen's SSDI payments began in 1970. Through his SSI eligibility, Mr. Bensen simultaneously became eligible for both In-Home Support Services (attendant services) and Medical (California Medicaid). The In-Home Support Services Program pays for his morning and evening attendants, 170 hours a month, or five to six hours a day. He hires his own attendants by running ads in local papers and interviewing applicants. Mr. Bensen has lived with a woman friend, on and off, for many years. They met in his home town. She works as a teacher and also as his paid attendant during the evenings and on the weekends. The attendants help him get up, out of bed, dressed, and assist him with a range of motion exercises. The personal assistance service system works efficiently for him.

Classic Bind: Employment or Benefits

Mr. Bensen's SSDI payments started at $135 a month and had risen to $651 a month when he was dropped from the program in April 1987. Current federal regulations stipulate that one can be employed for only fifteen months -- the Trial Work Period - while covered by SSDI, at which point the payments are terminated. Mr. Bensen was appealing this ruling to the Social Security Administration at the time of the interview. He said appeals are sometimes resolved at that level. If not, he will consider appealing to the federal courts.

Catch 22: Disabled or Employable

Federal regulations have created a dilemma for Mr. Bensen. At the time of the interview, he was receiving $675 a month in social security payments due to be terminated in two months. He said: "They don't consider me disabled any longer because I have been working for more than 15 months." The rules place him in a bind and force him to make a major decision. If he continues to work, the social security payments will stop, and he will have to keep working because it is almost impossible to re-start the payments. He said, "Most people worry about getting on the system. You don't hear too much about how they try to kick you off of it." Mr. Bensen was extremely anxious about this dilemma, noting again that he did not have a lot of physical stamina and was always vulnerable to medical problems. Working full-time was too hard for him. Yet, without social security payments, he would need to work full-time to survive financially. The anxiety and fear expressed by Mr. Bensen are pervasive among persons with severe disabilities.

System Promotes Dependence and Poverty

Federal regulations stipulate that a disabled individual can continue to receive social security benefits only if earning less than $300 a month. At the time of the interview, Mr. Bensen was trying to assess whether to work fewer hours at his job and pay for all his attendant care, van expenses, and other health-related costs out of pocket, so that he could deduct them, in order to pull his net earnings to just below the $300 a month ceiling. If Mr. Bensen decides to continue working full-time, thus losing his social security benefits, he will also lose his Medicare/Medical benefits because his income and assets are approaching those ceilings as well. He was not sure when those benefits would terminate, but he knew it was within the year. Medicare and Medical pay all his doctor bills and cover all his medical supplies. He could survive without those benefits only if his income were to increase substantially. He is caught in a bind created by government regulations. He wants to work as much as he is able, yet doing so may jeopardize both his financial and medical security.

Health care benefits and economic status are linked by federal regulations. In order to be eligible for Medicare benefits, a disabled individual under 65 must be receiving SSI or SSDI. And to qualify for Medicaid, one must be indigent (Murphy, 1987). Moreover, De Jong and Wenker (1983) frame the broader problem that a persistent feature of American publicly subsidized health and social service benefits is that they are inexorably and traditionally tied to an individual's earned income. These facts wreak havoc on a person's desire and ability to be a part of the workforce, to contribute to society, and to garner self-esteem in the economic marketplace. Mr. Bensen is a vital member of society who is being jeopardized by his ability to earn a living.

Olivia Evans -- Loss of a Hand, Loss of Free Choice

Mrs. Evans had been employed as a housekeeper at a community hospital for thirteen years when she was injured on the job. One evening in 1984, as she was routinely preparing to open the door to the laundry chute in the basement of the hospital, the latch became jammed. As she struggled with the door, she caught her right thumb in the latch and could not release it. It took three men to get her hand out. Later she learned there had been three tons of pressure on the door, and subsequently on her hand. She was in excruciating pain and was taken immediately to the hospital emergency room. There were multiple fractures in her thumb. She was treated and released. Ten days later she had a hematoma in her forearm and was still in severe pain. A month later (December 1984), though still in pain, she returned to work. In April 1985, her orthopedist recommended that she stop working because she had developed many more hand problems: swelling, greatly reduced strength (she could not hold a coffee cup), and much more pain. She finally quit her job. In May 1985, Mrs. Evans had hand surgery to release some of the tendons in an attempt to reduce the pain and swelling. She wore a cast for six weeks. When it was removed, her hand was not healed. Moreover, pains were shooting up through her arm and into her neck and head. Her doctor sent her to a hand rehabilitation therapist and she received hand therapy for two years.

By the end of 1985, Mrs. Evans had developed other symptoms that were a direct result of the injury. She could not move her right elbow, shoulder, or neck, lacked range of motion in the right arm, and had severe pain all through her right side. She began wearing splints at night to restore circulation to the right arm and reduce the numbness. She said that the left hand, due to overcompensation, had developed problems in the seven months before the interview. As a result, she was wearing splints on both hands at night, which she reported were extremely uncomfortable and prevented her from sleeping well. The hospital that had employed Mrs. Evans paid for all of her care: the emergency room surgery, subsequent doctor bills, subsequent surgery, and all hand therapy. They also paid her workers' compensation, 75 percent of her regular wages, from the time she stopped working until January 1987.

Discrimination Against People in Pain

Following the surgery, when Mrs. Evans was still complaining of severe pain, her surgeon said to her, "There is nothing wrong with your hand, it's all in your head. I want you to see a psychiatrist." She was humiliated and extremely angry that the physician thought she was imagining pain. She nevertheless went to a psychiatrist, who reassured her that the problem was in her hand, not her head. The hand therapists were familiar with the post-injury syndrome she suffered and they confirmed it as a physical, not a mental, problem. She resented the doctor's attitude so much that she decided to see a lawyer who brought a suit against the company that provided the laundry chutes to the hospital. She said her anger at her orthopedic surgeon pushed her to take legal action. The lawyer discovered that four people had previously been injured by the chute door. The lawsuit was still in progress at the time the interview was conducted. Mrs. Evans had no idea what the settlement might be. If she wins, she will receive 66 percent of the settlement.

Private Disability Plans Exist for Profit, Not for People

In 1986, the insurance carrier determined through its vocational rehabilitation service that Mrs. Evans could return to work. Officials informed her that she would have to switch occupations since she could no longer perform heavy work. She had been a seamstress in the 1960s, but she could not do the fine needle work anymore because of her injury. The insurance carrier expected her to find work related to sewing and expected her to look for a job by going to six potential places of employment a day until she found a job. After she had searched for a job for four weeks, the carrier found her a job as a bridal consultant at a boutique, designing, not sewing, the clothing.

As a hospital housekeeper, Mrs. Evans had earned $10.25 an hour with full health care and retirement benefits. She lived two miles from her work and drove there in about five minutes. The bridal consulting job began in January 1987 with a 45-minute commute, $7.00 an hour, and no benefits. At the time of the interview (May 1988), she had received a $1.00 an hour raise.

Suffering of Children

Mrs. Evans's husband died more than 10 years before the injury. She said, "The loss of my hand was in some ways worse than the loss of my husband. It was like another death in the family." At the time of the injury, her children were aged 10 and 18. She reported that the injury brought about definite, negative changes in the family. The children became depressed because they were not accustomed to seeing their mother helpless and unable to function. They needed to help dress and bathe her. "All the housework fell on them. They had to open bottles, peel potatoes, everything," Mrs. Evans said. "The children were sort of confined to school, home, and school again. We didn't have money for anything, not even the movies." She felt her children suffered through her injury even more than she did and said, "I feel I robbed my children of three years. They had to do for me, rather than me doing for them." She said she also went through her life savings following the injury. She borrowed $20,000 from a private party to cover her bills. At the time of the interview she was struggling to pay off that loan.

Private disability insurance is designed to get people through the system as quickly and efficiently as possible. In forcing individuals to quickly accept jobs, the industry does not consider the pain and suffering of the injured person, nor the appropriateness and wage level of employment secured. This policy undermines personal autonomy and self -respect.

Especially Vulnerable

Alone, Poor, and Unable to Work

The 1980 census revealed that 12,320,000 citizens between the ages of 16 and 64 had impairments that limited or prevented them from being gainfully employed. This was 8.5 percent of the total labor force. The median income of the disabled population was about 62 percent that of the nondisabled population in 1980. Correspondingly, one out of ten able-bodied people lived below the poverty line in 1980, and one in four people with disabilities were in the poverty group. This difference is due mainly to the fact that 58.2 percent of disabled men and 76.5 percent of disabled women are completely out of the labor force and must depend on public assistance for economic survival (Bowe 1983; Murphy 1987). The following case study shows how Mrs. Goode became a statistic in this group.

Bernice Goode -- Problems of a Hidden Disability

Each year, more than 75,000 people in the United States sustain brain injuries that result in permanent disability (Kraus et al., 1984; Kraus, 1985b). What happens to a brain-injured person who cannot work and who is not permanently cared for by a family member? Because of her injury, Mrs. Goode was unable to work. Yet, after many years in the labor force, she was denied social security benefits when officials could not adequately define the disability of this woman who spoke articulately and was not physically impaired. She nearly became homeless and destitute as a result of falling through the cracks in the system. A resourceful and compassionate rehabilitation counselor came to her rescue by creatively ‘packaging’ Mrs. Goode’s organic impairment so she could receive benefits from the Social Security Administration. Only then was Mrs. Goode able to live alone and begin to participate in community life.

In 1984, Mrs. Goode, at the age of 45, was severely beaten by a male acquaintance. She was at home, asleep. Her adult daughter was visiting from out of town. When the man arrived at about 2:00 a.m., Mrs. Goode’s daughter let him in the house and began talking with him. Mrs. Goode arose from bed and joined them in the kitchen. She reported that the man was on drugs and became violent. In a split second, Mrs. Goode decided to draw the man’s attention to herself to keep him from attacking her daughter. She went outside the apartment door, where he followed and beat and kicked her until she was unconscious. Her face was lacerated and her left arm was badly hurt. She does not remember being taken by ambulance to the nearest hospital. Mrs. Goode had been working as a Licensed Vocational Nurse for 14 years at one hospital. She enjoyed her job and felt worthwhile and productive in her caretaking role. She was earning $8 an hour at the time of the injury.

Mrs. Goode was in a coma for about a week in the hospital intensive care unit. She was hospitalized for two and a half weeks and discharged with mild brain damage and a severely bruised left arm and hand. She returned home and her daughter stayed with her for another month. Mrs. Goode recalled that she could not function on her own during that period. She could not use her left hand and arm at all. She experienced memory loss and severe vertigo -- nausea and dizziness when standing up or moving rapidly or spontaneously -- which she continued to suffer from at the time of the interview, four years later. When her daughter left, Mrs. Goode’s sister invited her to live at the sister’s home, realizing that Mrs. Goode could not be left alone. Friends helped her pack her belongings, put some possessions in storage, and make the 500-mile move to her sister's apartment. Mrs. Goode lived with the sister for one year, until the landlord told them that the lease specified one tenant only and that Mrs. Goode would have to leave.

For the first three months of her stay at her sister's home, Mrs. Goode took the bus three times a week to the Veterans Administration Hospital for physical therapy on her left arm. She received outpatient therapy for three months -- heat therapy and range-of-motion exercises. When she was discharged, her arm and hand were functional again. Her second husband was retired from the military, so she received the treatments as a dependent, free of charge. She was not divorced, but had not seen this husband since 1982 and did not know where he was living.

Not Sick Enough for Benefits

Mrs. Goode received disability insurance payments from her job for one year after the injury. When the disability insurance was terminated, which was at the same time she was forced to leave her sister's home, she applied for Social Security benefits. She was denied a claim. Officials informed her that she was able to work; they could not see that anything was wrong with her. She was not physically handicapped in any obvious way, and she was able to carry on an ordinary conversation and follow routine instructions without any apparent difficulty. She applied for benefits a second time and was denied again. She then managed to qualify for welfare, but only for one month. She received $204 for that month. She also succeeded in getting $80 a month in food stamps, which continued until December 1986.

When she was forced to move out of her sister's apartment and there were no more disability insurance checks, an elderly woman of 77 invited Mrs. Goode to live with her. The woman asked for $150 a month rent, but when Mrs. Goode's welfare payment stopped after one month, the woman allowed Mrs. Goode to continue to live with her without paying because she wanted a companion. For over a two-year period, Mrs. Goode's only income was the $80 a month in food stamps. If she had not been offered free housing, she would have been on the street. She stressed that she came very close to being destitute and homeless.

Extreme Despair, Declining Mental Health Lead to Eligibility

Because she had been denied Social Security benefits, Mrs. Goode looked in the yellow pages of the telephone directory and found a social security lawyer. The lawyer, together with the rehabilitation counselor and psychiatrist to whom he referred her, succeeded in accumulating enough evidence of disability to ensure Mrs. Goode's eligibility for benefits. That process took two years. Mrs. Goode was entitled to **Social** Security benefits as the result of a psychiatric evaluation, for which the psychiatrist and rehabilitation counselor pressed. Mrs. Goode had become severely depressed and withdrawn. The rehabilitation counselor noted that Mrs. Goode was not entitled to benefits until she "almost went completely crazy." Before that time, she was considered too functional to qualify for benefits. When she became more disoriented, the health professionals were able to classify her condition to fit the eligibility requirements of the Social Security Administration. Her type of organic impairment, alone, was not enough to qualify her for benefits, even though she could not remember things, could not function at a job, and was extremely dizzy and nauseous all the time. The rehabilitation therapist, in conjunction with the psychiatrist, prescribed medications to control Mrs. Goode's anxiety as well as the dizziness and nausea brought on by the vertigo. In 1987, SSDI payments began at $435 a month, with SSI at $88 a month. At the time of the interview (1988), she received SSDI at $518 a month and SSI at $77 a month. The food stamp money ended when the SSDI payments began.

Functioning "Just Barely"

In May of 1987, the elderly woman with whom Mrs. Goode lived died and left the house to her adopted daughter. The daughter and other family members had keys and were coming in at all hours of the night, upsetting Mrs. Goode terribly. The rehabilitation counselor arranged for Mrs. Goode to move to nearby government-subsidized housing in June 1987. Mrs. Goode felt lucky to have a studio apartment for $220 a month at the time of the interview. The rent is adjusted annually in conjunction with the Social Security payments. Mrs. Goode reported that she finally felt settled and that her medications were under control. She felt she was functioning, "but just barely." She became a Jehovah's Witness about six months after the injury and said her religion, along with Bible study and church activities, gave her the strength to go on living. She planned to be more involved in church activities in the future. Through the rehabilitation counselor, she began peer counseling with other brain-damaged adults. This opportunity to continue to help other people as she did in her former employment was important to Mrs. Goode.

People with hidden disabilities, such as certain types of brain damage, are discriminated against by federal programs simply because the lack of functional ability is not apparent to system officials. To be eligible for benefits, disability must be obvious, and in the case of Mrs. Goode, allowed to increase in severity. Federal guidelines stipulate extreme illness and destitution in order for an individual to qualify for benefits.

Trauma to the Self

Burns and Disfigurement

Approximately 60,000-90,000 people are hospitalized in the United States each year for the treatment of bum injuries. With medical advances in burn care, people are surviving severe burns covering over 70 percent of the body surface. Burn patients undergo multiple operations for skin grafting and repeated admissions to hospitals for reconstructive surgery, and they live with permanent scarring. A severe burn is considered by many to be the most devastating injury a person can survive (Locke, Rossignol, Boyle, and Burke, 1986).

Numerous studies of severely burned patients point to the deep and complicated emotional reactions that accompany burns (for example, Andreasen, Noyes, Hartford, et al., 1972; Bernstein, 1975; Hamburg, Artz, Reiss, Amspacher, and Chambers, 1953; Noyes, Andreasen, and Hartford, **197l).** Facial disfigurement caused by **a** severe bum potentially alters consciousness more drastically and creates more serious emotional problems than other forms of disability because the face represents oneself, one's essential being, more than any other part of the body. A burned and unrecognizable face creates a metamorphosis in a profound sense, as one's identity is deeply threatened by the physical transformation. The following case presents one woman's struggle and method for coping with that horrible transformation.

Laura Frank -- Loss of Her Face, Loss of Her Self

Pulling up to a stop sign, with her boyfriend in the driver's seat of the car, was the last thing Ms. Frank, aged 35 at the time, remembered about the night in 1977 when her injury occurred. She was told later that a car rammed hers, and that the explosion from the gas tank knocked both Ms. Frank and her friend unconscious. A passerby pulled her friend out. She was left in the car for a time because the flames obscured her. Someone finally saw her and pulled her out. She recalled waking the following morning in a hospital bed, surrounded by doctors and nurses who told her where she was and what had happened. Until they spoke to her, she thought a nuclear bomb had dropped.

Thirty-five percent of Ms. Franks face, upper body, arms, and hands were burned. She was hospitalized for two and a half months, during which time she received the standard excruciatingly painful treatment for bums. She recalled, "After breakfast every day, they gave me my morphine, and then took me in for the tubbings, the baths that every burn patient gets to promote healing and prevent infection. Every time they put me in the wheelchair to take me down there, and pulled the sheet over me, it was like knives in my shoulder." During the same period, she underwent surgery several times for skin grafts and had the fingers on her right hand amputated. She was right-handed. The initial skin grafts on her face were not successful and had to be done again.

Afraid of, Devastated by Frightening Image of Self

Ms. Frank was afraid to look in the mirror. During her initial hospitalization, she avoided all shiny surfaces and managed never to see her reflection. In retrospect, she stated that it was a real disservice that the social service, psychiatry, and nursing staffs never confronted, supported, or guided her in dealing with facial disfigurement. On the day the nurse drove her home, she went into the bathroom and saw herself for the first time. She began screaming hysterically. For the first time, she wanted to die. She did not recognize her own face. She stated that if the nurse had not been there, she would have gone "stark raving mad." The next day, in the tub room at the hospital, she lost control of her emotions as never before. She recalled crying, screaming, and wanting to die. At that moment, she recalled, she came close to a psychotic breakdown. The hospital staff got her out of the tub and in to see a psychiatrist. That was the first time the hospital offered her psychological counseling of any sort.

When she was first discharged from the hospital, Ms. Frank went to live with her boyfriend. After a month, he told her he wanted to date other women, and that he could not take the responsibility of her burns and care. She was absolutely devastated by his behavior: "I felt I would never have another relationship. Who would even want to look at me let alone hold me and kiss me? How was I ever going to be part of life again. I had a lot of anger and grief." She had no family in California and moved in with a woman friend with whom she lived from June 1977 until April 1978. For the first four or five months after hospitalization, Ms. Frank also had a live-in nurse who dressed her, fed her, and drove her to the hospital for the daily tub baths and occupational therapy treatments she still required. Those gradually were reduced to three times a week, then twice a week.

Insurance and More

Ms. Frank was a junior high school teacher of English and journalism. The insurance plan through her school district covered all of her initial hospitalization costs and all of her many subsequent surgeries. The insurance covered 80 percent of the outpatient burn and occupational therapy treatments, which went on for months after she was discharged. Some of the 20 percent of the remaining costs was paid by her boyfriend's insurance. The rest came from her savings. She could not go back to work for the remainder of the academic year nor the next year, 1977-1978. The superintendent of her district, where she had been teaching for eight years, made the personal decision to pay one-half of her salary during that entire period. This payment was not stipulated by her contract.

Support from Psychologist, Friends

Ms. Frank then began to see a psychologist who helped her deal with her burn scars, confront her disfigurement, accept her right hand with no fingers, and regain her sense of self-worth. Because the psychologist with whom she worked did not have a Ph.D. degree, Ms. Frank's medical insurance would not cover the therapy costs. Her friends got together and paid for her therapy, which went on for about a year. Ms. Frank said that her friends were extraordinarily supportive through the entire recovery process, and that she owes whatever emotional strength she found to their constant support.

Reconstructive Surgery

There were many surgeries. Ms. Frank had face reconstructive surgery in November 1977. In February 1978, she elected to have joint replacement surgery on her left fingers. She wanted to regain the use of those fingers, but later felt that the surgery did not help and may have hurt her in the long run. She then had more surgery on her eyes, her nose, and her right hand. That hand surgery enabled her to have a strong grip, and she resumed writing with her right hand. All surgeries were covered 100 percent by her insurance. She had lots of emotional support, always going home with a friend for a week or two following the surgeries.

Healing -- A Horrible Appearance

Ms. Frank went back to her teaching job in September 1978. She scheduled the surgeries over the school holidays. During the first two years of resumed teaching, she wore a heavy, tight mask over her entire face and a covering over her right arm. They are used to reduce the severity of the scarring while the grafts heal. She was terrified of what the students at school would think of her in her mask because she looked so awful. When it was time to take the mask off, she was terrified again of what everyone would think of her face. None of her fears were realized however; everyone was nice to her. After reentering school, Ms. Frank prepared an entire curriculum to educate staff and students about burns, burn treatments, and facial disfigurement. She said the program helped people cope with her, and her with them. She went on to teach in another junior high school and in a high school for another three years. Each time she changed schools, she presented her program on burn education. She decided she wanted to spend more time developing burn and disfigurement curriculum for the schools.

Winning Lawsuit Changed Life

During the same period, Ms. Frank was involved in litigation against the automobile company. The lawsuit was started immediately after the injury by a lawyer who was a friend. The suit was settled in 1980. She received close to one million dollars in a lump sum payment. The settlement enabled her to buy a larger home. Ms. Frank wanted to develop a reentry curriculum to be used in schools for children or staff with burns and other disfiguring disabilities. The settlement enabled her to take time off from teaching to do this. She initially took a one-year leave of absence, but has not returned to teaching since.

Ms. Frank's curriculum development work began with a grant from a private foundation. In 1986, she began working as a paid staff member with the county rehabilitation medical center, creating reentry programs for disfigured children that are used now by school districts all over the state. She has added a "corrective cosmetic and total disfigurement center," to give practical advice about how to make the most of one's looks for those with severe burns and disfigurement caused by injury or illness. She was motivated to do this work by the absence of advice and care for coping with disfigurement. She said burn centers simply do not address the issue of community reentry or the severe self-image problems of burn victims. The lack of psychological counseling in the days and months following Ms. Frank's injury proved to be profoundly devastating. Winning a sizable lawsuit enabled her to devote her life to making sure other disfigured individuals do not undergo emotional trauma due to lack of professional support. This case illustrates the fact that emotional and psychological support following an injury are absolutely necessary, and that the need for support may continue for years.

Attendant Services

Who is in Control?

More than 7.7 million people or 3.3 percent of the United States population require some help from another person to accomplish normal, everyday tasks because of functional limitation. Age is a significant factor in determining the need for personal assistance. Only

2.2 percent of the population aged 18-64 needs assistance, but more than 16.8 percent of the population over age 64 requires such assistance (World Institute on Disability, 1988).

Disabled individuals who associate themselves with the independent living movement measure independence -- that most cherished national value -- not by the number of tasks one can do by oneself, but by the quality of life one can have with appropriate assistance. In the context of this movement, aid is considered a civil right, an entitlement that permits the individual with a disability to participate in work, recreation, family, community, and political life. Attendant services are viewed as indispensable to participation in society and thus are considered an inalienable right.

The two cases presented below represent extremes in the exercise of control. The first, Mr. Morgan, controls his services by hiring, training, firing, and determining the wages of his personal assistants. He perceives his attendants to be extensions of himself. They work for him, and their work enables him to consider, at age 23, an education, a career, and a productive future. The second case, Mrs. Chapman, is at the mercy of the personalities and behaviors of the attendants sent to care for Mr. Chapman by a social service agency. Rather than being freed by the attendants to participate more fully in the life they once had, the Chapmans have become limited to an existence of coping with the attendants themselves. These cases represent the extremes of a continuum and illustrate how attendant services can be an opportunity for the bolstering of self-esteem and the control of one's destiny, or can seriously erode self-respect and autonomy.

Bart Morgan -- His Whole Life Ahead of Him

In 1981, at the age of 17, Bart Morgan was thrown off his motorcycle while speeding. He severed his spinal cord between the second and third vertebrae and was left quadriplegic, able to move only the fingers of his left hand and dependent on a ventilator to breathe. Mr. Morgan, who was in the Midwest visiting his father at the time, was hospitalized for three months and then transferred to a hospital in the San Francisco Bay Area where his mother and three siblings resided. He was hospitalized there for four months. He had numerous surgeries for infections in his neck resulting from the fracture and quadriplegia. During the entire seven months of hospitalizations, he was medically unstable and not sure if he would live. When his life was no longer in danger, he was transferred to a rehabilitation hospital where he stayed for almost a year, participating in an active rehabilitation program. He returned to his mother's home in 1983 and has lived there since. He requires 24-hour-a-day Licensed Vocational Nurse (LVN) care, which he will need for life.

Medicaid Waiver Prevents Institutionalization

The family's private health insurance covered all of Mr. Morgan's medical, rehabilitation, and LVN care costs until 1985, when the $1 million coverage ran out. At that point, he applied and became eligible for a Medicaid waiver to cover his 24-hour LVN care, at $15.75 an hour. Medicaid waivers allow states to develop demonstration projects to serve people who would otherwise be in hospital or nursing home beds. Mr. Morgan is fortunate to be included in one of the few demonstration programs in the country.

Learning to Live With Personal Assistants

At the time of the interview, Mr. Morgan had been receiving Medicaid funded attendant services for two and a half years. For the year before that, his private insurance had paid for his attendants. Until approximately six months before the interview, Mr. Morgan's time at home -- three and a half years – was spent mainly in learning to recruit, train, and get along with attendants. By the time of the interview, he had acquired as much autonomy as possible in his home environment by creating and managing a smoothly running schedule for himself using his attendants.

When Mr. Morgan was discharged from the rehabilitation hospital to his home, a rehabilitation counselor motivated him to become an activist in his own care and to take charge of both his current condition and his future life. Over time, that counselor became for Mr. Morgan a model of the independent living movement philosophy and a father figure as well. Mr. Morgan stressed that the counselor helped him grow up, learn about his body, and understand other people: "I learned from him that my nurse is an extension of me. If I go out there and fix myself lunch, the nurse helps me fix lunch. The dishes we use are our responsibility to wash and put away. It is real clear, and it is a common courtesy." Mr. Morgan underscored the independent living philosophy as he further explained, "I was taught by the rehab counselor how to train my nurses. I had to learn how to be the boss, how to be diplomatic when personality conflicts arose between me and the staff, or between my mother and the staff. I've had 40 nurses since I came home. When I interview them, we go through everything so I don't waste my time, their time, or the state's money to train them."

Advocate for Assistants

Mr. Morgan acts as an advocate for his nurses, "If you want good people, you have to pay for them.". He interviewed representatives from several agencies who accepted Medicaid contracts before finding one that would pay the nurses a salary of $10 an hour. He stated that Medicaid pays the agency $15.75 an hour for the LVNs, but he had to negotiate the $10 an hour salary. There is no industry-wide or agency-wide policy on attendant salaries.

On to Education and Job

In 1982, when Mr. Morgan turned 18, his SSI benefits began at $450 a month. He used part of that money to pay rent, "to help out my mom," who worked full-time as a supervisor in an electronics plant. The rest was his own spending money. He spent two years attending the local community college, taking general education courses. His education there was financed by the State Department of Rehabilitation. At the time of the interview, Mr. Morgan was working part-time as a peer counselor for other ventilator-dependent quadriplegics. He said he was lacking direction in his education and was ready for specific job training. He was searching for a state-financed program that would train him for computer work, which he physically could do (with the help of an attendant) and in which he was quite interested. With his nursing care under control, Mr. Morgan had entered a period of frustration concerning the next hurdle in his life, job training and employment. Mr. Morgan needs a ventilator to help him breathe. He can only move two fingers on his right hand. Yet he has learned to take control of his bodily functions and daily routine through his attendants. Now, his goal is to expand his horizons by entering the workplace -- with his attendants as extensions of himself.

Vulnerability and Dependence After a Fall

The tendency to fall is a serious problem associated with aging. 72 percent of deaths due to falls in the U.S. occur in the 10 percent of the population that is aged 65 or older. About a third of this age group living at home will fall each year, and about 1 in 40 of them will subsequently be admitted to a hospital. Repeated falls are a common reason for admission of previously independent elderly individuals to long term care institutions (Rubenstein, 1983). This example illustrates the response of Mrs. Alice Chapman to the ramifications of her husband's fall. Managing the care of her disabled spouse plunged Mrs. Chapman into a position of vulnerability and dependence on the social service system.

One year after he had a stroke, Mr. Chapman, aged 78, fell while walking in his kitchen and fractured his hip. From the time of his stroke until that moment, Mr. and Mrs. Chapman had lived in their comfortable, two-bedroom apartment, up a flight of stairs. As a result of the hip fracture, Mr. Chapman was hospitalized for about six weeks. He had his hip pinned surgically and then spent weeks in physical therapy attempting to relearn to walk. He complained of intolerable pain and did not resume walking. At the time of his hospital discharge, the hospital social worker informed Mrs. Chapman, who was able-bodied and relatively healthy, that her husband would now require a round-the-clock attendant at home because of his inability to walk even to the bathroom. His generally weakened condition made him unable to care for his personal needs, which included the use of a catheter.

The hospital discharge planner referred Mrs. Chapman to a local agency from which she hired for her husband one attendant to work Mondays through Fridays, and another for the weekends. Medicare does not cover attendant services, nor do 'Medigap' private insurance policies. Long term care insurance, which is now beginning to serve elderly people by paying for expenses that Medicare will not cover, has many restrictions and conditions on attendant service coverage and will not pay for it in most cases. Mrs. Chapman paid for 24-hour-a-day care. The Family Survival Project in San Francisco estimated the average cost of a live-in Nursing Assistant or Home Health Aide to be $110-120 a day in 1987.

Alice Chapman's Story

Since Mr. Chapman's return from the hospital (three months prior to the interview), Mrs. Chapman's once active and community-oriented life had shrunk to the narrow focus of dealing with her husband's attendants and the uncertainty and crises they caused. The weekday attendant began work as soon as Mr. Chapman returned home. Mrs. Chapman reported that this attendant was a "prima donna." He did not like their children to visit and said they were interfering in his care of Mr. Chapman. Whenever friends and family came by, the attendant was always there, standing by Mr. Chapman's wheelchair saying, "Show them all how high you can pick your hand up," or "He had this many units of urine today," which made Mr. and Mrs. Chapman feel degraded.

The weekend attendant, in contrast, was very cordial. The Chapmans felt comfortable with him. But after only two weekends, he telephoned Mrs. Chapman from jail, and asked her for $250 to get him out. He did not return to work, but the weekday attendant offered to work straight through until Mrs. Chapman found another attendant for the weekends. She reported, "He worked for nine straight days, and then he had a fit; he just went crazy and he became awful. He became abusive and was absolutely impossible. Meanwhile, I got somebody else from the agency for the weekends. I never liked him. My husband was terrified of him. On the first Sunday the new man was with us, he had just made up my husband's bed and put him back in it, when my husband soiled it. He let out a blue streak of swearing at my husband. It was degrading and awful." She finally found another weekend attendant.

From Bad to Worse

Things were getting worse with the weekday attendant. Mrs. Chapman reported, "I had a handyman over to fix things, and I decided I wanted my privacy so I had a lock put on my bedroom door. The attendant said to me: 'Why are you doing that? Don't you trust me? First your children interfere with everything I do, and now you don't trust me.' But the last straw was when I called the doctor, to talk to him about my husband's condition. After we had talked for a few minutes, I said, 'I'll get the attendant on the line to talk to you about medications; he takes care of that.' He had been listening on the extension phone anyway, and said, 'I'm right here.' They started to have a conversation, and I interjected something, and he yelled at me through the extension phone, so that the doctor was right there to hear. He said, 'Mrs. Chapman, how can you interfere? The doctor is a busy man, and I'm handling this, I'm taking care of this.' I hung up the phone, but I was boiling, absolutely boiling, so humiliated." After he left, she took the attendant's clothes and paycheck to the agency, and he never came back. The new weekend attendant began to work four days a week and a friend of his worked the other three days. Mrs. Chapman summed up her ordeal, "Until these two arrived, it was an absolute nightmare."

Even people who can afford to pay for attendant services cannot get the services easily or readily. The Chapmans' situation illustrates the dangers of being dependent upon the private, for-profit marketplace. This case is a powerful example of why this country needs a long term care system that responds to people's needs for appropriate assistance in the home.

Impact On the Family

Mothers and Children

Twenty million children in the United States have a chronic physical or mental condition; 3.2 million of them are limited in daily activities because of the disability. Mothers serve as the primary caregivers for these children, whether or not the mothers are employed outside the home. Caregiving for disabled children has enormous emotional costs; the most negative consequences include depression, anxiety, frustration, and feelings of helplessness (U.S. House, 1988). When injury resulting in severe, permanent disability occurs, the entire family is affected. Though the injury physically impairs only one person, it has many impacts on all family members. The disability will change the schedules, daily activities, and responsibilities of those who live with or are responsible for the injured person. Roles and places of residence may be altered. The changes may be subtle or dramatic, and they may be permanent. Change is experienced by the individual as loss -- loss of predictable patterns of daily living, free time, recreational and employment opportunities, money, sleep, and independence. More frustrating, frightening, and disappointing is the loss of the injured person as a fully functioning family member. The primary caregiver of the injured person potentially experiences the most disruption, anger, guilt, and resentment of any family member. Change, loss, and the fact that there is never a return to 'normal' are the noneconomic, yet absolutely real, costs of injury to the family.

Mothers' Perspectives: Disability All-Consuming

Four stories were told by mothers of severely injured children (all male). Two adult children, aged 18 and 21 at the time of their injuries, sustained severe brain damage, making them unable to be left alone safely and dependent on their families for the rest of their lives. One three-year-old suffered severe brain and central nervous system damage as a result of nearly drowning. He will be wheelchair-bound and unable to speak or care for himself in any way for the remainder of his life. A sixteen-year-old broke his neck in a school-sponsored wrestling match and became quadriplegic. He died 18 months later of complications resulting from the quadriplegia. All four mothers devoted their lives to caring for their disabled children with as much common sense and mental well-being as seems possible.

Their stories illustrate the fact that money and services are critical to caring for a severely disabled child. No one in this study group was independently wealthy. Legal settlements enabled three of the families to survive what otherwise would have been financial difficulty or devastation from the injury. Moreover, the settlements made it possible for two of the parents to bring their children home to a changed and accessible environment, enabling the patient to be in familiar surroundings and be nurtured by family members. The three mothers each emphasized that they would have become bankrupt or completely unable to cope had they not been awarded a sizable sum of money. The fourth case is an example of the parental stress and lack of adequate care and treatment for the injured person that results from inadequate funds. Carolyn Vash writes of family members who become “casualties of the system” (Vash, 1981, pp. 59-60). This occurs when family member needs for practical or emotional support either are ignored by individuals in health care or social service agencies, or are not met because appropriate services do not exist. Of the four case studies in this group, two can be described as casualties of the system, one in an extreme form.

Caring for Brain-Injured Adults

It is estimated that each year in the United States, 410,000 people sustain brain injuries. While the great majority experience good recovery, approximately 17,600 do not. Of these, over 10,600 have a moderate recovery, 5,000 are left with severe impairment, and 2,000 remain in a permanent vegetative state. Approximately half of these injuries are sustained in motor vehicle crashes, about 20 percent from falls, about **17** percent from assault (about 5 percent from firearms), about 10 percent from sports and recreation, and the rest from other blunt trauma (figures extrapolated from Kraus et al., 1984.)

Two of the mothers’ stories share certain characteristics. At the time of the injuries, their sons were about the same age, 18 and 21, and were both employed and living on their own. Both became severely brain-damaged. Though their mothers placed them in sheltered housing environments for a time, those situations were not entirely appropriate, and both young men eventually returned home to live with the family. Both sons have needed nearly constant supervision since the injury. Both mothers have been divorced for many years and have worked outside the home to support their families. They have borne the full burden of their sons’ disabilities without financial or emotional support from a spouse or ex-spouse.

The two stories also differ in several critical ways. One mother, Mrs. Smith, has four other, healthy children who rallied round her and gave their full and constant physical and emotional support to their disabled brother. The other mother, Mrs. Jones, has one other child, a daughter, who married shortly after her brother was injured and moved to a different city. Thus, the burden of care was placed completely upon Mrs. Jones. Secondly, Mrs. Smith won a legal settlement that permitted her to buy **a** large, comfortable home so that the entire family could remain together and so that Bobby, the brain-damaged son, could live in a normal family environment. Mrs. Jones, without any familial support, initiated but did not win a lawsuit, and she has struggled to find housing, employment, and care for her son from the time of the injury to the present, 15 years later. Third, Mrs. Smith is a practicing registered nurse. Her professional knowledge enabled her to make informed decisions about her son's care that were also appropriate for the family. Looking back, she felt all her decisions were the right ones, and that her son's best interests were served. She said that her medical knowledge made it possible to cope with the uncertainty of her son's recovery. Mrs. Jones, a secretary and writer, had no medical training to guide her through the maze of decisions she had to make on her son's behalf. She said repeatedly that she did not know anything about rehabilitation, brain damage, or community resources, and that nobody told her anything about these things. She felt her son suffered because of her lack of knowledge and that he did not recover as much as he might have, had he been given more aggressive early treatment and more consistent care over the years.

Bobby Smith -- A Family Rallies Around

In October 1985, Bobby Smith was working at a California ski resort; he has no recollection of what happened to him. Apparently, he backed into, and fell, 13 feet through a door at the top of a tramway. He was 21 years old. He was alone at the time of the fall and was found perhaps 20 or 30 minutes later, unconscious. 'In extremis,' he was taken to the nearest hospital, a small facility. He had an epidural hemorrhage. Doctors performed an emergency brain decompression, a nine-hour procedure. Bobby was in the hospital for two months. All hospitalization costs and surgeons' fees were paid for by Bobby's workers' compensation.

Bobby is the fourth of five children. At the time of his injury, he was living near the ski resort with one of his sisters. Two brothers were living in a large city, about a three-hour drive from the hospital. Mrs. Smith lived with her youngest child, a daughter who was still in high school, in an East Coast city. When the family was notified, the oldest brother, Alex, took over all caregiving and decision-making responsibilities until Mrs. Smith arrived from the East Coast. Alex said that his other brother, who was actually closest to Bobby, had a very hard time emotionally during the entire post-injury period and could not make any of the necessary practical decisions regarding Bobby's care. Mrs. Smith said that when she arrived after Bobby's two emergency surgeries, she thought he was going to die. He was on a respirator. Hospital staff asked her if they should discontinue the respirator, which she declined. "It really puts you in touch with your own mortality, and it is a terrible, terrible thing to have to face," she said.

Battling the Insurance Industry

Bobby's medical care was outstanding at the small hospital, Mrs. Smith thought. After Bobby had spent two months there, the family had to decide where to send him for rehabilitation. 'That decision became our first battle with the insurance representative," Mrs. Smith said. "He wanted to send Bobby to a hospital in Colorado, and we later learned that he owned a part of that hospital. He pushed us very hard, and even flew us out to see it." But Mrs. Smith found that hospital no better than local rehabilitation facilities, and her biggest concern was keeping the family together during this crisis. She felt, along with all her children, that Bobby's recovery depended upon his being near his family as much as upon his medical rehabilitation program. She decided to send him to a hospital in the San Francisco area where three of her children were living. She had planned to move to the area herself the following year when the youngest child graduated from high school.

Family Life Revolves Around Patient

Bobby was in the rehabilitation hospital for one year. During that time, Mrs. Smith flew out from the East Coast every month for six months until June, when her daughter finished school and they moved West. She began working full-time as a nurse on the night shift. She spent her days with Bobby in the hospital. Until she arrived, Alex went to the hospital every morning at 9:00 a.m., to be with Bobby for most of the day. He worked as a waiter in a restaurant during the evenings. When his mother finally moved to the area, he confessed his emotional exhaustion, and asked his mother to take over. Both Mrs. Smith and Alex are convinced that their presence and care for Bobby saved his life and enabled him to recover as much as he has.

Hospital Liability and Restricted Treatment

Bobby's insurance covered all his medical bills at the rehabilitation hospital. He was medically unstable during periods. He was missing 40 percent of his skull. He had a pressure shunt inserted. He had plastic plates inserted in his skull to control the pressure shifts. Mrs. Smith reported that the hospital staff was afraid to do active rehabilitation with him because he was so unstable. They had liability issues, she reported. If Bobby fell during physical therapy, for example, hospital staff were afraid that the family would initiate a lawsuit, so they did not do active therapies and did not encourage him to begin to do things for himself. As a result, the family felt Bobby was not getting enough rehabilitation. So Alex learned how to do much of the staffs work, including inserting feeding tubes before Bobby learned how to swallow, and initiating therapeutic exercises. Bobby was in the rehabilitation hospital for one year.

Post-Rehabilitation Experience

The family had heard about a sheltered, transitional housing facility in the area for brain-injured people. They decided to place Bobby there, to try it out. Bobby lived in a condominium there and participated in a day treatment program complete with psychological nursing services and rehabilitation services. Bobby was the first patient in that facility. He was there for nine months. Mrs. Smith was commuting there once or twice a week, a two-hour ride on public transportation, while she was working full-time on the night shift.

The facility staff concluded they could not do anything more for Bobby at the same time that the family decided to take him home. Bobby had become like a small child, but the family believed he could learn to do things for himself. The family wanted to control his re-education and did not want him living away from them. They had thought all along that they could provide the best care and a situation in which Bobby could learn and thrive. If they were not with him, they felt his functional abilities would deteriorate and that he would suffer emotionally. They were renting a four-bedroom house in San Francisco with only one bathroom, which was upstairs and too small for a wheelchair.

Winning a Lawsuit Freed the Family to Have a Home

On the day of the injury, Bobby's lawyer referred Alex to other lawyers who began a lawsuit against the company that built the door through which Bobby fell. They settled out of court nearly two years later, in July 1987. The settlement is an annuity that pays Bobby a monthly check of $5,057. It will pay $7.5 million over Bobby's lifetime. The settlement freed the family to decide to care for Bobby permanently. They would never have had the money for a home without the legal settlement.

Liability Paranoia

As soon as Bobby returned home from the transitional facility, Mrs. Smith took him to a neurologist with the goal of taking him off medications. The family realized he was overmedicated both at the rehabilitation hospital and at the transitional facility. They referred to this fact as a "catch 22." It is well known that certain kinds of patients, especially those who are brain-damaged or mentally ill, are frequently heavily medicated because of liability concerns. Sedated patients are not likely to run off or injure themselves, but they are not able to achieve maximum rehabilitation, either. Bobby was wheelchair-bound while at the transitional facility. He was having seizures, a common result of brain damage, about once a month. After the neurologist reduced his seizure medication by half, he still had about one seizure a month, but was able to function much more effectively.

Gambling on Good Health

SSDI payments began for Bobby in September 1987. Mrs. Smith applied when he came home, and received one year in additional retroactive payments. He receives $97 a month. He will be eligible for Medicare after receiving SSDI for 24 months, and Medicare will pay 80 percent of his medical bills for life. The “catch” or “gamble,” as Mrs. Smith and Alex expressed it, is that they currently have no health insurance for Bobby. The family is taking a calculated risk that Bobby will not fall, have another brain injury, or have a major acute illness in the two-year period before Medicare payments begin. All the family members save as much money as they can against the possibility of a catastrophic illness for Bobby.

The entire family has become involved with the community brain-injured support network. They find support group meetings very helpful. Mrs. Smith was recently asked to serve on the board of the network. She feels lucky when she compares her experience to other stories she hears about brain injury. She emphasized that the whole family was grateful to be working and able to support themselves and Bobby. The settlement enabled them to buy the perfect house for their needs and to keep the family intact. Bobby’s condition has improved over the years. Their risk is that he will incur a major medical expense before the Medicare payments begin. Again, winning a lawsuit greatly enhanced the quality of life for every member of this family. Federal regulations regarding the two-year waiting period for Medicare payments could potentially undo their security.

Stan Jones -- Falling Through the Cracks in the System

In July 1973, the automobile in which eighteen-year-old Stan Jones was the passenger was hit by a speeding car driven by a teenager with 22 moving traffic violations on his record. Stan was thrown from the vehicle and instantly knocked unconscious. Aside from the head injury, he suffered only minor cuts and bruises. Police witnessed the crash and rushed him to a hospital.

No Private Insurance

Stan was a patient at a trauma center for several months, and in a coma for the first six to eight weeks. Because the family had no private insurance, he was placed in a city-run convalescent hospital where “he was with old, demented men mainly,” Mrs. Jones said. She felt that was a terrible situation, and that Stan would "definitely go crazy there." After several months, she found another placement for him in a suburban convalescent and rehabilitation hospital where he stayed for ten months. For the first four months following the injury, Stan could not eat; he could not speak for ten months. When Stan was moved to the suburban rehabilitation hospital, Mrs. Jones moved also to be nearer to him. She felt he did not get enough rehabilitative therapies there because he had behavioral problems resulting from the brain damage. He was very disruptive, causing the staff to prefer to leave him alone. Mrs. Jones said that during the first year after the injury, no one told her where to go for adequate rehabilitation for her son. She made every decision in a vacuum and, without appropriate information or education, learned how to interact with and care for her son. All of Stan's acute care and rehabilitation costs were covered by Medical.

Impact on a Sibling

The family also consisted of a daughter, one year younger than Stan, who was out of town at the time of injury. "Our family was not able to pull together after this," Mrs. Jones said. "My daughter recoiled from the whole thing; she did it for her own survival. She married a year after the injury, in response to it. That marriage lasted four years. She pulled back emotionally from me and from her brother."

Ramifications on Employment

Divorced for many years, Mrs. Jones had worked as a secretary and raised the children on her own. She did not work at all for the first six months after her son's injury. Then, when she got a new job, she could not concentrate and was fired. She said that she would have quit anyway. Her doctor arranged for her to receive disability insurance for a time and told her that it was best if she did not attempt to resume work.

Effects of Brain Damage

In the middle of 1974, Stan was discharged from the rehabilitation hospital to home. By then he could walk, dress himself, and talk, but he could not be left alone. He was hallucinating some of the time. He would close the curtains of the house and play records. He had trouble getting into the shower; he was very hypersensitive, and the water irritated him. Mrs. Jones stressed that no one told her that his behavior was due to the brain damage. Nobody told her what to expect; she had to "learn everything from scratch." She was overwhelmed. At the time of the interview, 15 years post-injury, his behavior is still unpredictable.

He will scream out regarding something he does not like or something that upsets him. He has limited judgment and control.

No Appropriate Housing or Treatment

After two years of having Stan at home with her, Mrs. Jones realized she could not care for him adequately, or cope with the situation emotionally, so she placed him in a half-way house for mentally ill people. This was the best setting she could find for him, but it was not entirely appropriate. He lived there for 18 months, but he kept trying to leave by walking away. She emphasized how, at every stage, her son "fell through the cracks of the treatment and care system." There are no appropriate institutional settings for brain-damaged people.

In 1977, Mrs. Jones remarried and remained in the marriage until 1980. The husband arranged for Stan's eligibility and placement in a federally subsidized (Section 8) housing project. Stan moved into an apartment shared with a couple who were supposed to be his attendants. He lived there from 1977 to 1981.

A **Glimmer** of **Improvement**

Through the half-way house, Stan received a grant from a private foundation for an aide to go to his apartment to teach him the basic skills he needed to live independently. The aide worked with Stan for two and a half years, until the money from the grant was terminated. Mrs. Jones felt this was extremely worthwhile and benefited her son greatly. During this period, his functional skills improved. His gait almost returned to normal. His voice tone became more normal. He began to run for exercise and to read a bit. The private foundation also paid for Stan to attend a local private college once a week for two years. He went to a learning center there to work on regaining cognitive skills. Mrs. Jones felt this was very helpful. During that period, she spent much time with her son, "bombarding him with verbal stimulation, and just being with him."

In 1981, Mrs. Jones and Stan bought and moved into the house in which they currently reside. It is small and run-down, but adequate for their needs. Stan has a separate entrance to a small apartment downstairs, giving him a feeling of independence. Also in 1981, Mrs. Jones went back to full-time secretarial work, which she continued for six and a half years.

No Package for the Problem

While she worked, Mrs. Jones had various attendants come to the home to care for Stan because he could never be left alone. She always had difficulty finding attendants who would remain on the job. She has spent most of her time and energy organizing systems of care for her son. When a caregiver leaves, she begins all over again. The past 15 years have been one long attempt to cope with his care. ‘There was no package for this problem,” she said. Professionals simply could not help her out. Although the state and county, through MediCal, paid for Stan’s round-the-clock attendant care for the first two years, there was no major legal settlement to aid her in hiring the help she needed for his care when those payments ceased. She became a casualty of the system with no financial backing of her own to pay privately for services. Though she owns her own home, she and her son live quite marginally. Stan’s emotional and behavioral problems have become worse over the years because of his early lack of emotional care in the days following the injury. Stan realizes and is angry about how dependent he is on his mother. At the age of 34, he suffers emotionally because of his dependence and lack of productivity. Mrs. Jones is both fed up with having the full burden of his care and emotionally exhausted. But she stated that she would never abandon him. At the time of the interview, she had no financial resources to draw on beyond those to cover her most basic food and shelter costs, and there were no appropriate community services available free of charge for her son’s care or rehabilitation. She felt that her situation was truly hopeless.

Lawsuit Nightmare

The day after the injury occurred, an attorney friend referred Mrs. Jones to another lawyer who began a lawsuit. She said, ‘The entire situation was a nightmare. I had no idea what I was doing.” She hired a “top firm” but felt, in retrospect, that the attorney did not do an adequate job. She sued the California Department of Motor Vehicles and the city of San Francisco (in two separate offices) on negligence charges. The lawsuit went on for 11 years. Mrs. Jones won in the court of appeals but then lost in the California Supreme Court. In 1980, there was a $16,000 settlement from one of the automobile insurance companies. The lawyers received $8,000 of that as their fee. Later, she received $4,000 more. She used some of the money for a tutor for Stan, bought a car for herself, and saved some of the money. The $8,000 enabled her to put a down payment on the current residence. The legal proceedings finally ended in 1984. She received nothing. She felt that more money would have enabled her to give Stan a lot more rehabilitation in the first years after the injury and to place him in a private residential facility with vocational training. He would have become much more independent had he had that opportunity.

Mrs. Jones has none of the support needed to cope adequately with her son's injury: respite and emotional support from family or friends, insurance to provide rehabilitation opportunities, and a legal settlement to improve the quality of family life are all lacking. Stan is an example of the disabled person who can benefit tremendously from a specially trained attendant. This service was temporarily provided to Stan by a private foundation, but could be part of the publicly funded long term care system.

Caring for Severely Disabled Children

Joe Campbell -- Trauma, Devotion, Death

In April 1984, Joe Campbell, aged 16, attended a school-sponsored wrestling match. Toward the end of the day, with the coach gone for a few minutes, Joe began playing around with a boy 70 pounds heavier than he. The boys did some moves for which they were not well trained. They both fell and Joe screamed. He had broken his neck and was instantly paralyzed from the neck down. The coach ran in and performed first aid. Paramedics took Joe to the nearest hospital where he remained for two days. He was then transferred to a rehabilitation hospital where he stayed for 14 months. He died 4 months later.

Joe was the youngest of three boys in the family. The others were 19 and 20 and were living at home at the time of his injury. Mrs. Campbell, a deeply religious Christian woman, worked two days a week at a church-sponsored nursery school. Mr. Campbell worked for a chain retailer; his gross income at the time of his son's injury was less than $25,000 a year.

Long Hospitalization

Joe had 23 doctors who cared for him after he was injured. Mrs. Campbell felt that they all were good, and that her son received consistently excellent care from the entire health care team throughout his hospitalization. His medical problems were profound. He had pressure sores from his inability to move. He developed skin rashes, allergic reactions to different medications. He was on a respirator for the first seven months of his hospitalization. His inability to talk because of the respirator was extremely frustrating for family members, who desperately wanted to communicate with him.

Insurance Coverage

Joe's medical care was covered by three insurance carriers. First, there was a group plan through her husband's employer. But his union had negotiated only $150,000 maximum coverage. Mrs. Campbell told me she suffered a tremendous amount of anxiety when she was told initially that the $150,000 would probably cover only six months of Joe's care. After only three weeks, the hospital bills were $45,000, and she started to panic. The second insurance carrier was through the national letter carriers. Her husband had worked years before for the U.S. Post Office. Over the years, she had continued to pay the premium at $1,600 a year. That policy was the one that covered most of Joe's care, in spite of its one-year clause. At the end of one year, the insurance had paid about $400,000. Then, MediCal covered Joe's hospitalization for two additional months, until the family was able to bring him home. On the day of the wrestling match, Joe had paid $7 for $10,000 of insurance. With the loopholes Mrs. Campbell searched for and discovered, that third carrier contributed $20,000 toward Joe's care. But even three policies did not cover all his medical expenses.

Insurance Not Enough

The family needed more money for Joe's medical care than the insurance could provide, and Mrs. Campbell was advised to begin a suit against the local wrestling association. The settlement came to $100,000. The lawyer got a third of the settlement in fees, plus a few hundred dollars in expenses. Joe had just turned 18 by the time the settlement came through, and Medical, which had been covering his medical costs, received half of the net of the settlement. The family ended up with $33,000. They did not receive the settlement until April **1987,** after Joe had died. The grand total of Joe's medical care: $604,576.11.

The Complexity of Going Home

The family had to significantly remodel their home in order for Joe to be able to live as a wheelchair-dependent quadriplegic. They had a ramp built to the front entrance of the house and they needed to rebuild a bathroom, which required plumbing changes throughout the house. In addition, they added a room for Joe, off the kitchen. The total cost of the remodelling was $23,000. Mrs. Campbell explained that there was an enormous amount of red tape with the city planning department. She worked with an architect from the city housing department, a service subsidized by the city. In order to pay for the construction, she borrowed $17,000 from her parents. $7,000 of that was paid back to them from the legal settlement. Her parents refused to accept any more money. In addition, she used all the money in Joe's savings account; they borrowed against their life insurance; an aunt gave them $1,000, and the church set up a "homecoming fund" for Joe and raised $7,000 toward the cost of the construction.

Disrupting the Family

Joe's homecoming proved to be a major adjustment for the family. The younger brother very reluctantly gave up his room for Joe. The older brother, who was closest to Joe, was studying accounting at the time of the injury. He quit his course and has become depressed and without direction since. Joe was home for three months before he died. During that time, Mrs. Campbell had full responsibility for his care and was completely exhausted by it. In her attempt to hire an attendant, she interviewed scores of people, finding most of them inappropriate. She finally managed to hire a man for eight hours a day, five days a week, but he disappeared after the first month. She continued to interview others after that, but did not find anyone satisfactory. She did all his care herself, with some help from her husband. Her other sons did not help her out in any way. Joe's physical care was all-consuming, and the 'bowel and bladder" program had to go on every four hours. She did the 1:00 a.m. shift and her husband helped at 5:00 a.m., before he went to work, so she could sleep until 8:00 a.m.

Joe came home in June 1985. In September, he began school again at the public high school. He attended for four days, then got pneumonia, both bacterial and viral. Mrs. Campbell drove him to the hospital in the middle of the night, when he had great difficulty breathing. She was not sure he was going to make it through the night. But he lived in the hospital for three weeks. During that time, the family knew he was going to die. When he died three weeks later, Mrs. Campbell felt there was nothing left unsaid, and that her son "went home to God." During the final weeks of Joe's life, family members and close friends from church met in the hospital and planned his memorial service. Mrs. Campbell said this was extremely therapeutic and healing. She organized and hosted the memorial, attended by 200 people from all walks of Joe's short life: school, sports, hospital, doctors, and church. Insurance from three carriers was not enough to cover Joe's catastrophic injury, and the family needed to win a lawsuit to help pay for Joe's medical and related expenses. Most people are unaware of the enormous cost of a catastrophic injury.

Jason Stuart -- Youngest Child, Most Profound Disabilities

In 1982, three-year-old Jason walked out his kitchen door onto the back patio while his mother was not watching and fell into the swimming pool located several steps from the back door. At the time, Mrs. Stuart was married and had a six-year-old daughter and a five-month-old daughter. She and her husband ran **a** trucking and transportation business from their home. Mr. Stuart was out of the house when Jason fell into the pool and Mrs. Stuart was very busy with the business telephones. The six-year-old came screaming to her that Jason was in the pool. Mrs. Stuart found him floating on top of the water and estimated that he had been there at least 20 minutes. She jumped in, dragged him out, and ran screaming with him to the front of the house. Her neighbor, who happened to be a physician, came running out and attempted to resuscitate the child. Another neighbor called an ambulance. The child was pronounced Dead On Arrival at the nearest hospital. When they revived him some minutes later, hospital staff informed Mrs. Stuart that though he was technically alive, he would probably be blind, deaf, and permanently comatose.

Mother Initiates Rehabilitation

After Jason was hospitalized for seven weeks, Mrs. Stuart was told she could take home her still-comatose son. She had heard from a friend about a physician-designed rehabilitation program called Patterning, in which the coma victim is bombarded with stimuli. The program requires hundreds of volunteers. Its goal is to stimulate all the senses and bring the injured person out of the coma. Jason's doctors strongly discouraged Mrs. Stuart from trying this program and they were very pessimistic about Jason's prognosis. But Mrs. Stuart made the decision that she would do everything possible to revive her child and she began the Patterning program. She went to a local office, found out what she needed to do, and proceeded to gather all the materials (flash cards, pictures, other visual stimuli), which she paid for out of pocket. She also arranged for 125 volunteers a week to come to her house to run the program. For six months, from 7 a.m. to 8 p.m., she had volunteers who came to her home, touched and massaged Jason, read to him, flashed picture/word cards in front of him, and in many other ways stimulated the child constantly. During that period, she woke up every hour and a half during every night in order to turn the child over, preventing him from getting pressure sores.

Five months after the injury, the child emerged from the coma. Mrs. Stuart continued the Patterning program for another month. She felt his recovery was owed entirely to the stimulation he received from the program, which she stressed she carried out against her doctor's wishes. At six months after the injury, she decided to terminate the program. She felt at the time that it could continue to benefit the child, but she was too exhausted to recruit and train the many volunteers needed.

Extent of Disability

With severe central nervous system damage, including brain damage, the child was not able to learn to do the normal, developmental tasks of a three-year-old. He could do nothing for himself when he emerged from the coma, and now, six years later at age nine, still cannot do anything. He cannot sit up unaided, though he can hold his head up. He cannot control his movements and thus cannot feed himself. He is confined to a wheelchair when he is awake. Ironically, his vision and hearing are within normal limits and he can comprehend simple commands and sentences when someone speaks to him.

Insurance and Legal Issues

Eight months after the injury, Mrs. Stuart's insurance broker informed her that her health insurance carrier would no longer cover the huge medical expenses of the child and that the family would be switched to another carrier, which would give Jason the same coverage. For six months, the new carrier did not pay for any treatment or rehabilitation services for Jason, so he did not receive physical or speech therapy. Mrs. Stuart claimed that Jason would be less disabled today had he received those services in the early months following the injury. Mrs. Stuart retained a lawyer and sued the insurance carrier. She won the case and settlement back payments began in 1986.

About a year after the injury, Mr. and Mrs. Stuart became aware that they could collect from their home owner's insurance policy. Mrs. Stuart learned this after receiving misinformation for quite some time. In 1986, she finally received $500,000 for Jason's care, paid to him in monthly installments. The money is used for his needs, at her discretion. The bulk of it is in trust for him.

Catch 22 of Therapy

When he turned four, Jason began to attend the public school every week day, from 8:00 a.m. to 1:00 p.m. in a program for handicapped children. Jason has been in that school program for five years. Mrs. Stuart claimed the greatest strength of the school program was, and has always been, the speech therapy program in which Jason receives a lot of verbal stimulation. Over the years, he has learned to nod yes and no, and to recognize pictures, words, and commands. Although the school district technically provides a physical therapy program, the physical therapists cannot actually touch Jason during any exercises at all because of school district liability concerns. Mrs. Stuart deeply regrets this. She believes her child would have greatly benefited from 'hands on' physical therapy, which he does not receive. Like Mrs. Smith and Mrs. Jones, Mrs. Stuart also explained that she was caught in a "catch 22 situation" regarding physical therapy for Jason. To participate in the school district program, one cannot hire, even privately, a physical therapist. The reason given is that the school district does not want to duplicate services. She is legally prevented from getting physical therapy for the

child if she wants to continue sending him to school. At the time of the interview, she had been fighting this policy with the school district for some time. She was convinced that Jason's overall physical condition was deteriorating because he could not get physical therapy. She said Jason had become much more stiff, especially in the past two **years,** and that his scoliosis (a common problem for wheelchair-bound individuals) had become more pronounced.

Divorce

In 1985, Mr. and Mrs. Stuart divorced, a common occurrence among parents of severely injured children (for example, see Nixon and Pearn, 1977, regarding near drowning). Mr. Stuart gave his wife no emotional support and his disabled son no physical help at all after the injury. He simply could not cope with his son's condition. Mrs. Stuart said that one day her husband walked downstairs with his suitcase and announced he was leaving. She had no idea he had planned to leave. She knew he could not cope with Jason's condition but was shocked that he would leave her and the children. The oldest child, then seven and a half, fell apart emotionally.

The family business had gone bankrupt several months after the injury. The divorce was settled with Mr. Stuart paying $500 a month in alimony and $1,200 a month for child support. This **was** not enough for the family. To meet the $1,500-a-month mortgage payments and other household expenses, Mrs. Stuart took on one, then two, then three **part-**time jobs. The alimony payments stopped about one year before the interview when Mrs. Stuart started a new relationship.

Remarriage

Mrs. Stuart remarried three months before the interview was conducted. At that time, Mr. Stuart wanted to stop the child support payments. Mrs. Stuart was furious at him for this and was determined that the payments continue. She was prepared to take him to court if the payments should stop. Her second husband works as an auto mechanic and brings home $480 a week. Mrs. Stuart said she would not give up the child support without a huge fight.

Emotional Toll on Siblings

Mrs. Stuart spoke about the emotional burden the injury placed on her two other children. Her eldest daughter was seriously affected by Jason's near drowning (Nixon & Pearn, 1977, report that emotional trauma typically follows the near drowning of a family member). Mrs. Stuart reported that about six months after the injury, the six-year-old confessed to her mother that the drowning was her fault. Her mother had told her to watch Jason. She felt guilty when she realized she had not been watching him and he fell into the pool. Mrs. Stuart tried repeatedly to explain that it was not her fault or responsibility. At present, that daughter, at age 12, is resentful of any help she has to give Jason. Mrs. Stuart felt she had neglected the oldest child over the years. The youngest child, now six, is more compassionate, Mrs. Stuart said, and she reads to her brother. But Mrs. Stuart worries that she may be learning-disabled. The father rarely comes to see the children and the oldest child misses him greatly.

Severe disability of a child, including a grown child, usually means that the mother must devote her life to the child's care. Extensive medical insurance and large legal settlements are essential to ensure that the family financially survives the catastrophe. A severe injury has profound, long-term ramifications on all family members. Individual responses are highly variable, yet divorce and the emotional instability of uninjured children are typical results.

Conclusion

A number of findings are consistent across these ten cases. Money is central to the well-being of the injured person and the family. The cost of serious injury goes far beyond initial medical treatment and includes housing, disability-related equipment, and long-term rehabilitation, education, and vocational training. For most individuals, the ability to financially survive a catastrophic injury depends on winning a large legal settlement in addition to having good private insurance coverage. Yet, even with a legal settlement and excellent medical coverage, it is realistic to be continually fearful of the cost of potential medical complications, follow-up surgical procedures, and future rehabilitation, housing, education, or job-training. The needs do not stop with medical stabilization; they continue for years or for a lifetime.

The consequences of severe injury have a far-reaching impact that goes beyond the economic cost. Profound disability affects all aspects of the survivors' existence for the rest of their lives, however long they may be. The disability disrupts, changes, and dominates family life forever. One family member, usually the mother or spouse, becomes the primary caregiver and devotes her life to the well-being of the injured person by calling upon all the personal and community resources of which she is aware. Emotionally surviving the burden of injury and disability depends on a supportive network for both the injured person and the primary caregiver from family, friends, health care professionals, and community groups.

Government benefits are set up on an either/or basis: disabled or employable; sick or healthy; indigent or ineligible for funds. Such inflexible criteria may not fit individual needs or unusual situations. Federal regulations are insensitive to the fact that many severely disabled people want to work and are capable of doing so. SSI and Medicaid have complex and variable eligibility criteria and are designed to provide benefits to the disabled at or below the poverty level. Services for the disabled are not consistently available across the country. In California they are more diverse, more individually tailored, and easier to acquire than in other places, especially in rural areas.

All people interviewed for this project thought there should be a "safety net," that is, they felt they should be able to rely on the "social service system" when a catastrophic injury occurs. They all expressed a "right" to more help with such extraordinary problems. They thought the social service system should be more comprehensive, more flexible, more supportive, and finally, more generous. Yet, in spite of their great need for the resources of society, all individuals illustrated characteristic American values: a determination to be self-reliant, a need to remain independent, and a profound responsibility toward disabled family members, regardless of the emotional and financial burden of that responsibility.

Recommendations

Injury in the United States has an enormous impact on society. The lifetime direct and indirect costs of injuries occurring in the United States in a single year amount to $158 billion and over 10 million lost life years. The consequences of disabling injury are economically and personally devastating for individuals, families, and the community.

The case studies presented in this report vividly describe how the lives of injured persons and their families are significantly and permanently changed. The high cost associated with injury, including the first and later year costs, demonstrate that the long-term economic effect of severe injury is a significant burden on society. All sectors of the nation's economy share the burden, including federal, state, and local governments and the private sector. Injury is a major public health problem that needs to be addressed by a variety of strategies. Prevention, control, treatment, and rehabilitation planning are required to reduce the number of deaths and nonfatal injuries as well as the associated high costs. Both new injury research and the application of existing knowledge deserve high national priority.

The estimated lifetime cost of injury in the United States reported herein is the best estimate based on existing data. The conduct of the present study involved use of information from numerous sources, but in many cases estimates were necessarily made on the basis of limited data. The recommendations presented herein address the following injury issues:

- Injury prevention and control,
- Coding and measurement,
- Data needs, and
- Treatment and rehabilitation.

Injury Prevention and Control

The science of injury control has improved markedly in the past twenty-five years. The effectiveness of passive protection, environmental modification, and performance standards for consumer products has been documented in specific circumstances of injury. However, the enormous burden of injury demands that additional resources be devoted to injury prevention research and control evaluation.

Resources Needed for Injury Prevention Research

In *Injury in America,* the Committee on Trauma Research report published by the National Academy of Sciences (Committee, 1985) identifies significant research needs in the areas of injury epidemiology, prevention, biomechanics, and treatment and concludes that in light of the magnitude of the injury problem, increased efforts are warranted. One of the major recommendations of that report is for the establishment of a Center for Injury Control at the U.S. Centers for Disease Control (CDC) to support research and prevention in the identified problem areas. The results of the research reported herein shed further light on the magnitude of injury cost, the impact on individuals and families, and the burden on public resources, which continue to dwarf efforts to diminish these impacts. A new focus on the problem of injury in the United States is needed at this time. Increased investment in the prevention of injury will pay substantial dividends.

RECOMMENDATION: Direct greater resources to the prevention of injuries and the mitigation of their results through the application of existing knowledge and the development and evaluation of new strategies. Establish and fund a Center for Injury Control within CDC to provide a focal point for national injury prevention activities. Provide additional resources to existing agencies that currently pursue the prevention and control of injury resulting from motor vehicles, fires, consumer products, and occupational hazards.

Evaluation of Injury Control Interventions

Numerous interventions for injury control have never been evaluated or have been studied on a scale too small to produce reliable results. For most interventions, there are insufficient data to estimate cost effectiveness. Evaluation is necessary to identify and replicate successful interventions, and to avoid adverse effects. Well-designed studies of the costs and benefits of alternative injury control interventions are needed.

RECOMMENDATION: Conduct research and controlled experiments to evaluate the effectiveness and savings of a wide range of injury control interventions and implement programs shown to be cost effective.

Many injury prevention measures have been shown to be effective in reducing the frequency and severity of injury but have not been systematically applied. These interventions relate to changes in the physical environment and in behavior. The barriers to the implementation of these interventions need to be investigated. Injury prevention research should evaluate why measures that have been proven to be effective are not implemented or are discontinued.

> ***RECOMMENDATION: Conduct research to evaluate the societal barriers to the application of injury prevention strategies that have been proven to be effective.***

Coding and Measurement Issues

A major limitation of existing data sources for injury surveillance and epidemiologic research is the lack of uniform information on the cause, type, and severity of injuries. Discharge data on hospitalizations involving injury routinely include codes for the diagnosis of the specific nature or type of injury (e.g., fracture or sprain), but are less likely to include codes for cause (e.g., motor vehicle crash or fall), although classification systems exist for describing the cause of injury.

Cause of Injury

The International Classification of Disease-g-Clinical Modification (ICD-9-CM) External Cause of Injury and Poisoning Codes (E-codes) have generally been used to classify cause of injury. Although information on cause of injury is critical in the design and evaluation of injury control -programs, cause of injury codes are not routinely incorporated in the National Health Interview Survey, the National Hospital Discharge Survey, or in statewide hospital discharge abstract systems. Requiring the uniform and routine collection of this information would greatly enhance the utility of these data bases. To ensure the success of this effort, however, the cause of injury should be coded in a data field separate from the description of the nature or type of the injury. Coding the cause in one of the limited number of fields **used** for describing the nature of the injury is not appropriate because it leads to underutilization of the cause of injury codes, especially if multiple injuries and/or comorbidities are present.

The Committee to Review the Status and Progress of the Injury Control Program at the Centers for Disease Control (1988) states: “Incorporation of E-codes into hospital records and hospital discharge data bases is essential for determining the causes and incidence of injuries. ... Data systems that monitor injury incidence and prevalence and the morbidity and mortality associated with injury, as well as the causes of injury, are critical to the development of effective interventions” (Committee, 1988, p. 50).

RECOMMENDATION: Require the use of both cause and nature or type of injury codes for all hospital discharge data systems and for all data bases having the potential of providing national injury estimates. Require a separate field for the cause of injury code.

Standardization of Injury Coding

Four additional coding conventions are employed by various federal and state agencies and private organizations.

- ICD-N and ICD-E codes. The most widely used coding convention is the International Classification of Diseases (ICD-9-CM), Nature of Injury Code (N-code). The N-codes classify injury and poisoning (Codes 800-999) according to the nature or type of injury and the body part injured (e.g., sprains and strains and fractures of neck and trunk, lower limb). Currently, the sample surveys conducted by the National Center for Health Statistics (NCHS) -- the National Health Interview Survey, the National Hospital Discharge Survey, the National Ambulatory Care Survey, and the National Medical Care Utilization and Expenditure Survey -- employ the N-codes in classifying the nature of injury. The Health Care Financing Administration requires the use of N-codes for reimbursement purposes. In current plans for the 10th revision, the ICD will not employ the 'N-code' and 'E-code' terminology. Chapters replacing these codes will be entitled "Injuries, Poisonings, and Certain Consequences of External Injuries" and "External Causes of Mortality and Morbidity" (Israel, 1989).
- ANSI Z16.2 codes. The Z16.2 coding system of the American National Standards Institute (ANSI) is used by insurers to code injuries for Workers' Compensation. The basic data on workplace injury are derived from the Supplemental Data System of the U.S. Department of Labor and the Detailed Claims Information data base of the National Council on Compensation Insurance, as well as numerous state data bases. The scheme is designed for coding from records that lack the diagnostic detail required for ICD coding. A serious gap in the scheme is its failure to code the nature of internal injuries or neurological injuries.
- NEISS codes. The National Electronic Injury Surveillance System (NEISS) operated by the U.S. Consumer Product Safety Commission employs a less diagnostically demanding coding scheme than the ICD to record injury-related visits and admissions to a sample of hospitals. The scheme includes more detailed cause codes than the ICD-E codes. A strength of this scheme is the ability to code from emergency room records that often lack the detail needed for ICD-N coding. A deficiency in the NEISS system is the lack of identification of products by manufacturer and model.

- OIC codes. The National Accident Sampling System operated by NHTSA uses Occupant Injury Codes (OIC)which generally are more detailed than ICD codes and differentiate injuries according to threat to life. Nature or type of injury codes are not recorded.

RECOMMENDATION: Standardize coding of injuries by multiple coding of nature and cause of injury for all data bases intended to provide national estimates of injury. Agency needs for specific information can be met by the addition of customized codes.

Injury Severity Measurement

Injury severity determination provides an important tool for classifying injuries according to their potential threat to life or residual impairment. Classification of injuries by severity is central for monitoring patterns of injury and evaluating alternative strategies for prevention and treatment. Injury severity determination serves trauma care systems by assisting prehospital triage, clinical management, outcome evaluation, and medical research on injury.

A variety of scores and scales have been developed over the years to determine injury severity (Cales, 1986; MacKenzie, 1984; Gustafson, 1983). Included are the Abbreviated Injury Scale (AIS), the Injury Severity Score (ISS), the Trauma Index, the IPCAR Score, the Illness-Injury Severity Index, the Trauma Score, the Glasgow Coma Scale, the CRAMS Scale, the Therapeutic Intervention Scoring System (TISS), the Acute Physiology and Chronic Health Evaluation (APACHE), and the Hospital Trauma Index, to name a few.

Although significant advances have been made in severity of injury scaling in the past three decades, substantial limitations persist. The Abbreviated Injury Scale (AIS) is the most widely recognized severity scoring system based on anatomic descriptors. A major drawback to incorporating the AIS in large population-based data systems, however, has been the need to review the entire medical record for adequate scoring. The recent development of computer software that translates ICD-9-CM codes into AIS severity scores affords the opportunity to classify injuries according to AIS severity using computerized hospital discharge abstracts. This conversion is, however, based on many assumptions due to the lack of specificity in the ICD-9CM nature of injury codes. Modest changes to the ICD classification would enhance the compatibility of the ICD and AIS classification systems and provide population-based injury information specific to severity as measured by the AIS.

RECOMMENDATION: Ensure tke compatibility of tke ICD and AIS systems for classifying anatomic description of injury to permit tke computerized conversion from ICD to AIS for assigning severity scores on national data bases.

Impairment Classification Systems

The AIS is primarily a measure of severity based on potential threat to life. There is no comparable measure based on expected levels of impairment. Impairment-based severity scales are critical, however, in determining the direct and indirect costs of injury and in evaluating the impact of alternative therapies and programs on the prevention of disability.

Injury often leads to impairments that reduce the capacity for functioning. Impairment is a chronic physiological, psychological, or anatomical abnormality of bodily structure or function caused by injury or disease (Rice and LaPlante, 1988). The World Health Organization has proposed a classification entitled International Classification of Impairments, Disability, and Handicap (ICIDH) (WHO, 1980). The ICIDH is an extension of the taxonomic approach of the widely used International Classification of Diseases (ICD). The WHO (1980) manual treats impairment as a classification of disturbances at the level of the organ, disability as a taxonomy of individual limitations, and handicap as a classification of circumstances that place individuals with disabilities at a disadvantage relative' to their peers when viewed from societal norms.

The purpose of the ICIDH is to provide a framework for the organization of information about the consequences of disease and injury. There is substantial disagreement on the extent to which the ICIDH has achieved this goal (Haber, 1989). Moreover, the use of the ICIDH as a classification system in the United States has been limited.

The classification of impairment can be used as a measure of societal impact as it directly measures the reduction in the ability of disabled people to live at full capacity. There have been several approaches to the development of injury impairment factors in this country (Hirsch, 1983; Luchter, 1987).

RECOMMENDATION: Conduct research on tke development and evaluation of a valid and useful classification sysiem for impairments tkat will meet tke needs of researchers, program administrators, and rehabilitation specialists.

Data Needs

The present study has utilized currently available data on cost, incidence, severity, and consequences in an effort to identify the magnitude and range of lifetime costs of injury in the United States. The data were found to be lacking in many respects. More complete and accurate measurement of the incidence of injury and related cost is required to target injury prevention and control programs in the future. The present research points the way to the following recommendations on methods to obtain better data to improve this measurement.

Injury Surveillance

Timely injury data are needed to identify important shifts in rates and patterns of injury, to identify newly emerging problems, and to form the basis for planning, analysis, and evaluation of injury control efforts. Information on injuries and events relating to injury may be obtained from a variety of sources. Examples of national databases designed for the surveillance of specific types of injury include: the Fatal Accident Reporting System (FARS), the National Accident Sampling System (NASS), the National Electronic Injury Surveillance System (NEISS), and the Survey of Occupational Injuries and Illnesses. These surveillance systems have provided important and useful information for monitoring the epidemiology of specific types of injury. Criticisms have nevertheless been raised regarding the completeness of coverage, the scope of content, and the high cost of these systems (Panel on Occupational Safety and Health Statistics, 1987; U.S. GAO, 1988).

Other sources that provide data on injuries, although not designed specifically for the purpose of injury surveillance, are surveys from the National Center for Health Statistics and mortality data from the national vital statistics system. Two specific surveys of relevance are the National Health Interview Survey (NHIS) and the National Hospital Discharge Survey (NHDS). These surveys can provide uniform data on all injuries regardless of cause or nature, but their utility for surveillance is limited by their mode of collection. As large national surveys, they are collected and tabulated on an annual basis with data appearing approximately 9-12 months after the end of the data collection year. Such a design does not lend itself to some surveillance needs.

Mortality data from the national vital statistics system are also general purpose statistics that can provide information on injuries. These data, based on information reported on death certificates, are of two types: final and provisional. Final data, based on counts of all deaths in the United States, include both external causes and nature of injury information, as well as place of injury. The fact that final data are tabulated only once a year limits their usefulness for surveillance.

In contrast, provisional mortality data are tabulated monthly, with an approximate four-month lag from the time of death to the publication of aggregate statistics in the *Monthly Vital Statistics Report* (MVSR) of the National Center for Health Statistics. Provisional data include cause of injury codes but not type of injury. A special adaptation of provisional mortality data for surveillance purposes is the Mortality Surveillance System (MSS) introduced into the *Monthly Vital Statistics Report* in 1989 (U.S. NCHS, 1989a). This is a graphic presentation and brief expository text of trends in selected causes of death, including injury, by age, sex, and month. The presentation is designed to graphically identify major departures of mortality patterns from the underlying trend and seasonal pattern in mortality, with a reasonably short time delay.

Some state medical examiner and hospital discharge record systems have the potential for providing timely, detailed mortality and morbidity data for the most severe injuries. With the increasing availability of statewide hospital discharge abstract databases, new opportunities exist for developing timely and cost efficient surveillance systems. Currently, 28 states maintain databases that contain, at a minimum, the items incorporated in the Uniform Hospital Discharge Data Set (UHDDS). When linked to death certificate data, hospital discharge abstracts provide population-based data on a significant subset of all injuries -- namely, those that are serious enough to result in death or hospitalization. An important advantage of these statewide databases is that they include all hospital discharges and provide data specific to the state and its local communities.

No single national database is likely to be adequate for the comprehensive surveillance of injury. An effective, cost-efficient strategy of surveillance will depend on a combination of methods for gathering information from a variety of sources. Coordination of these efforts is essential to ensure uniform definitions and comprehensive surveillance of all types of injuries regardless of their severity or cause.

RECOMMENDATION: Develop a national coordinated program of injury surveillance for the quick identification and control of outbreaks of specific injuries and for epidemiologic research on injuries. For this effort, rely on the integration of uniformly collected data derived from multiple sources at both the national and local levels. To compensate for the time lag inherent in national data bases, states in which the medical examiner and/or hospital discharge data have the necessary quality and currency could monitor their data as an early warning system. Provide resources to achieve these objectives.

Population-Based Data on Injury

The National Health Interview Survey (NHIS) conducted by the National Center for Health Statistics is a continuing, nationwide, household interview survey. A probability sample of households in the civilian noninstitutionalized population of the United States is surveyed each week by interviewers from the Bureau of the Census. The survey provides data on the incidence of injury and acute conditions, limitation of activity, persons injured, hospitalizations, disability days, physician visits, and the prevalence of selected chronic conditions. It contains no data on circumstances or cause of injury. The NHIS 'core' set of questions has remained virtually unchanged from year to year.

To provide data on special topic areas in addition to the basic NHIS data, supplements to the NHIS have been conducted annually. Topics covered by the supplement vary from year to year. A special supplement on injury conducted in 1970-72 and 1975 focused on the cause of injury. In 1985, the Health Promotion and Disease Prevention Supplement included questions on occupant restraints, smoke detectors, and hot water temperature settings. In 1987, a supplement conducted on cancer risk factors included questions on occupational exposure. In addition, a 1988 supplement on occupational health included an extensive set of questions on work injuries and work-related health conditions. The 1990 Health Promotion and Disease Prevention supplement will repeat the questions on the 1985 supplement and add questions about adolescent use of helmets and other guards when engaged in sports. A comprehensive NHIS supplement on injury should be conducted to collect detailed information on the cause of injury, the involvement of consumer products, whether the injury was job related, the nature of the resulting disability, and the medical care and rehabilitation services provided.

RECOMMENDATION: Expand core NHIS questions relevant to injury to describe the circumstances of injury. In addition, conduct a comprehensive supplement to the NHIS on incidence, medical care, rehabilitation, and disability related to injury. Provide adequate finds for the expansion of the core NHIS questions and for the conduct of a comprehensive injury supplement.

Longitudinal Studies

Longitudinal data sets are increasingly essential to provide dynamic descriptions of injury and the short- and long-term consequences on individual injured persons, their families and friends, the community, and society. Injury refers to damage inflicted on a body by some traumatic, usually external, force. Injured individuals may undergo physical, mental, economic, and emotional changes that prevent, disrupt, or permanently change their ability to carry on their usual activities. They may incur large and repeated medical and rehabilitation expenses. They may develop impairments, disabilities, and handicaps that require personal assistance in daily living and major changes in the means of livelihood. Injury may also entail loss of income, social status, or social contacts. It is essential that dynamic descriptions of injuries and their consequences be fully understood and documented as a basis for the formulation of policy in the areas of prevention, treatment, rehabilitation, and research. Very few longitudinal studies of severely injured persons have been conducted to provide improved estimates of lifetime costs.

Injured Persons in the General Population

The major national source of population-based data on injury is the National Health Interview Survey (NHIS). Conducted continuously since 1957, the NHIS provides national data annually on the incidence of unintentional injury, the prevalence of acute and chronic conditions and impairment, the extent of disability, the utilization of health care services, and other health-related topics. The National Center for Health Statistics conducts targeted population surveys (TPS), which are follow-up studies of NHIS respondents who report specific conditions at the time of the household interview or represent a certain demographic characteristic. Examples of TPS are the Post-Polio Survival Survey, an epidemiologic study of 800 persons identified during the 1987 NHIS as being at risk for post-polio syndrome, and the Work Injury Followback Survey, a followback study of about 200 persons reporting occupational injuries during the two-week reference period prior to the NHIS interview.

A sample of injured persons in the NHIS could be selected and followed periodically to track the physical and economic consequences of injury. Precedent for this approach is the Longitudinal Study of Aging (LSOA), a family of surveys based on the Supplement on Aging (SOA) to the 1984 National Health Interview Survey. The SOA provides comprehensive information on family structure, housing, use of community and social supports, occupation and retirement, functional limitations, and conditions and impairments. All respondents are followed through death records from the National Death Index, acquisition of cause of death codes from the death certificates, and linkage with Medicare files from the Health Care Financing Administration (HCFA). Subsamples have been selected for re-interviews in 1986, 1988, and 1990 to measure changes in functioning, provision of help, living arrangements, and use of medical and nursing home care. The LSOA provides an excellent means of monitoring the long-term impact of injuries, especially falls, on disability impairment and mortality of elderly people.

> ***RECOMMENDATION: Conduct, with adequate finding, a follow-up survey of respondents to the proposed NHIS Injury Supplement to determine the long-term physical and economic consequences of injury in the general population. Oversample respondents with severe injury resulting in long-term disability.***

Patients Treated in Trauma Centers

The modern trauma center is the locus for treatment of and the primary source of data on moderately to severely injured persons in the United States. Trauma centers provide a full array of services with a complete team of qualified personnel available on a 24-hour basis.

> ***RECOMMENDATION: Develop a series of well-designed, closely coordinated studies of the long-term physical, psychological, and economic consequences of patients treated in several trauma centers throughout the nation.***

Cost Data

For almost all types of medical care expenditure (e.g., hospital care, physician services, drugs and appliances, and rehabilitation), current data are unavailable from national data sources. Data from the 1980 National Medical Care Utilization and Expenditure Survey (NMCUES) conducted by the National Center for Health Statistics are used in this report by inflating per person or per visit 1980 costs to 1985 levels on the basis of the relevant medical care component of the Consumer Price Index. The NMCUES is a national probability sample of the noninstitutionalized population. About 10,000 households were sampled and five interviews conducted over a period of 15 months to obtain information on medical care utilization, expenditure, and other health-related information.

The National Medical Expenditure Survey (NMES) was conducted by the National Center for Health Services Research and Health Care Technology Assessment (NCHSR and HCTA) in 1987 and 1988. NMES consisted of six rounds of data collection covering an 18-month period. The household sample consisted of 14,000 households including oversamples of Blacks, Hispanics, low-income people, and people with functional impairments. Data collected includes expenditures and sources of payment for all major forms of medical care, sociodemographic and economic characteristics of respondents, insurance coverage of respondents, and access to medical care. This survey will be a rich source of cost data for injury as well as for other illnesses and conditions. The data were not yet available for use in the present study.

> ***RECOMMENDATION: Conduct, with adequate finding, a national medical expenditure suwey periodically, preferably every five years, to provide current expenditure data for the nation.***

Occupational Injury

Occupational injury is a major cause of illness and premature death in the United States. The Bureau of Labor Statistics (BLS) is responsible for collecting statistics on occupational injury and illness. It has been alleged that the number of occupational injuries reported by the BLS is seriously underreported because employers have a strong incentive not to report injuries. A recent study by the Panel on Occupational Safety and Health Statistics (1987) of the National Academy of Sciences Committee on National Statistics concludes that the BLS data systems are inadequate for providing the Occupational Safety and Health Administration (OSHA) with the data it needs for maintaining an effective program for prevention of workplace injury and illness. The Committee also concludes that there is no single agreed upon estimate for the number of occupational fatalities in the United States. Because of the inadequate data available on occupational injuries and fatalities, separate cost estimates for these injuries are not made herein.

The Panel report includes 24 important recommendations relating to the revision and improvement of existing BLS data systems, use of other data systems, and confidentiality issues relating to survey data on individual establishments. The first recommendation is that the “BLS annual survey should be modified to permit the collection of detailed data on severe occupational injuries categorized as injuries resulting in death, hospitalization, or outpatient surgery” (Panel, 1987, p. 103).

> ***RECOMMENDATION: Implement the recommendations of the National Academy of Sciences Panel on Occupational Safety and Health Statistics of the Committee on National Statistics as soon as possible to provide improved and accurate data on occupational injuries and fatalities.***

Firearm Injury Data

Firearms are the second leading cause of injury death in the United States. In the past, firearm injuries were considered the sole responsibility of the police, with no role allocated to public health departments. Although the National Crime Survey collects information on firearms involved in crimes, no existing source provides the necessary information on all firearm deaths: homicide, suicide, and unintentional death. The Fatal Accident Reporting System (FARS) data base, administered by the NHTSA, provides an excellent model of such a system. The FARS collects information on fatal motor vehicle crashes categorized by the characteristics of the accident, the vehicle/driver, and the persons involved. The FARS uses some or all of the following data sources: police, hospital, medical examiner/coroner, and EMS reports; state vehicle registration, driver licensing, and highway department files; and vital statistics documents and death certificates (U.S. National Highway Traffic Safety Administration, 1988a). A system on firearm fatalities, comparable to FARS, would become a primary resource for documenting the firearm problem, and for designing prevention strategies.

> ***RECOMMENDATION: Require that firearm injuries, in addition to being reportable to the police, be reportable to health departments. Place greater emphasis on coding the type of firearm on the death certificate. Develop a national fatal firearm injury reporting system, comparable to FARS, with sufficient data for documenting the firearm problem and designing prevention strategies.***

Treatment and Rehabilitation

Medical care provided to injured persons places a financial strain on the health care system. To relieve the enormous economic burden of disability on the society and on individuals and families, treatment and rehabilitation research and program development are essential.

Trauma Care

Communications systems are needed for medical management at the site of injury and for rapid delivery of the patient to the hospital for prompt medical care. When a severely injured person arrives at the hospital or trauma center, an experienced team of specialists with necessary back-up facilities, such as a blood bank, is required to avoid unnecessary morbidity, mortality, and residual disability. Since the 1970s, trauma care has become increasingly specialized. Guidelines for trauma center designation developed by the American College of Surgeons have permitted systems of regional trauma care to be designed and implemented. Recently, economic pressures on trauma centers due to uncompensated care have threatened the viability of such systems and centers. While trauma centers treat the most severely injured patients, hospitals with no trauma service continue to treat less severely injured patients. Studies are needed to examine the economic and treatment issues involved in trauma systems in order to assure that trauma care is provided most efficiently and effectively. The talents of epidemiologists, statisticians, biomedical engineers, trauma and rehabilitation physicians, behavioral scientists, and health economists will aid in this process.

> ***RECOMMENDATION: Conduct collaborative interdisciplinary research to identify and evaluate factors in trauma care that produce optimal results.***

Rehabilitation

Rehabilitation is the process by which biologic, psychologic, and social functions are restored or developed to permit an injured person to achieve maximal personal autonomy. Rehabilitation is achieved both through functional change in the injured person and through changes in the physical and social environment. More persons survive major injuries today than in the past and need functional restoration of cognition, sensation, movement control, and mobility after brain, spinal cord, and musculoskeletal injuries. Rehabilitation units have developed improved procedures for amputation, prosthetics, and management of multiple musculoskeletal injury and neurotrauma. Progress has been made in reconstructive surgical procedures for improved function and correction of deformities. The Independent Living Movement provides community resources and role models for people living with disabilities.

Resources are currently devoted to the development of expensive, high-tech rehabilitation devices that are not used because they are not affordable or reliable enough to meet the needs of the average person living with disabilities. Additional research and development resources must be devoted to the design and production of affordable, reliable assistive devices.

> ***RECOMMENDATION: Greatly expand research for the development and evaluation of cost-effective model systems of rehabilitation and for the design and production of affordable and reliable assistive devices to serve the needs of people with disabilities. Involve people with disabilities in the decision-making process.***

Appendix A

Injury Diagnoses

Classification of ICD-9-CM Codes (E800-E999) by Cause and Intent*

Cause and Intent	ICD-9 **E-Code**
Motor Vehicles	
Traffic and non-traffic accidents	E810-E825
Suicide and self-inflicted injury by crashing of motor vehicle	E958.5
Injury by crashing of motor vehicle, undetermined whether accidentally or purposely inflicted	E988.5
Falls	
Accidental falls	E880-E888
Suicide and self-inflicted injuries by jumping from high place	E957
Assault by pushing from a high place	E968.1
Falling from high place, undetermined whether accidentally or purposely inflicted	E987
Firearms	
Accident caused by firearm missile	E922
Suicide and self-inflicted injury by firearms and explosives	E955
Assault by firearms and explosives	E965
Injury due to legal intervention by firearms	E970
Injury by firearms, undetermined whether accidentally or purposely inflicted	E985.0-E985.4
Poisonings	
Accidental poisoning by drugs, medicinal substances, and biologicals; other solid and liquid substances, gases, and vapors	E850-E869

Suicide and self-inflicted poisoning by solid or liquid substances, gases in domestic use, or other gases and vapors	E950-E952
Assault by poisoning	E962
Injury due to legal intervention by gas	E972
Poisoning by solid or liquid substances, gases in domestic use, or other gases, undetermined whether accidentally or purposely inflicted	E980-E982

Fire/Burns

Accidents caused by fire and flames, hot substance or object, caustic or corrosive material, and steam	E890-899, E924
Suicide and self-inflicted injury by burns, fire, or scald	E958.1, E958.2
Assault by fire or hot liquid	E968.0, E968.3
Injury by burns, fire, or scald, undetermined whether accidentally or purposely inflicted	E988.1, E988.2

DrowningslNear Drownings

Accidental drowning and submersion, including accident to watercraft causing submersion, or other accidental submersion or drowning in water transport accident	E830, E832, E910
Suicide and self-inflicted injury by submersion	E954
Assault by submersion	E964
Submersion, undetermined whether accidentally or purposely inflicted	E984

Other

Railway accidents	E800-E807
Road vehicles accidents (other than motor vehicles)	E826-ES29
Water transport accidents causing injury other than submersion or drowning	E831, E833-E838
Air and space transport accidents	E840-E845
Vehicle accidents not elsewhere classifiable	E846-E849
Accidents due to natural and environmental factors	E900-E909

Accidents caused by suffocation and foreign bodies	E911-E915
Other accidents, including falling objects, striking against or struck by objects or persons, caught in between objects; accidents caused by machinery, cutting or piercing instruments, or caused by explosion of pressure vessel	E916-E921
Accidents caused by explosive material, electric current, exposure to radiation	E923, E925, E926
Overexertion and strenuous movements	E927
Other and unspecified environmental and accidental causes	E928
Late effects of accidental injury	E929
Suicide and self-inflicted injury by hanging, strangulation, and suffocation, cutting and piercing instruments, extremes of cold, electrocution, crashing of aircraft, caustic substances (except poisoning), other specified and unspecified means;	E953,E956,E958.3 E958.4,E958.6-E958.9
Late effects of self-inflicted injury	E959
Homicide and injury purposely inflicted by other persons, including fight, brawl, rape, assault by corrosive or caustic substance (except poisoning), hanging and strangulation, and cutting and piercing instruments	E960,E961,E963, E966
Child battering and other maltreatment	E967
Assault by other means, including striking by blunt or thrown object, criminal neglect, and other specified and unspecified means	E968.2,E968.4, E968.8,E968.9
Late effects of injury purposely inflicted by other person	E969

Legal intervention by explosives, blunt object, cutting and piercing instrument, other specified and unspecified means (excluding firearms, or gas)	E971,E973-976
Late effects of injuries due to legal intervention;	E977
Legal execution	E978
Undetermined whether accidentally or purposely inflicted: hanging, strangulation, or suffocation, injury by explosives, cutting and piercing instruments, or other and unspecified means (except bums, fires, scalds, and motor vehicle crashes)	E983,E985.5, E985.6,E986,E988.0, E988.3,E988.4, E988.6-E988.9
Late effects of injury, whether accidentally or purposely inflicted	E989
Injury resulting from operations of war	E990-E998
Late effect of injury due to war operations	E999

*Excludes misadventures to patients during surgical and medical care (E870-E879), drugs, medicinal and biological substances causing adverse effects in therapeutic use (E930-E949). For hospitalized injuries, E-codes E929, E959, E977, E989 are excluded.

Appendix B

Methodology

Estimation of Lifetime Cost

(Chapter 2)

The lifetime cost of injury for 1985 is estimated as the product of two components: incidence (the number of new injuries occurring in 1985) and lifetime cost per person. The model of per person cost is discussed here.

Direct Cost

The direct cost of injury is the value of resources that could be allocated to other uses in the absence of injury, such as expenditures for hospitals and nursing home care, physician and other professional services, rehabilitation, community-based services, drugs and medical equipment. Also included are related expenditures for insurance administration costs, vocational rehabilitation, and home modifications. The direct cost represents actual expenditures for goods and services. In this model, direct cost is calculated as the sum of discounted cost in each year (arbitrarily truncated at 99 years) times the survival probability of the individuals as follows:

$$PVDC = \sum_{n=y}^{99} \left[\frac{P^{i}_{y,s}(n)\ DC^{i}_{y,s}(n-y+1)}{(1+r)^{n-y}} \right]$$

where:

PVDC	=	present discounted value of direct costs per person
n		age of the individual
y	=	age at which the individual was injured

$P^{i}_{y,s}(n)$	=	probability that a person of sex s with injury i acquired at age y will survive to age n
s	=	sex of the individual
DC(n)	=	direct costs incurred in year n following injury
r	=	real discount rate

Morbidity Cost

The morbidity cost is represented by wages lost by people who either are unable to work at all because of injury and disability or cannot work at a level of full effectiveness; for persons too sick to perform their usual housekeeping services an imputed value of these services is included. Calculating the morbidity cost involves applying average earnings by age and sex to work-loss years for those currently employed, attaching a dollar value to housekeeping services lost because of illness, and applying labor force participation rates and earnings to persons who are too sick to be employed. In this model, morbidity due to injury is calculated as the number of days of restricted activity times average daily earnings, real or imputed, adjusted to reflect the probability that the person will survive, as follows:

$$PV_{morbidity} =$$

$$\sum_{n=y}^{99} P^{i}_{y,s}(n) D(n) \frac{\left[Y_s(n)\, E_s(n) + Y^h_s(n)\, E^h_s(n) \right]}{365} \times \frac{(1+g)^{n-y}}{(1+r)^{n-y}}$$

where:

PVmorbidity	=	present discounted value of earnings losses due to injury per person
D(n)		days of restricted activity during the year of a person currently age n
$P^{i}_{y,s}(n)$	=	probability that a person of sex s with injury i acquired at age y will survive to age n

n		age of the individual
$Y_s(n)$	=	mean annual earnings of an employed person of sex s and age n
$E_s(n)$	=	proportion of the population of sex s and age n that are employed in the labor market
$Yh_s(n)$		mean annual imputed value of homemaking services of a person of sex s and age n
$Eh_s(n)$		proportion of the population of sex s and age n that are keeping house
g	=	rate of increase of labor productivity
Y		age at which the individual was injured
r	=	real discount rate

For fatal and hospitalized injuries, restricted activity time and earnings were calculated on an annual (not daily) basis.

Mortality Cost

Premature mortality is the current monetary value of future output lost due to premature death. The estimated cost or value to society of all deaths 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 pattern of earnings at successive ages, varying labor force participation rates, imputed value for housekeeping services, and the appropriate discount rates to convert a stream of costs into its present worth. Mortality due to injury is calculated as the earnings that the individual would have had in the absence of injury, as follows:

$$PV_{mortality} = \sum_{n=y}^{99} P_{y,s}(n) \left[Y_s(n) \; E_s(n) + Y_s^h(n) \; E_s^h(n) \right] \times \frac{(1+g)^{n-y}}{(1+r)^{n-y}}$$

where:

$PV_{mortality}$	=	present discounted value of loss due to injury death per person
$P_{y,s}(n)$	=	probability that a person of sex s and age y will survive to age n
i	=	type of injury
Y	=	age at which the individual was injured
s	=	sex of the individual
n	=	age of the individual
$Y_s(n)$	=	mean annual earnings of an employed person of sex s and age n
$E_s(n)$	=	proportion of the population of sex s and age n that are employed in the labor market
$Y^h_s(n)$	=	mean annual imputed value of homemaking services of a person of sex s and age n
$E^h_s(n)$	=	proportion of the population of sex s and age n that are keeping house
g	=	rate of increase of labor productivity
r	=	is the real discount rate

Methods and Assumptions of Cost and Savings Analysis
(Chapter 5)

Most of the assumptions and methods in the cost and savings analysis are specified in the text. This appendix notes the steps in the analysis.

The analysis of savings that could be accomplished by injury control programs included the following steps:

1. Search the scientific literature for research that demonstrates the effect of programs on injuries. Use only research that deals with programs that have not been fully implemented and that demonstrates an effect on injury rates. Studies of attitudes and behavior thought to be related to injury were excluded unless actual effects on injury rates were found. Where several studies were done and the results differed, a judgment was made about the scientific validity of the research. For example, the results of a controlled experiment were given more weight than a quasi-experiment (comparison group without random assignment) which, in turn, was given more weight than a before-after study.

2. Obtain information on the cost of implementing a given program. As noted in the text, this was possible on only a fraction of the identified programs. In some cases, such as costs of law enforcement to implement a law, the incremental costs are unknown. In others, the extent of implementation of programs that have been implemented partially, such as physician's counseling, is unknown.

3. Estimate the distribution of injury severity that would be reduced by the program. In most cases, this was accomplished by assuming that the program would affect the known distribution of severity of injuries relative to fatal injuries, as noted in the text in each case. In certain instances, special computer tabulations were done to obtain the injury estimates. These included the number of people killed in crashes where a driver was a certain age and the number of motorcyclists killed in states without helmet laws, both tabulated from the Fatal Accident Reporting System file for 1985. The estimated proportionate reduction in injuries of specified severity to be expected from implementation or increase in a given program was then multiplied by the number of injuries of a given severity that the program could be expected to reduce.

4. Where the necessary elements could be reasonably estimated, costs of the injuries that could be prevented by a given program were estimated by multiplying the number of injuries of a given severity expected to be reduced by the costs of the injuries of that severity. Two costs are employed -- the human capital costs reported in Chapter 2, and the willingness-to-pay costs reported in Chapter 4. The following

computer program run in BASIC can be used to estimate savings of motor vehicle occupant injuries in a given area (such as a state) where the deaths in a given category are known:

```
10    DATA 104.588,8.97,1.99,0.32,.1065,1
20    DATA 1570,30423,40014,170543,741039,401302
30    DATA 3000,31000,115000,375000,1525000,2000000
40    DIM RATIOD(6),COST1(6),COST2(6),INJ(6),SAV1(6),
      SAV2(6)
50    FOR I=1 to 6
60    READ RATIOD(I)
70    NEXT I
80    FOR I=1 to 6
90    READ COST1 (I)
100   NEXT I
110   FOR I=1 to 6
120   READ COST2(1)
130   NEXT I
140   INPUT DEATHS
150   LPRINT "DEATHS=",DEATHS
160   FOR I=1 to 6
170   INJ(I)=RATIOD(I)*DEATHS
180   SAVl(I)=INJ(I)*COSTl(I)
190   SAV2(I)=INJ(I)*COST2(1)
200   TOTl=TOTl+SAVl(I)
210   TOT2=TOT2+SAV2(1)
220   LPRINT I,INJ(I),SAVl(I),SAV2(1)
230   NEXT I
240   TOTl=TOT1/1000000
250   TOT2=TOT2/1000000
260   LPRINT "HUMAN CAPITAL= $",TOTl,"MILLION,
      WILLINGNESS TO PAY=$",TOT2,"MILLION"
270   TOTl=0
280   TOT2=0
290   GOT0 140
300   END
```

For example, if 600 car occupants died in a given state and a belt-use law would reduce those deaths 7 percent, the number of deaths to be reduced would be 600 x .07 or 42. Enter 42 at the ? prompt when the program is run and the estimated savings will be printed.

5. Potential savings of each of these types of costs are estimated by subtracting the cost of implementing or incrementing a given

intervention from the estimated costs of the injuries that could be reduced by the intervention.

Methodology for Case Studies

(Chapter 6)

In-depth interviews were conducted with injury survivors and their family members in order to discover the impact of injury and disability on individuals and families. The anthropological technique of open-ended interviewing was employed. This interpretive analytic technique is widely used in the social sciences when the goal of the project is to collect richly textured information from a small number of subjects. With this technique, the group under investigation may not be widely representative of the larger population, but the investigator is able to gain a deeper knowledge of meanings in that group. Anthropological interpretation generalizes in a different way from survey or other positivist approaches. It describes individuals systematically and accurately in order to highlight patterns and principles. Findings come not through explicit statements about specific variables or generalities, but rather through concrete portrayal of individual events and lives. This was not a survey and no survey techniques were used. Because the aim of this anthropological part of the project was not to test a hypothesis, no variables were isolated or tested. The goal was to interpret data collected about the meaning of injury and disability over the long term.

The interviewer was interested in hearing what the subjects perceived as meaningful events and experiences and the way in which they interpreted what happened. Thus, facts were not checked nor were any external measures of validity employed. Two to three hours were spent with each subject. All interviews were informal in style and were intended to be relatively nondirective. No precise preworded questionnaire was used, though an interview topic guide, shown below, was followed. Questions were designed to get people to talk about what was meaningful to them, rather than to have specific queries answered. A detailed questionnaire would have forced survivors and families to structure their answers according to researchers' priorities rather than their own. The guiding principle was to encourage people to talk about what had happened to them from their own point of view.

Interviews elicited information on the following topics: details of how the injury occurred; the acute care and rehabilitation experience; use of medical, legal, and social services; impact of the injury on family dynamics and employment; feelings about disability, recovery, loss, and disruption; the changed self; and expressed needs over the post-injury years. Thus, interviews centered on the important events -- as perceived by the subject -- that had happened since the injury, and the meaning of those events to the injured person or family member. Interviews were undertaken in a spirit of friendliness and honesty. Data obtained in this manner were spontaneous, thoughtful, and usually self-reflective. Information about injury and disability was anchored in the occurrences of everyday life and the social and economic forces that impact the individual's immediate environment. All interviews, conducted between January and June 1988, were tape-recorded and the tapes were fully transcribed.

Interview Guide for Case Studies

Demographic Background

1. Age
2. Principal source of income
3. Level of education
4. Religious affiliation
5. Current occupation
6. Marital status
7. Who live with currently. Where live currently.

The Injury

1. How did the injury happen? Where? When? Describe.
2. What happened immediately following? Who arrived on the scene? When? What did they do?

Post-Injury Acute Care Hospitalization

1. How long hospitalized?
2. Types of treatment?
3. Total costs? How covered?

Rehabilitation and Other Post-Hospital Treatment

1. Kinds of home care, outpatient rehabilitation therapies since injury? Costs? How covered?
2. How long did formal rehabilitation services last?
3. What about other types of treatment services? Costs? How covered?
4. What about related social/psychological services since injury? What services received, for how long, costs, how covered.

5. Were **you** satisfied with your rehabilitation? Want(ed) more? Why?

Legal Issues

1. Was a lawsuit involved? Settled in or out of court? Award?
2. Workers' compensation involved? Describe.

Employment

1. Describe any job/career changes since injury. Lose job? Modify/change jobs? Over what time period? Alter type of work, amount of work, or work schedule? Resulting salary changes?

Living Standard

1. Could you describe to me in what ways your standard of living has changed each year since the injury?

Household Arrangements

1. Who assists with physical care? To what extent?
2. Who is responsible for scheduling these activities?
3. Who cooks, cleans house, shops, home repairs, etc.?
4. How have these activities changed since injury?
5. What activities have you had to give up since injury?

Perceptions of Adjustment

1. How have you been feeling since the injury? (Probes for physical and emotional factors)
2. What is your day like? Describe from beginning to end.
3. What kinds of changes have you noticed?
4. Do you feel any basic changes in your life have occurred? Describe.
5. What are your plans for the future?
6. What does your family think about this?

Attitudes Toward Disability and Dependence

1. How are your abilities limited now? How has this changed since injury?
2. What do you do, can you do, about these limitations? How has this changed over time?
3. How is it for you to depend on (family, other caregiver) for aspects of personal hygiene? Aspects of daily routine? Recreation? Financial security? Social interaction? Other? (How is it to have patient dependent upon you for the above?)

Overall Adjustment

1. What new household routines have been established since injury?
2. What devices or home reconstructions would make life easier, safer?
3. Who takes over tasks patient can no longer perform?
4. Have you established any new routines to make patient care easier on other family members? What?
5. What arrangements have to be made for continuing with all forms of therapy and treatment?
6. What financial, or insurance coverage arrangements have you had to make, if any?

Appendix C

Detailed Tables

Table C-3

United States Civilian Population Estimates, 1985

Age Group	Both Sexes	Males	Females
Total	237,055,667	114,626,333	122,429,667
0-4	17,995,333	9,208,000	8,788,000
5-14	33,919,333	17,367,667	16,551,667
15-24	38,765,000	19,254,667	19,511,000
2544	72,926,667	35,824,667	37,102,000
45-64	44,890,000	21,423,000	23,466,333
65-74	17,027,333	7,484,667	9,542,333
75+	11,532,667	4,064,000	7,469,000

* Estimates derived from annualizing 1984,1985 and 1986 estimates

Table C-2

Motor Vehicles: Number and Rate of Injured Persons by Sex, Age, and Class of Injury, 1985

Age and Sex	Total Number (thousands)	Total Rate per 100,000 Persons	Fatalities** Number	Fatalities** Rate per 100,000 Persons	Hospitalized Number	Hospitalized Rate per 100,000 Persons	Nonhospitalized Number (thousands)	Nonhospitalized Rate per 100,000 Persons
Total	5,372	2,266.1	45,923	19.4	523,028	220.6	4,803	2,026.l
0-4	112 *	622.7	1,195	6.6	8,853	49.2	102 *	566.8
5-14	328 *	965.8	2319	6.8	42,277	124.6	283 *	834.3
15-24	1,763	4548.4	14,296	36.9	164,892	425.4	1,584	4,086.2
25-44	2,064	2,830.5	15,062	20.7	185,156	253.9	1,864	2556.0
45-64	793	1,767.6	6,891	15.4	77,590	172.8	709	1579.4
6574	203 *	1,190.2	3,016	17.7	25,642	150.6	174 *	1,021.9
75+	109 *	943.1	3,144	27.3	18,619	161.4	87*	754.4
Male	2,459	2,145.2	32,454	28.3	311,496	271.7	2,115	1,845.1
0-4	70 *	757.9	696	7.6	5,090	55.3	64*	695.0
5-14	189 *	1,089.8	1,481	8.5	27,787	160.0	160 *	921.3
15-24	763	3,963.2	10,696	55.6	105,411	547.5	647	3360.2
25-44	1,036	2,890.5	11,424	31.9	116,105	324.1	908	2534.6
45-64	254	1,187.3	4,687	21.9	38,677	180.5	211 *	984.9
65-74	70 *	935.1	1,687	22.6	10,305	137.7	58 *	774.9
75+	77 *	1,892.3	1,783	43.9	8,121	199.8	67 *	1,648.6
Female	2,913	2379.3	13,469	11.0	211,532	172.8	2,688	2,195.5
0-4	42 *	480.9	499	5.7	3,763	42.8	38 *	432.4
5-14	138 *	835.7	838	5.1	14,490	87.5	123 *	743.1
15-24	1,000	5,125.7	3,600	18.5	59,481	304.9	937	4,802.4
2544	1,029	2,772..6	3,638	9.8	69,051	186.1	956	2576.7
45-64	539	2,297.4	2,204	9.4	38,913	165.8	498	2,122.2
65-74	133 *	1390.3	1,329	13.9	15,337	160.7	116 *	1,215.6
75+	32 *	426.5	1,361	18.2	10,498	140.6	20 *	267.8

* Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)
** Excludes 6,452 deaths occuring in later years due to injuries incurred in 1985

Table C-3

Falls: Number and Rate of Injured Persons by Sex, Age, and Class of Injury, 1985

Age and Sex	Total: Number (thousands)	Total: Rate per 100,000 Persons	Fatalities**: Number	Fatalities**: Rate per 100,000 Persons	Hospitalized: Number	Hospitalized: Rate per 100,000 Persons	Nonhospitalized: Number (thousands)	Nonhospitalized: Rate per 100,000 Persons
Total	12,289	5,184.1	12,866	5.4	783,357	330.5	11,493	4,848.2
0-4	1,316	7,313.4	132	0.7	34,944	194.2	1,281	7,118.5
5-14	2,484	7,322.6	79	0.2	59,697	176.0	2,424	7,146.4
15-24	1,825	4,707.6	535	1.4	52,363	135.1	1,772	4,571.1
25-44	2,591	3,552.2	1,384	1.9	124,131	170.2	2,465	3380.1
45-64	1,755	3,909.5	1,815	4.0	143,156	318.9	1,610	3,386.5
65-74	1,058	6,215.2	1,728	10.1	108,549	637.5	948	5,567.5
75+	1,261	10,931.7	7,193	62.4	260,518	2,259.0	993	8,610.3
Male	5,633	4,914.2	7,002	6.1	317,980	277.4	5,308	4,630.7
0-4	692	7,516.7	91	1.0	20,050	217.7	672	7,298.0
5-14	1,266	7,292.1	61	0.4	38,409	221.2	1,228	7,070.6
15-24	1,071	5,560.6	462	2.4	36,217	188.1	1,034	5370.1
25-44	1,405	3,922.7	1,151	3.2	77,140	215.3	1,327	3,704.2
45-64	716	3,341.7	1,312	6.1	62,577	292.1	652	3,043.5
65-74	248 *	3309.0	1,022	13.7	31,645	422.8	215 *	2,872.5
75+	235 *	5,778.7	2,903	71.5	51,942	1,278.1	180 *	4,429.1
Female	6,656	5,436.8	5,864	4.8	465,377	380.1	6,185	5,051.9
0-4	624	7,099.9	41	0.5	14,894	169.5	609	6,929.9
5-14	1,217	7,354.6	18	0.1	21,288	128.6	1,196	7,225.9
15-24	754	3,865.6	73	0.4	16,146	82.8	738	3,782.5
25-44	1,185	3,194.5	233	0.6	46,991	126.7	1,138	3,067.2
45-64	1,039	4,428.0	503	2.1	80,579	343.4	958	4,082.4
65-74	811	8,494.9	706	7.4	76,904	805.9	733	7,681.6
75+	1,026	13,735.0	4,290	57.4	208,576	2,792.6	813	10,885.0

* Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)
** Excludes 3,604 deaths occuring in later years due to injuries incurred in 1985

Table C-4

Firearms: Number and Rate of Injured Persons by Sex, Age, and Class of Injury, 1985

Age and Sex	Total Number (thousands)		Total Rate per 100,000 Persons	Fatalities" Number	Fatalities" Rate per 100,000 Persons	Hospitalized Number		Hospitalized Rate per 100,000 Persons	Nonhospitalized Number (thousands)		Nonhospitalized Rate per 100,000 Persons
Total	268	*	112.9	31,556	13.3	65,129		27.5	171	*	72.1
0-4	0	*	1.7	104	0.6	199	*	1.1	0	*	0.0
5-14	24	*	71.6	590	1.7	2,684	*	7.9	21	*	61.9
15-24	60	*	155.6	6,879	17.7	28,420		73.3	25	*	64.5
2544	164	*	225.1	13,140	18.0	26,018		35.7	125	*	171.4
45-64	12	*	27.7	6398	14.3	6,047		13.5	0	*	0.0
65-74	4	*	20.9	2547	15.0	1,010	*	5.9	0	*	0.0
75+	3	*	23.0	1,898	16.5	749	*	6.5	0	*	0.0
Male	216	*	188.5	26,366	23.0	56,718		49.5	133	*	116.0
o-4	0	*	1.4	61	0.7	71	*	0.8	0	*	0
5-14	20	*	113.1	464	2.7	2,186	*	12.6	17	*	97.9
15-24	52	*	271.9	5,894	30.6	25,456		132.2	21	*	109.1
2544	129	*	358.7	10,831	30.2	22,672		63.3	95	*	265.2
45-64	10	*	47.6	5,217	24.4	4,970		23.2	0	*	0
65-74	3	*	40.9	2,202	295	862	*	11.5	0	*	0
75+	2	*	54.1	1,697	41.8	500	*	12.3	0	*	0
Female	52	*	42.1	5,190	4.2	8,411		6.9	38	*	31.0
0-4	0	*	1.9	43	0.5	128	*	1.5	0	*	0
5-14	5	*	27.9	126	0.8	498	*	3	4	*	24.2
15-24	8	*	40.7	985	5	2,964	*	15.2	4	*	20.5
2544	36	*	96.1	2,309	6.2	3,346		9	30	*	80.9
45-64	2	*	9.6	1,181	5	1,077	*	4.6	0	*	0
65-74	0	*	5.2	345	3.6	148	*	1.6	0	*	0
75+	0	*	6.0	201	2.7	249	*	3.3	0	*	0

* Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)
** Excludes 1,030 deaths occuring in later years due to injuries incurred in 1985

Table C-5

Poisonings: Number and Rate of Injured Persons by Sex, Age, and Class of Injury, 1985

Age and Sex	Total: Number (thousands)	Total: Rate per 100,000 Persons	Fatalities: Number	Fatalities: Rate per 100,000 Persons	Hospitalized: Number	Hospitalized: Rate per 100,000 Persons	Nonhospitalized: Number (thousands)	Nonhospitalized: Rate per 100,000 Persons
Total	1,702	718.2	11,894	5.0	218,554	92.2	1,472	621 .O
0-4	339	1,884.3	93	0.5	24,986	138.8	314	1,744.9
5-14	266 *	784.9	94	0.3	11,132	32.8	255 *	751.8
15-24	137 *	353.2	1,518	3.9	50,386	130.0	85 *	219.3
25-44	547	749.9	5,942	8.1	66,942	91.8	474	650.0
45-64	256 *	570.1	2,690	6.0	31,223	69.6	222 *	494.5
65-74	100 *	585.2	772	4.5	14,870	87.3	84*	493.3
75+	58 *	501.2	785	6.8	19,019	164.9	38*	329.5
Male	688	600.5	7,621	6.6	97,754	85.3	583	508.6
o-4	157 *	1,706.9	52	0.6	14,121	153.4	143 *	1553.0
5-14	130 *	747.4	43	0.2	4,771	27.5	125 *	719.7
15-24	41 *	212.9	1,025	5.3	20,975	108.9	19 *	98.7
25-44	220 *	612.7	4,241	11.8	32,270	90.1	183 *	510.8
45-64	91 *	426.5	1,484	6.9	13,886	64.8	76 *	354.8
65-74	43 *	573.2	389	5.2	5,516	73.7	37 *	494.3
75+	7 *	162.5	387	9.5	6,216	153.0	0 *	0.0
Female	1,014	828.3	4273	3.5	120,800	98.7	889	726.1
o-4	182 *	2,069.9	41	0.5	10,865	123.6	171 *	1,945.8
5-14	136 *	824.2	51	0.3	6,361	38.4	130 *	785.4
15-24	96 *	491.5	493	2.5	29,411	150.7	66 *	338.3
2544	327 *	882.4	1,701	4.6	34,672	93.5	291 *	784.3
45-64	165 *	701.2	1,206	5.1	17337	73.9	146 *	622.2
65-74	57 *	594.6	383	4.0	9354	98.0	47 *	492.5
75+	51 *	685.5	398	5.3	12,803	171.4	38 *	508.8

* Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)

Table C-6

Fire/Burns: Number and Rate of Injured Persons by Sex, Age, and Class of Injury, 1985

	Total		Fatalities **		Hospitalized		Nonhospitalized	
Age and Sex	Number (thousands)	Rate per 100,000 Persons	Number	Rate per 100,000 Persons	Number	Rate per 100,000 Persons	Number (thousands)	Rate per 100,000 Persons
Total	1,463	617.2	5,671	2.4	54,397	22.9	1,403	591.8
0-4	145 *	804.1	811	4 5	11,885	66.0	132 *	733.5
5-14	168 *	4965	485	1.4	4,940	14.6	163 *	480.6
15-24	370	955.4	442	1.1	8,937	23.1	361	931.3
25-44	494	677.8	1,150	1.6	16,119	22.1	477	654.1
45-64	129 *	287.2	1,118	2.5	7,818	17.4	120 *	267.3
65-74	106 *	621.8	676	4.0	2,196 *	12.9	103 *	604.9
75+	50 *	437.8	989	8.6	2,505 *	21.7	47 *	407.5
Male	797	695.6	3,438	3.0	38,946	34.0	755	658.7
0-4	59 *	642.9	464	5.0	7,736	84.0	51 *	553.9
5-14	46 *	265.8	266	1.5	3,892	22.4	42 *	241.8
1524	179 *	931.9	290	1.5	7,142	37.1	172 *	893.3
25-44	366	1,021.0	787	2.2	11,992	33.5	353	985.4
45-64	108 *	502.5	756	3.5	5,896	27.5	101 *	471.5
65-74	21 *	277.7	387	5.2	1,399 *	18.7	19 *	253.9
75+	18 *	452.2	488	12.0	890 *	21.9	17 *	418.3
Female	666	543.7	2,233	1.8	15,451	12.6	648	529.3
0-4	85 *	972.9	347	3.9	4,149	47.2	81 *	921.7
5-14	122 *	738.7	219	1.3	1,048 *	6.3	121 *	731 .o
15-24	191 *	978.7	152	0.8	1,795 *	9.2	189 *	968.7
25-44	128 *	346.3	363	1.0	4,127	11.1	124 *	334.2
45-64	21 *	90.7	362	1.5	1,922 *	8.2	19 *	81 .0
65-74	85 *	891.7	289	3.0	797 *	8.4	84 *	880.3
75+	32 *	430.0	501	6.7	1,615 *	21.6	30 *	401.7

* Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)

** Excludes 39 deaths occuring in later years due to injuries incurred in 1985

Table C-7

Drownings/Near Drownings: Number and Rate of Injured Persons by Sex, Age, and Class of Injury, 1985

Age and Sex	Total: Number (thousands)	Total: Rate per 100,000 Persons	Fatalities**: Number	Fatalities**: Rate per 100,000 Persons	Hospitalized: Number	Hospitalized: Rate per 100,000 Persons	Nonhospitalized: Number (thousands)	Nonhospitalized: Rate per 100,000 Persons
Total	**38 ***	15.9	6,171	2.6	5,564	2.3	26 *	11.0
0-4	29 *	159.6	720	4.0	1,993 *	11.1	26 *	144.5
5-14	1 *	3.7	589	1.7	672 *	2.0	0 *	0.0
15-24	2 *	5.6	1,461	3.8	722 *	1.9	0 *	0.0
25-44	3 *	4.2	1,858	2.5	1,195 +	1.6	0 *	0.0
45-64	2 *	3.4	845	1.9	678 *	1.5	0 *	0.0
65-74	1 *	3.2	388	2.3	157 *	0.9	0 *	0.0
75+	0 *	4.0	310	2.7	148 *	1.3	0 +	0.0
Male	35 *	30.4	4,951	4.3	3,928	3.4	26 *	22.7
0-4	28 *	299.7	462	5.0	1,132 *	12.3	26 *	282.4
5-14	1 *	6.1	458	2.6	605 *	3.5	0 *	0.0
15-24	2 *	9.6	1,317	6.8	526 *	2.7	0 *	0.0
25-44	3 +	7.2	1,613	4.5	967 *	2.7	0 *	0.0
45-64	1 *	5.6	652	3.0	547 +	2.6	0 *	0.0
65-74	0 *	4.0	254	3.4	49 *	0.7	0 *	0.0
75+	0 *	7.3	195	4.8	103 *	2.5	0 +	0.0
Female	3 *	2.3	1,220	1.0	1,636 *	1.3	0 *	0.0
0-4	1 *	12.7	258	2.9	861 *	9.8	0 *	0.0
5-14	0 *	1.2	131	0.8	67 *	0.4	0 *	0.0
15-24	0 *	1.7	144	0.7	196 *	1.0	0 +	0.0
25-44	0 *	1.3	245	0.7	228 *	0.6	0 *	0.0
45-64	0 *	1.4	193	0.8	131 *	0.6	0 *	0.0
65-74	0 +	2.5	134	1.4	108 *	1.1	0 *	0.0
75+	0 *	2.1	115	1.5	45 *	0.6	0 *	0.0

* Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)

** Excludes 116 deaths occuring in later years due to injuries incurred in 1985

Table C-8

Other: Number and Rate of Injured Persons by Sex, Age, and Class of Injury

Age and Sex	Total		Fatalities**		Hospitalized		Nonhospitalized	
	Number (thousands)	Rate per 100,000 Persons	Number	Rate per 100,000 Persons	Number	Rate per 100,000 Persons	Number (thousands)	Rate per 100,000 Persons
Total	35,726	15,070.8	28,487	12.0	696,707	293.9	35,001	14,764.9
0-4	2,130	11,835.8	1,308	7.3	29,576	164.4	2,099	11,664.1
5-14	6,917	20,393.8	806	2.4	83,647	246.6	6,833	20,144.9
15-24	8,592	22,163.4	4,281	11.0	158,362	408.5	8,429	21,743.8
25-44	12200	16,729.2	9,288	12.7	258,758	354.8	11,932	16361.6
45-64	4,423	9,853.4	5,844	13.0	110,326	245.8	4,307	9,594.6
65-74	913	5363.6	2,750	16.2	27,536	161.7	883	5,185.8
75+	551	4,775.2	4,210	36.5	28,502	247.1	518	4,491.6
Male	22,288	19443.8	20,972	18.3	494,752	431.6	21,772	18,993.9
0-4	1,451	15,756.3	744	8.1	17,094	185.6	1,433	15,562.6
5-14	4332	24942.6	584	3.4	60359	347.5	4,271	24291.7
15-24	5,918	30,735.9	3,411	17.7	122,687	637.2	5,792	30,081 .O
25-44	7,787	21,737.7	7,565	21.1	192,908	538.5	7,587	21,178.1
45-64	2,283	10,655.1	4,585	21.4	75,067	350.4	2,203	10,283.3
65-74	326 *	4,356.8	1,810	24.2	15,280	204.2	309 *	4,128.4
75+	191 *	4,690.7	2,273	56.0	11357	279.5	177 *	4355.3
Female	13,438	10,976.5	7,515	6.1	201,955	165.0	13,229	10,805.4
0-4	679	7727.0	564	6.4	12,482	142.0	666	7278.5
5-14	2,586	15,620.8	222	1.3	23,288	140.7	2,562	15,478.8
15-24	2,674	13,702.8	870	4.5	35,675	182.8	2,637	13,515.5
25-44	4,413	11,893.1	1,723	4.6	65,850	177.5	4,345	11,711 .o
45-64	2,141	9,121.7	1,259	5.4	35,259	150.3	2,104	8,966.0
65-74	587	6,153.6	940	9.9	12,256	128.4	574	6,015.3
75+	360	4,821.0	1,937	25.9	17,145	229.5	341	4,565.5

* Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)
** Excludes 1,853 deaths occuring in later years due to injuries incurred in 1985

Table C-9

Motor Vehicles: Lifetime Cost* of Injury by Age, Sex, and Type of Cost, 1985

Age and Sex	Amount (millions)				Per Injured Person			
			Indirect cost				Indirect Cost	
	Total	Direct	Morbidity	Mortality	Total	Direct	Morbidity	Mortality**
Total	$48,683	$12,270	$19,085	$17,328	$9,062	$2,304	$3,583	$330,843
0-4	1,004	207	539	258	8,963	1,869	4,864	215,084
5-14	3,107	817	1,553	737	9,485	2,512	4,775	264,858
15-24	16,107	3,890	5,259	6,957	9,135	2,224	3,007	401,696
25-44	20,652	4,370	8,620	7,662	10,005	2,132	4,206	444,497
45-64	5,939	1,828	2,534	1,577	7,485	2,325	3,222	211,640
65+	1,874	1,158	579	137	6,017	3,793	1,898	21,429
Male	33,328	6,765	12,912	13,652	13,554	2,788	5,321	370,618
0-4	628	124	342	162	8,993	1,798	4,945	232,365
5-14	2,145	511	1,131	503	11,336	2,724	6,025	288,666
15-24	11,379	2,243	3,639	5,497	14,912	2,981	4,836	426,407
2544	14,987	2,625	6,106	6,256	14,472	2,563	5,962	488,672
45-64	3,511	799	1,537	1,175	13,801	3,199	6,157	230,665
65+	679	463	157	60	4,622	3,226	1,093	16,488
Female	15,355	5,506	6,173	3,676	5,271	1,899	2,129	236,553
0-4	377	83	198	96	8,913	1,987	4,730	191,172
5-14	962	306	422	234	6,952	2,222	3,068	225,039
15-24	4,728	1,647	1,620	1,460	4,727	1,653	1,626	329,752
25-44	5,665	1,745	2,514	1,406	5,507	1,703	2,453	316,971
45-64	2,429	1,030	997	402	4,505	1,918	1,856	170,558
65+	1,195	695	423	77	7,263	4,295	2,611	27,864

* Discounted at 6 percent

** Based on 52,375 deaths, including 6,452 deaths occuring in later years due to injuries sustained in 1985

Table C-10

Falls: Lifetime Cost* of Injury by Age, Sex, and Type of Cost, 1985

Age and Sex	Amount (millions)				Per Injured Person			
			Indirect Cost				Indirect Cost	
	Total	Direct	Morbidity	Mortality	Total	Direct	Morbidity	Mortality**
Total	$37,279	$14,689	$21,049	$1,541	$3,033	$1,197	$1,715	$93,554
0-4	1,161	612	520	28	882	465	395	192,473
5-14	2,626	1,042	1,556	29	1,057	420	626	165,944
15-24	6,456	1,006	5,170	280	3,538	551	2,834	235,831
25-44	10,994	2,019	8,259	716	4,244	780	3,190	342,264
45-64	6,243	2,288	3,573	383	3,558	1,305	2,038	131,459
65+	9,799	7,722	1,972	105	4,226	3343	854	10,547
Male	21,041	5,445	14,335	1,261	3,735	968	2,548	138,042
0-4	690	341	328	21	996	493	474	226,150
5-14	1,820	632	1,165	24	1,437	499	920	152,833
15-24	4,792	661	3,881	250	4,476	618	3,626	248,858
25-44	8,224	1,265	6,332	627	5,852	901	4,510	371,720
45-64	3,539	1,003	2,237	298	4,943	1,403	3,131	153,627
65+	1,976	1,543	391	42	4,096	3,225	817	9,800
Female	16,239	9,245	6,714	280	2,440	1,390	1,010	38,136
0-4	471	271	192	8	755	435	308	137,748
5-14	806	411	390	5	662	337	321	278,119
15-24	1,663	344	1,289	30	2,205	456	1,709	164,677
2544	2,770	755	1,927	89	2,337	637	1,626	220,582
45-64	2,705	1,285	1,335	84	2,603	1,237	1,286	87,053
65+	7,823	6,178	1,581	63	4,260	3,373	863	11,105

* Discounted at 6 percent

** Based on 16,470 deaths, including 3,604 deaths occuring in later years due to injuries sustained in 1985

Table C-11

Firearms: Lifetime Cost* of Injury by Age, Sex, and Type of Cost, 1985

Age and Sex	Amount (millions) Total	Direct	Indirect costs Morbidity	Mortality	Per Injured Person Total	Direct	Indirect costs Morbidity	Mortality**
Total	$14,410	$911	$1,418	$12,080	$53,831	$3,860	$6,006	$370,706
0-4	33	2	8	23	108,386	11,566	39,586	217,900
5-14	293	38	48	207	12,087	1,606	2,039	268,924
15-24	4,204	365	394	3,445	69,720	6,834	7,372	468,860
2544	7,838	379	677	6,782	47,746	2,510	4,483	504,781
45-64	1,848	90	228	1,530	148,516	14,891	37,769	237,665
65+	193	37	63	93	31,123	20,940	35,767	20,779
Male	12,328	784	1,054	10,491	57,053	4,132	5,554	384,424
0-4	20	1	4	14	148,146	10,541	62,799	235,216
5-14	241	32	38	171	12,242	1,674	1,960	265,249
15-24	3,669	320	308	3,041	70,078	6,896	6,620	484,188
25-44	6,740	326	523	5,890	52,450	2,774	4,448	530,351
45-64	1,535	74	160	1,301	150,637	14,858	32,220	247,444
65+	125	30	21	74	23,732	22‘258	15,122	18,739
Female	2,081	128	365	1,589	40,338	2,749	7,855	300,035
0-4	13	2	3	8	77,694	12,135	26,711	193,337
5-14	53	6	11	36	11,430	1,313	2,377	287,707
15-24	535	45	86	404	67,363	6,418	12,390	378,732
2544	1,098	53	154	892	30,791	1,580	4,606	382,152
45-64	314	16	68	229	138,946	15,047	63,374	194,140
65+	68	7	42	19	72,358	16,421	106,595	35,524

* Discounted at 6 percent

** Based on 32,586 deaths, including 1,030 deaths occuring in later years due to injuries sustained in 1985

Table C-12

Poisonings: Lifetime Cost *of Injury by Age, Sex, and Type of Cost, 1985

Age and Sex	Amount (millions)				Per Injured Person			
			Indirect Cost				Indirect Cost	
	Total	Direct	Morbidity	Mortality	Total	Direct	Morbidity	Mortality**
Total	$8,537	$1,703	$2,441	$4,394	$5,015	$1,007	$1,444	$369,402
04	168	148	0	20	495	437	0	212,671
5-14	108	77	0	30	405	291	0	321,663
15-24	1,484	321	429	734	10,839	2,370	3,167	483,760
25-44	4,761	510	1,299	2,952	8,706	943	2,401	496,835
45-64	1,429	272	536	621	5,582	1,072	2,116	230,877
65+	588	374	177	36	3,734	2,402	1,138	23,154
Male	5,589	726	1,599	3,265	8,119	1,066	2349	428,358
0-4	96	83	0	12	608	531	0	232,417
5-14	52	36	0	15	398	281	1	352,238
15-24	942	133	277	532	22,973	3,329	6,927	518,891
25-44	3,452	246	900	2,306	15,728	1,144	4,182	543,726
45-64	870	119	365	386	9,523	1,328	4,059	260,066
65+	177	107	57	14	3,583	2,200	1,162	17,450
Female	2,948	977	842	1,129	2,907	968	834	264,252
0-4	72	65	0	8	398	356	0	187,626
5-14	56	41	0	15	411	301	0	295,885
15-24	542	188	152	202	5,652	1,968	1,591	410,720
25-44	1,309	264	399	646	3,998	811	1,224	379,924
45-64	558	152	171	235	3,394	932	1,047	194,959
65+	411	267	121	23	3,804	2,494	1,127	28,821

* Discounted at 6 percent
** Based on 11,894 deaths

Table C-13

Fires/Burns: 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	$3,832	$920	$1,548	$1,364	$2,619	$631	$1,062	$238,841
0-4	326	137	14	175	2,253	953	100	215,188
5-14	267	80	42	144	1,583	478	252	296,928
15-24	785	155	417	212	2,118	420	1,128	479,831
25-44	1,607	301	743	563	3,252	610	1,507	489,644
45-64	642	118	286	238	4,977	921	2,238	205,653
65+	205	129	44	32	1,313	832	288	19,302
Male	2,801	608	1,237	955	3,513	766	1,559	274,804
0-4	188	77	3	108	3,173	1,316	50	231,852
5-14	176	49	42	86	3,816	1,062	912	321,624
15-24	630	114	366	. 150	3,509	638	2,041	516,360
25-44	1,233	227	582	424	3,371	622	1,594	539,050
45-64	489	86	228	174	4,541	806	2,134	219,468
65+	86	55	17	14	2,187	1,427	446	15,895
Female	1,030	312	310	408	1,548	470	468	182,844
o-4	138	60	11	67	1,615	702	134	192,905
5-14	91	32	0	58	741	259	4	266,932
15-24	155	41	52	62	811	214	271	410,137
25-44	374	74	161 '	139	2,914	579	1,260	382,530
45-64	153	32	58	63	7,182	1,506	2,766	175,315
65+	120	74	27	18	1,021	636	235	23,076

* Discounted at 6 percent

** Based on 5,710 deaths, including 39 deaths occuring in later years due to injuries sustained in 1985

Table C-14

Drownings/Near Drownings: 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	$2,453	$78	$107	$2,268	$64,993	$2,466	$3,339	$360,707
O-4	183	26	0	157	6,376	917	6	218,365
5-14	201	8	2	190	159,021	11,270	3,720	323,347
15-24	767	11	28	728	351,406	15,023	38,738	498,496
25-44	1,039	17	48	974	340,247	14,344	39,999	524,131
45-64	236	12	23	202	155,285	17,200	34,058	209,934
65+	27	5	5	16	26,516	16,205	17,851	23,221
Male	2,117	56	76	1,986	60,704	1,873	2,526	391,884
o-4	122	15	0	108	4,434	539	6	232,785
5-14	163	7	2	155	153,160	11,115	2,584	337,383
15-24	700	8	22	670	379,937	15,570	41,662	508,823
25-44	928	14	35	879	359,571	14,753	35,745	544,861
45-64	191	10	16	166	159,460	17,738	28,614	215,934
65+	13	3	2	9	21,788	16,834	11,479	19,579
Female	335	22	31	282	117,372	13,302	19,171	231,221
O-4	61	11	0	50	54,257	12,820	0	192,542
5-14	38	1	1	36	190,483	12,674	13,975	274,276
15-24	67	3	6	58	196,748	13,557	30,892	404,045
25-44	111	3	13	95	234,848	12,611	58,042	387,650
45-64	45	2	7	36	139,839	14,952	56,790	186,060
65+	14	2	4	7	33,584	15,580	24,182	29,788

* Discounted at 6 percent

** Based on 6,287 deaths, including 116 deaths occuring in later years due to injuries sustained in 1985

Table C-15

Other: 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	Morbiditv	Mortalitv	Total	Direct	Morbiditv	Mortality**
Total	$42,421	$14,235	$19,272	$8,914	$1,187	$399	$540	$293,817
0 4	1,252	677	303	273	588	318	142	200,418
5-14	3,097	1,964	865	268	448	284	125	243,540
15-24	9,340	3,187	4,028	2,125	1,087	371	469	460,224
25-44	18,931	5,127	9,034	4,770	1,552	421	741	483,403
45-64	7,634	2,149	4,131	1,353	1,726	487	935	216,622
65+	2,167	1,131	910	126	1,480	776	625	17,602
Male	30,790	9,524	13,831	7,435	1,381	428	621	331,363
0 4	788	432	188	168	543	298	130	212,363
5-14	2,178	1,329	645	204	503	307	149	300,406
15-24	7,025	2,313	2,944	1,768	1,187	391	498	478,829
25-44	14,744	3,707	6,932	4,105	1,893	476	891	507,116
45-64	5,294	1,318	2,853	1,123	2,319	578	1,252	228,878
65+	761	426	269	66	1,473	831	524	15,551
Female	11,631	4,711	5,441	1,479	866	351	405	187,187
0 4	464	245	115	104	683	361	169	183,764
5-14	919	635	220	64	355	246	85	151,472
15-24	2,315	874	1,084	357	866	327	406	385,946
25-44	4,187	1,420	2,102	665	949	322	476	375,074
45-64	2,340	832	1,278	230	1,093	389	598	171,707
65+	1,406	705	642	59	1,484	747	679	20,647

* Discounted at 6 percent

** Based on 30,343 deaths, including 1,853 deaths occuring in later years due to injuries sustained in 1985

Table C-16

Mortality, Including Deaths in Later Years, by Age, Sex, and Cause of Injury, 1985

Age and Sex	Total	Motor Vehicles	Falls	Fire-arms	Poison-ings	Fires/ Burns	Drown-ings*	Other
Total	155,665	52,375	16,470	32,586	11,894	5,710	6,287	30,343
0-4	4,434	1,199	147	104	93	811	720	1,360
5-14	5,992	2,782	172	770	94	485	589	1,100
15-24	33,896	17,320	1,189	7,348	1,518	442	1,461	4,618
25-44	51,279	17,238	2,089	13,435	5,942	1,150	1,858	9,867
45-64	27,854	7,450	2,913	6,437	2,690	1,157	961	6,246
65+	31,910	6,386	9,960	4,492	1,557	1,665	698	7,152
Male	111,867	36,836	9,136	27,289	7,621	3,477	5,067	22,441
0-4	2,618	696	91	61	52	464	462	792
5-14	3,986	1,741	154	644	43	266	458	680
15-24	26,502	12,892	1,005	6,280	1,025	290	1,317	3,693
25-44	40,327	12,803	1,686	11,102	4,241	787	1,613	8,095
45-64	20,245	5,092	1,943	5,256	1,484	795	768	4,907
65+	18,189	3,612	4,257	3,946	776	875	449	4,274
Female	43,798	15,539	7,334	5,297	4,273	2,233	1,220	7,902
0-4	1,816	503	56	43	41	347	258	568
5-14	2,006	1,041	18	126	51	219	131	420
15-24	7,394	4,428	184	1,068	493	152	144	925
25-44	11,252	4,435	403	2,333	1,701	363	245	1,772
45-64	7,609	2,358	970	1,181	1,206	362	193	1,339
65+	13,721	2,774	5,703	546	781	790	249	2,878

* Includes Near Drownings

Table C-17

Life Expectancy in Years, by Age and Sex, 1985

Age	Total	Male	Female
Under 1	74.6	71.2	78.1
1 4	73.1	69.7	76.5
5-9	68.7	65.3	72.1
10-14	63.8	60.3	67.2
15-19	58.9	55.5	62.3
20-24	54.2	50.9	57.4
25-29	49.5	46.3	52.6
30-34	44.8	41.7	47.7
35-39	40.1	37.1	42.9
4044	35.5	32.5	38.2
4549	31.0	28.1	33.6
50-54	26.6	23.9	29.1
55-59	22.6	20.1	24.9
60-64	18.8	16.5	20.8
65-69	15.4	13.3	17.1
70-74	12.3	10.5	13.6
75-79	9 5	8.1	10.5
80-84	7.2	6.1	7.8
85+	6.0	5.1	6.4

Source: National Center for Health Statistics: Vital Statistics of the United States, 1985, Vol. II, Sec. 6, Life Tables. DHSS Pub. No. (PHS) 88-1104. Public Health Service, Washington. U.S. Government Printing Office, 1988

Table C-18

Present Value of Lifetime Earnings by Age, Sex, and Discount Rate, 1985

Age	Males		Females	
	4 Percent	6 Percent	4 Percent	6 Percent
Under 1	421,235	208,631	341,274	173,738
1-4	454,561	236,117	368,388	196,515
5-9	519,459	293,977	420,790	244,559
10-14	602,092	374,790	487,557	311,678
15-19	689,576	468,782	552,141	384,026
20-24	745,680	541,021	578,481	425,804
25-29	749,695	568,546	558,019	424,982
30-34	717,630	565,043	513,796	402,176
35-39	653,498	532,289	454,897	364,873
40-44	561,016	471,190	388,555	319,090
45-49	450,452	389,462	319,279	268,529
50-54	331,478	294,646	249,422	214,826
55-59	213,719	194,878	181,151	159,614
60-64	108,880	101,085	117,333	105,272
65-69	42,879	39,713	67,346	61,103
70-74	19,176	17,802	36,593	33,574
75-79	9,383	8,789	18,847	17,531
80-84	4,698	4,457	9,164	8,655
85+	1,442	1,408	2,311	2,257

Table C-19

Selected Economic Variables Used in Estimating Mortality Cost by Age and Sex, 1985

	Percent of Population with Earnings		Mean Annual Earnings*		Mean Annual Value of Housekeeping Services**			
					In Labor Force		Not in Labor Force	
Age	Male	Female	Male	Female	Male	Female	Male	Female
15-19	44.9	41.5	$6,706	$6,353	$1,835	$4,691	$3,611	$9,330
20-24	85.0	71.8	19357	16,030	2,220	7,076	4,706	11,715
25-29	94.1	75.5	25,771	19,702	2,604	7,862	5,091	123%
30-34	94.4	74.1	30,950	22,268	2,871	8,491	5,327	13,130
3539	94.8	75.6	36,075	22,077	2,960	8,911	5,446	13,549
40-44	935	75.4	38,856	21,642	2,989	8,202	5,475	12,920
45-49	932	73.0	38,884	21,252	2,989	7,469	5,475	12,108
50-54	905	65.4	37,497	20,476	2,989	7,469	5,475	12,108
55-59	82.0	55.7	35,936	19,878	3,196	7,338	5,682	12,029
60-64	62.6	40.3	35,409	19,270	3,196	7,338	5,682	12,029
6569	24.6	13.3	33,412	19,552	3,196	7,155	5,712	11,793
70-74	12.9	5.5	27,898	16,529	2,276	5,094	4,067	8,397
75-79	a.4	3.0	23,284	13,988	1,547	3,464	2,766	5,710
80-84	5.5	1.5	19,418	11,824	899	2,013	1,607	3317
85+	3.5	1.0	16,212	9,999	509	1,139	909	1,878

* Mean annual earnings for year-round full-time workers, including supplements, consisting mainly of employer's contributions to social insurance

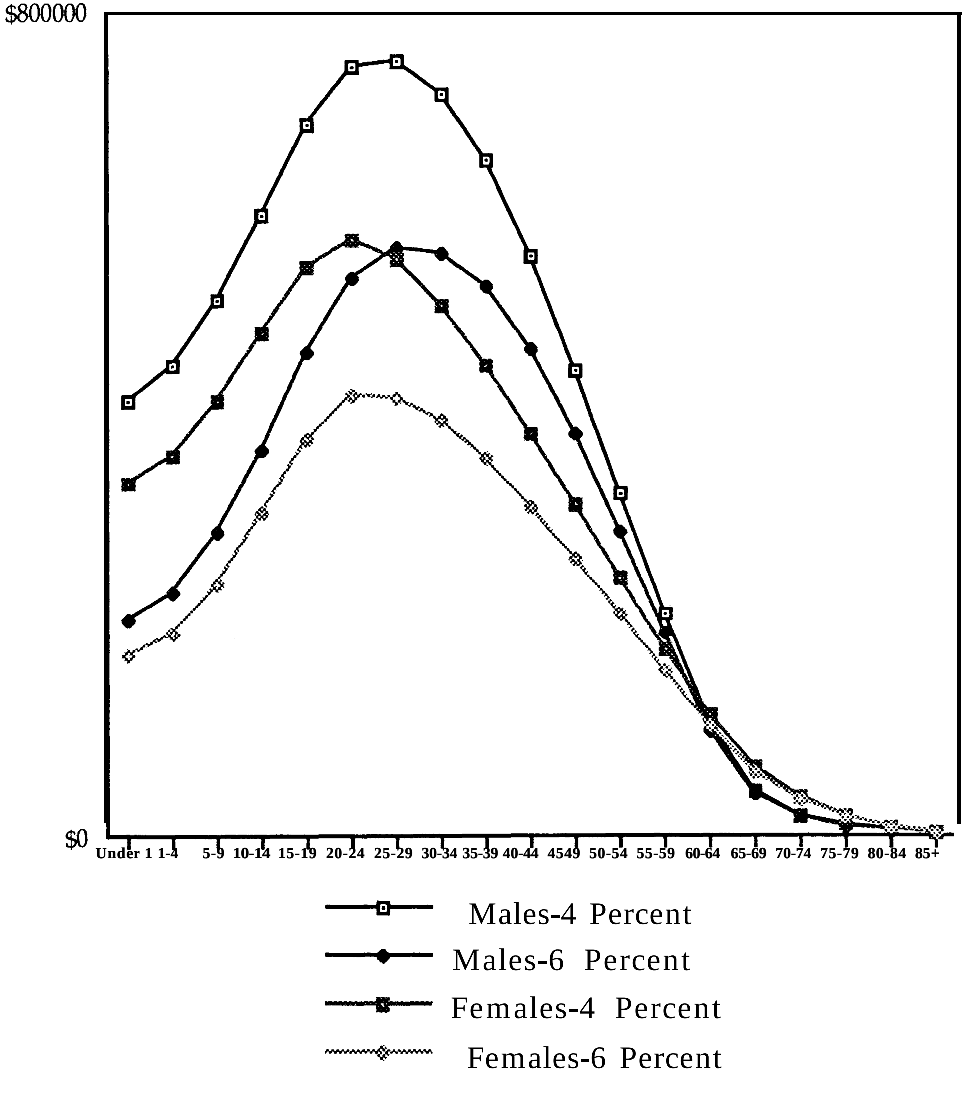
** Values are imputed by multiplying hours spent in each type of domestic activity by the wages for corresponding occupations

Source: U.S. Bureau of the Census, Current Population Reports, Series P-60, No. 156, "Money Income of Households, Families, and Persons in the United States, 1985." Tables 34 and 36. U.S. Government Printing Office, Washington, D.C.

U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, January 1986, Table 3

Figure C-1

Present Value of Lifetime Earnings, by Age, Sex, and Discount Rate, 1985



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Glossary

Government Agencies and Programs

Centers for Disease Control (CDC)
Consumer Product Safety Commission (CPSC)
Department of Health and Human Services (DHHS)
Department of Transportation (DOT)
National Center for Health Statistics (NCHS)
National Highway Traffic Safety Administration (NHTSA)
National Institutes of Health (NIH)
Old Age Survivor Disability Insurance (OASDI)
Social Security Administration (SSA)
Social Security Income (SSI)
Veterans Administration (VA)
Workers' Compensation (WC)

Sources of Data

Annual Survey on Occupational Injuries. An annual survey of establishments in the private sector conducted by the Bureau of Labor Statistics to collect statistics on occupational injuries and illnesses. A sample of approximately 280,000 establishments is selected from 5 million establishments with 11 or more employees. Information is provided on all work-related fatalities and illnesses and occupational injuries that involve loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment beyond first aid. Data are reported by industry on lost or restricted workdays, nonfatal cases that do not involve lost workdays, days away from work, and fatalities by cause.

Fatal Accident Reporting System (FARS). Data from traffic fatalities are collected from police reports, hospitals, medical examiners and coroners, Emergency Medical Services reports, state registration, driver licensing, highway department files, and death certificates. **FARS** is administered by the National Highway Traffic Safety Administration. Data are collected on time and location of the accident, age and sex of each person involved, alcohol involvement, and injury severity.

National Accident Surveillance System (NASS). A national random sample of police reports of motor vehicle crashes administered by the National Highway Traffic Safety Administration.

National Council on Compensation Insurance (NCCI). A random sample of nearly 500,000 Workers' Compensation cases in 16 states including detailed information on nature of injury, cost per case, and lost workdays. Claims have been tracked since 1979, and payments are reported at six months and every twelve months thereafter.

National Electronic Injury Surveillance System (NEISS). Data on patients sustaining injuries associated with consumer products collected from a national random sample of hospital emergency departments, administered by the Consumer Product Safety Commission.

National Health Interview Survey (NHIS). A continuing nationwide sample survey in which data on health status, acute and chronic conditions, and medical care use are collected through personal household interviews, administered by the National Center for Health Statistics. About 50,000 households with 125,000 persons are interviewed annually. In addition to a core set of questions repeated each year, supplement questionnaires on current health topics change each year in response to the need for data on special topics.

National Hospital Discharge Survey (NHDS). A continuing nationwide sample survey of about 500 short-stay hospitals, administered by the National Center for Health Statistics. Within each sample hospital, a systematic random sample of discharges is selected and data are abstracted from about 200,000 medical records. Data are collected on admissions, length of stay, diagnoses, and procedures.

National Medical Care Utilization & Expenditure Survey (NMCUES) A nationwide sample survey conducted in 1980 by the National Center for Health Statistics in which 10,000 households encompassing 17,000 individuals were interviewed five times at approximately 3-month intervals. Data were collected on health conditions, services, charges, sources and amounts of payments.

National Mortality Detail File (NMDF). Data from death certificates for all residents who die in the United States each year, administered by the National Center for Health Statistics. Included are demographic characteristics of the decedent and cause of death.

National Nursing Home Survey (NNHS). A periodic sample survey of nursing homes, administered by the National Center for Health Statistics. The 1985 survey data were obtained on the medical conditions and expenses of 6,023 discharges and 5,243 residents in 1,079 facilities.

Survey of Income and Program Participation (SIPP). A nationwide sample survey conducted by the Bureau of the Census that began in 1983. The sample includes approximately 21,000 households interviewed every ***4*** months for 2 and 2/3 years. Each February a new panel of households goes into the field and members of each panel go through interviews or waves. Data are collected on demographics, housing, income and wealth, health status, and health expenses.

Economic Terms

Cost-of-illness studies. Studies that quantify the cost associated with a particular illness, based on either the prevalence or incidence of the illness. Most studies attempt to measure both direct and indirect costs.

Currently employed. A term used in the NHIS to characterize persons 18 years of age and over who reported that at any time during the 2-week period covered by the interview they either worked or had a job or business.

Direct cost. The actual dollar expenditures related to illness or injury, including amounts spent for hospital and nursing home care, physician and other medical professional services, drugs and appliances, and rehabilitation.

Discount rate. A rate used to convert a future stream of dollars into the present value equivalent. The higher the discount rate, the lower the present value of a given stream of dollars.

Human capital. An approach to valuing life in which productivity is based on market earnings and an imputed value for housekeeping services.

Indirect cost. The value of lost output due to the reduced productivity caused by illness, disability, or injury. This includes the value of lost workdays and housekeeping days due to illness and disability, and losses due to premature death.

Labor force participation rate. The proportion or percent of the population employed at a given point in time.

Later year cost. The cost in later years associated with injuries sustained in 1985.

Life *expectancy.* The average number of years of life remaining to a person at a particular age based on a given set of age- and sex-specific death rates.

Life ***years lost.*** The number of years that an individual would have been productive in the absence of injury or impairment, based on the number of years of life expectancy remaining at the age of death.

Lifetime cost. The present discounted value of costs occurring in all future years.

Lifetime earnings. The present discounted value of earnings in future years for the remainder of an individual's life.

Market earnings. Wages and salaries earned in the labor market including supplements such as employer's contributions to social insurance.

Morbidity cost. The value of lost productivity by individuals unable to perform their usual activities due to injury or disability, or those who cannot perform at a level of full effectiveness.

Mortality cost. The value of lost productivity due to premature death resulting from injury. This is calculated as the present discounted value of future market earnings plus an imputed value for housekeeping services.

Productivity loss. The value of output not produced due to injury or disability.

Restriction of activity. A term used in the NHIS for categorizing limitations resulting from injury which encompasses four types of restriction: bed days, work-loss days, school-loss days, and cut-down days.

Transfer payment. A payment that represents a transfer of funds from one payer to another and does not represent new goods or services produced. 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.

Value of housekeeping services. An imputed value calculated by assigning the prevailing wage rate for performance of tasks similar to those performed by housekeepers. For example, time spent cooking might be valued using the prevailing wage rate for a cook.

Willingness to pay. An approach to valuing human life based on what an individual would be willing to pay for a change that reduces the probability of illness or death. It encompasses both the direct and indirect cost of illness.

Work-loss ***day.*** A term used in the NHIS for a day on which a currently employed person aged 18 years or over missed more than half a day from a job or business.

Injury Terms

Abbreviated Injury Scale (AIS). A six-point threat-to-life scale that categorizes injury severity based on the nature of the damage to different body regions, defined as follows: AIS 1 -- minor; AIS 2 -- moderate; AIS 3 – serious; AIS ***4*** -- severe; AIS 5 -- critical; AIS 6 – maximum.

Cause of death. Every death is attributed to one underlying condition, based on information reported on the death certificate and utilizing the international rules for selecting the underlying cause of death from the reported conditions.

Condition. A health condition is a departure from a state of physical and mental well-being. For NHIS, there are two types of condition: acute, which lasts less than three months and involves a physician visit or restricted activity; and chronic, which lasts three months or more.

Death rate. A measure derived by dividing the number of deaths in **a** population in a given period by the resident population at the middle of that period.

Disability. Any restriction or lack of ability to perform an activity in the manner, or in the range, considered normal.

Drowning. A death resulting from suffocation within ***24*** hours of submersion in water.

E-codes. International Classification of Diseases external cause of injury codes, developed by the World Health Organization. E-codes include injuries caused by motor vehicles, falls, firearms, drownings and near drownings, fires and burns, poisonings, and other causes.

Epidemiology. The study of the distribution and determinants of health-related states and events in populations, and the application of this study to control health problems.

Fatality. An injury that results in death.

Fire/burn injury. Damage to tissue caused by thermal, chemical, electrical, radiation energy, or by inhalation of smoke and toxic fumes caused by a fire.

Firearm injury. Damage to tissue caused by bullets fired from a firearm.

Hospital discharge. The completion of any continuous period of stay of one night or more in a hospital as an inpatient.

Hospitalized injury. An injury that results in hospitalization with survival to discharge.

Impairment. **A** chronic physiological, psychological, or anatomical abnormality of bodily structure or function caused by disease or injury.

Incidence. The number of instances of illness commencing, or of persons falling ill or sustaining injury, during a given period in a specified population. More generally, the number of new events, e.g., new cases of injury in a defined population.

Incidence rate. A measure of the rate at which new events occur in a population, derived by dividing the number of injuries reported during a defined period of time by the number of persons in the stated population in which the cases occurred.

Injury. Damage to tissue caused by the exchange of kinetic, thermal, chemical, electrical or radiation energy at levels intolerable to tissue, or the deprivation of oxygen due to suffocation.

Injury control. An organized effort to prevent injuries or to minimize their severity.

Intent. The state of mind of persons involved in an injury episode which forms the basis for categorizing an injury as unintentional (traditionally termed accidental), as homicide / assault, or as suicide / self-inflicted.

Intentional injury. An injury which is judged to have been purposely inflicted, either by the self or another.

International Classification of Diseases (ICD) codes. A classification of the nature (N-Codes) and external cause of illness and injuries (E-Codes), developed by the World Health Organization.

Motor vehicle injury. An injury sustained by a motor vehicle occupant, pedestrian, motorcyclist or bicyclist in motor vehicle crash.

N-codes. International Classification of Diseases of the nature of the injury and body part affected, developed by the World Health Organization. N-codes include, for example, head injury, spinal cord injury, fractures, abdominal / thoracic injuries, and others.

Near drowning. Survival for at least ***24*** hours after suffocation from submersion in water.

Nonhospitalized injury. ***An*** injury requiring medical attention without hospitalization, or resulting in one or more days of restricted activity without medical attention.

Prevalence. The number of instances of a given disease or disability in **a** given population at a designated time, regardless of the course of the disease or disability.

Prevalence rate. The total number of all individuals who have a disease or disability at a particular time (or during a particular period) divided by the population at risk of having that disease or disability at this point in time or midway through the period.

Severity score. A measure of the seriousness of an injury, usually related to probability of survival.

Survival rate. The proportion of survivors in a group, e.g., of patients, studied and followed over a period.

Unintentional injury. ***An*** injury which is judged to have occurred without anyone intending that harm be done.

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Biographical Sketches

Alison S. Jones, B.A., Research Associate, Department of Health Policy and Management, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, MD, has investigated topics such as cost containment impact on the poor and uninsured, the impact of rural hospital closure on Medicare beneficiaries residing in rural counties, and the effects of competition on the market for physician services. She is currently a Ph.D. candidate in Health Economics.

Sharon R. Kaufman, Ph.D., Research Anthropologist, Institute for Health & Aging, University of California, San Francisco, is a medical anthropologist whose research includes studies of development in late life; the culture of American medicine; and chronic illness, disability, and rehabilitation. She is the author of The *Ageless Self: Sources of Meaning in Late Life.*

Gregory de Lissovoy, Ph.D., M.P.H., Assistant Professor, Department of Health Policy and Management, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, MD, teaches health care financial management and health economics. His research interests include medical technology assessment, alternative delivery systems, and home health care.

Ellen J. MacKenzie, Ph.D., Associate Professor of Health Policy and Management and Assistant Director of the Health Services Research and Development Center, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, MD, maintains research interests in severity measurement, the long-term impact of traumatic injuries, and the evaluation of emergency medical services.

Wendy Max, Ph.D., Assistant Professor of Economics, California State University, Hayward, CA, and Affiliated Faculty Member, Institute for Health & Aging, University of California, San Francisco, is a health economist. She conducts research on Alzheimer's disease, the cost of injury, and the economics of aging.

Elizabeth McLoughlin, Sc.D., Associate Director, Trauma Foundation, San Francisco General Hospital, San Francisco, CA, has worked for the prevention of injury since 1973, when she became director of burn prevention at the Shriners Burns Institute in Boston. She evaluates burn prevention education and laws related to residential smoke detectors and flammable fabrics and is involved in the public debate on motorcycle helmet laws.

Ted R. Miller, Ph.D., Senior Research Associate, The Urban Institute, Washington, D.C., has 18 years of experience in economics and public policy analysis. He has written extensively on issues related to safety and insurance, including the cost of injury, the value of travel time, and the value of life.

Ida VSW Red, M.A., M.S.L.S., Senior Public Policy Analyst, Department of Social and Behavioral Sciences and Resource Director, Institute for Health & Aging, University of California, San Francisco, manages the research library and the publications program of the Institute. She is coeditor of *The* Nation's *Health* and coordinating editor of *Fiscal Austerity* and Long Term *Care* of *the Elderly.*

Dorothy P. Rice, Sc.D. (Hon.), Professor in Residence, Department of Social and Behavioral Sciences, with joint appointments at the Institute for Health & Aging and the Institute for Health Policy Studies, University of California, San Francisco, served from 1977 to 1982 as director of the National Center for Health Statistics. Previously she served as deputy assistant commissioner for research and statistics of the Social Security Administration. Her major interests are health statistics, the impact of an aging population, cost-of-illness studies, and the economics of medical care.

Leon S. Robertson, Ph.D., Lecturer at Yale University and President, Nanlee Research, a research firm in Branford, CT, has served on the faculties of Harvard University Medical School and Wake Forest University, was Senior Behavioral Scientist in the Insurance Institute for Highway Safety, and taught injury epidemiology in the Summer Session in Epidemiology at the Universities of Minnesota and Michigan for many years. He is coauthor of 5 books and author of *Injuries: Causes, Control Strategies and Public Policy,* as well as more than 100 articles and chapters in the scientific literature.

David S. Salkever, Ph.D., Professor, Department of Health Policy and Management, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, MD, has carried out research in a variety of areas in health economics over the past 20 years. His cost-related research includes studies of determinants of hospital cost inflation and cost control programs, cost-effectiveness in ambulatory care settings, the indirect cost of adult and children's chronic health problems and disabilities, and the direct and indirect cost of chronic back pain.

Gordon Smith, M.B., Ch.B., M.P.H., Assistant Professor, Department of Health Policy and Management, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, MD, is a member of The Johns Hopkins Injury Prevention Center faculty with a joint appointment in Epidemiology. He specializes in injury epidemiology and disease surveillance systems with research interests in alcohol and injury risk, drowning, injury in developing countries, and occupational injury. He is also a member of the World Health Organization Task Force to revise the External Cause Code for ICD-10.