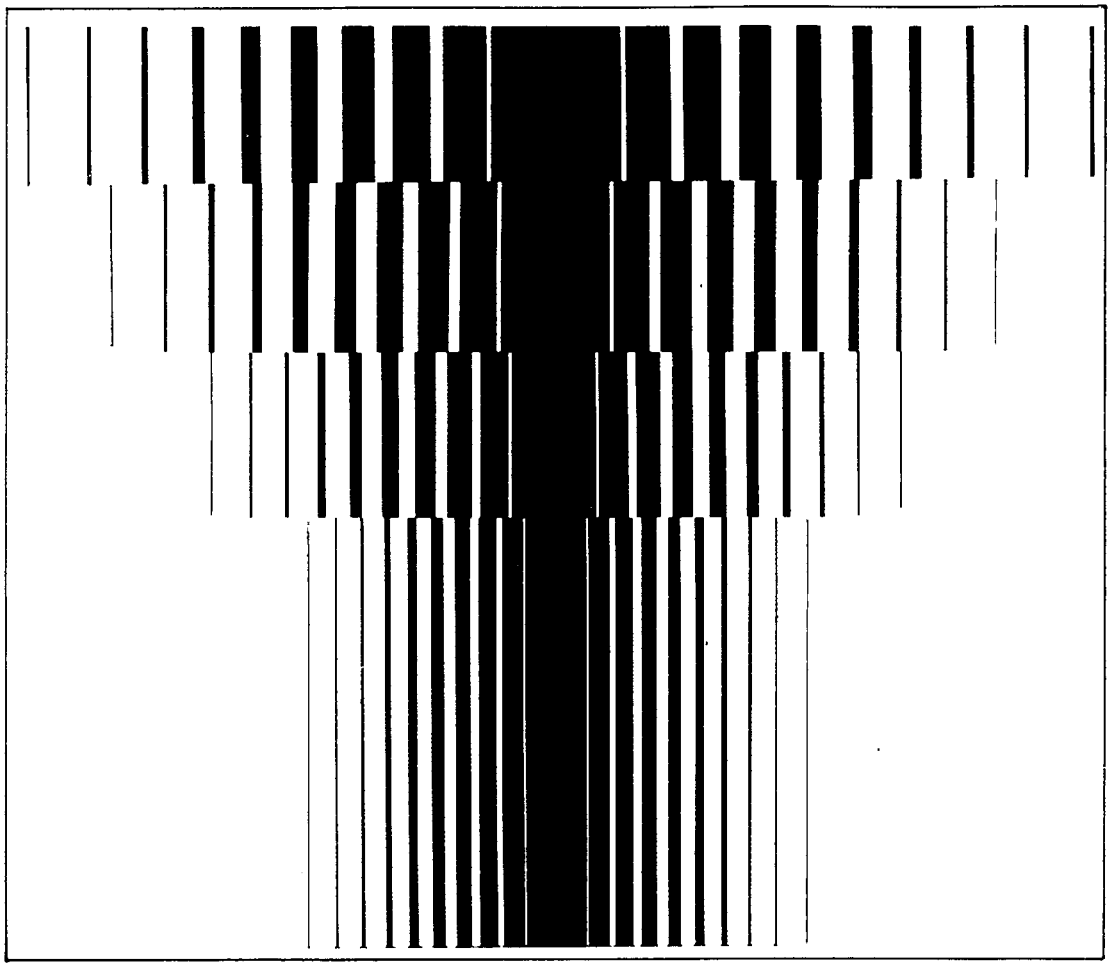
Costs of Illness
United States, 1980

Series C, Analytical Report No. 3



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National Medical Care Utilization and Expenditure Survey

The National Medical Care Utilization and Expenditure Survey (NMCUES) is a unique source of detailed national estimates on the utilization of and expenditures for various types of medical care. NMCUES is designed to be directly responsive to the continuing need for statistical information on health care expenditures associated with health services utilization for the entire U.S. population.

NMCUES will produce comparable estimates over time for evaluation of the impact of legislation and programs on health status, costs, utilization, and illness-related behavior in the medical care delivery system. In addition to national estimates for the civilian noninstitutionalized population, it will also provide separate estimates for the Medicaid-eligible populations in four States.

The first cycle of NMCUES, which covers calendar year 1980, was designed and conducted as a collaborative effort between the National Center for Health Statistics, Public Health Service, and the Office of Research and Demonstrations, Health Care Financing Administration. Data were obtained from three survey components. The first was a national household survey and the second was a survey of Medicaid enrollees in four States (California, Michigan, Texas, and New York). Both of these components involved five interviews over a period of 15 months to obtain information on medical care utilization and expenditures and other health-related information. The third component was an administrative records survey that verified the eligibility status of respondents for the Medicare and Medicaid programs and supplemented the household data with claims data for the Medicare and Medicaid populations.

Data collection was accomplished by Research Triangle Institute, Research Triangle Park, N.C., and its subcontractors, the National Opinion Research Center of the University of Chicago, Ill., and SysteMetrics, Inc., Berkeley, Calif., under Contract No. 233–79–2032.

Co-Project Officers for the Survey were Robert R. Fuchsberg of the National Center for Health Statistics (NCHS) and Allen Dobson of the Health Care Financing Administration (HCFA). Robert A. Wright of NCHS and Larry Corder of HCFA also had major responsibilities. Daniel G. Horvitz of Research Triangle Institute was the Project Director primarily responsible for data collection, along with Associate Project Directors Esther Fleishman of the National Opinion Research Center, Robert H. Thornton of Research Triangle Institute, and James S. Lubalin of SysteMetrics, Inc. Barbara Moser of Research Triangle Institute was the Project Director primarily responsible for data processing.

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Contents

List of Text Figures

List of Text Tables

Symbols

--- Data not available

... Category not applicable

- Quantity zero

0.0 Quantity more than zero but less than 0.05

† Sample size is less than 50

‡ Sample size is less than 25

NOTE: Data estimates in tables may not add to totals because of rounding.

Costs of Illness United States, 1980

By P. Ellen Parsons, National Center for Health Statistics, formerly of the University of Michigan, and Richard Lichtenstein, S. E. Berki, Hillary A. Murt, James M. Lepkowski, Sharon A. Stehouwer, and J. Richard Landis, University of Michigan

Executive Summary

The total costs of illness and injury in the U.S. civilian noninstitutionalized population in 1980 amounted to $381.7 billion. The direct costs of illness and injury—resource expenditures for the diagnosis, treatment, and management of medical and dental conditions—were $153.9 billion, or 40.3 percent of total costs. Indirect costs—economic losses from morbidity and mortality—were $227.9 billion, or 59.7 percent of total costs. Of indirect costs, $104.9 billion resulted from productivity losses because of morbidity, and $123.0 billion represent the present value of lost productivity from premature mortality based on a net effective discount rate of 4 percent.

These estimates, based on data from the 1980 National Medical Care Utilization and Expenditure Survey (NMCUES), differ from other estimates of the costs of illness and injury in 1980 (Gibson and Waldo, 1982; Rice, Hodgson, and Kopstein, 1985). The differences, which can be resolved, are attributable to two major factors: (1) NMCUES includes only the civilian noninstitutionalized population, but the other estimates include the institutionalized population and the military; and (2) NMCUES indirect cost estimates for the population unable to work include persons who were retired for health reasons in 1979 and 1980, disabled homemakers, and other persons who were disabled for the entire year 1980 but were not retired for health reasons in 1979, but the Rice et al. estimates do not include the last two categories in the population unable to work.

The principal NMCUES findings on the total costs of illness in the civilian noninstitutionalized population reinforce the importance of considering distributional effects. Persons 65 years of age and over represent one-tenth of this population yet account for more than one-fourth of direct costs and more than their share of total costs, even though the institutionalized elderly are excluded. More than two-thirds of total costs for this age category are accounted for by direct costs. Direct costs also account for more than two-thirds of total costs for people under 17 years of age. However, this youngest age category, which constitutes over one-fourth of the civilian noninstitutionalized population, generates only 12.3 percent of direct costs. In contrast, indirect costs account for well more than 60 percent of total costs for the working-age population (17–64 years of age). Within the working-age population, per capita direct costs are highest among persons who are not full participants in the work force, many of whom are not working full time or at all because of injury or ill health.

Black persons account for a disproportionately high percent of indirect costs but for a disproportionately low percent of direct costs. The high percent of mortality costs suggests earlier death in the black population than among the white and other population. The findings also suggest that the black population relies more heavily on the hospital for health care than the white and other population does.

Females comprise 51.8 percent of the civilian noninstitutionalized population and account for 56.0 percent of direct costs but only 41.6 percent of indirect costs. Direct costs for females are concentrated in the childbearing years (17–44 years of age). Males account for 52.6 percent of total costs because they have higher morbidity and mortality costs than females have.

Persons who live in families at lower socioeconomic levels generate both direct and indirect costs of illness and injury that are disproportionately high relative to their share of the population. However, persons in families with greater economic resources are more likely to generate direct costs for discretionary health services such as preventive dental care.

Diseases of the circulatory system account for 14.7 percent of total direct costs, excluding costs of dental services. Injury and poisoning, which rank second, account for 12.3 percent of direct costs. Diseases of the musculoskeletal system and connective tissue, neoplasms, and diseases of the respiratory system are next in rank. These five conditions together constitute more than 50 percent of direct costs.

The most costly diagnoses are essentially the same across sex and race categories, but differences exist among age categories. Respiratory diseases are most costly for people under 17 years of age. Injury and poisoning account for the largest percent of direct costs for persons 17–44 years of age. Diseases of the circulatory system constitute the highest cost category for persons 45 years of age and over and account for 27.6 percent of total charges for persons 65 years of

age and over in the civilian noninstitutionalized population.

Several major research and cost-containment priorities are suggested by the findings described in this report. To the extent that current methods used to valuate ıost productivity resulting from illness and injury reflect discrimination in the labor market, these methods systematically underestimate such losses for women. Further research is indicated. Scientific investigation of the various factors that contribute to the differential cost patterns generated by persons in the lower socioeconomic categories and in the black population is encouraged. Finally, the data suggest that prevention of injury and poisoning could significantly reduce health care costs.

NOTE: This report was prepared by the University of Michigan by contractual arrangement with the National Center for Health Statistics (Contract No. 282–83–2117). The authors are grateful for the support received during all stages of the preparation of this document, both from colleagues at the University of Michigan and from the staff of the National Center for Health Statistics. At the University of Michigan, Kenneth E. Guire was responsible for the overall preparation and correction of data files on which this report is based. Dr. Catherine McLaughlin and Dr. Leon Wyszewianski provided valuable conceptual help. Valuable consultation on matters related to the use of medications was given by Dr. Duane Kirking. Quality secretarial support in the preparation of the many tables included in the report came from Jan Feldman, Carolyn Parker, and Johanna Haaxma-Jurek. At the Institute for Social Research, University of Michigan, Nan Collier developed software for calculating sampling errors, and Judy Connors performed many of the analyses for generating sampling errors for national estimates.

Continual support and guidance were provided by the National Center for Health Statistics and our project officer, Dr. Mary Grace Kovar, Special Assistant for Data Policy and Analysis. Dr. Thomas A. Hodgson, Chief Economist in the Office of Analysis and Epidemiology, provided expert advice and many useful suggestions for the development of indirect cost estimation methodology. The authors are indebted to Dr. Robert J. Casady, Chief of the Statistical Methods Staff, for writing the major section in Appendix I in which the NMCUES survey design and estimation methodology are described. When potential errors in the data were identified during our analyses, Robert Wright and Michelle Chyba quickly solved the problems. Editors in the Publications Branch provided valuable assistance during all stages of the report, especially during the preparation of detailed tables.

Introduction

Reports of the rapid rise in the costs of medical care are ubiquitous. Escalation of health care costs has led to numerous attempts, in both the private and public sectors, to moderate the rate of inflation in the health care field. Data reported annually for the total U.S. population, such as estimates of national health expenditures by the Health Care Financing Administration (HCFA), show high and rapidly rising expenditures, but they do not provide a measure of the total economic impact of illness and injury. When the question "What is the cost to society of illness and injury?" is posed, the answer involves not only resources used for health care, the direct costs of illness, but also resources lost to the economy when otherwise productive people are unable to work because of illness, the indirect costs. In this report, the total costs of illness and injury for the civilian noninstitutionalized population of the United States in 1980 are calculated by estimating both the direct and indirect costs of illness. These estimates provide a more complete picture of the economic costs of illness and reveal that the data detailing charges for medical care, though high, represent only a portion of the total costs.

Sources of Data

The National Medical Care Utilization and Expenditure Survey

Data for this study come from the public use files of the National Medical Care Utilization and Expenditure Survey (NMCUES), a national household survey conducted from early 1980 through early 1981. Specific details concerning the sample design and data collection are outlined in Appendix I.

From February 1980 through April 1981, data on 17,123 persons in 6,798 families were collected at approximately 3-month intervals. A total of five interviews, two personal interviews followed by two telephone interviews and a final personal interview, were conducted. At the conclusion of the first interview, survey participants were provided with a specially designed calendar diary for recording data about medical events and costs in preparation for subsequent rounds of interviewing. Prior to each interview but the first, respondents were sent a summary sheet showing all medical events and costs reported in previous interviews.

Public Use Tapes

NMCUES public use tapes consist of six files: The person, medical visit, dental visit, hospital stay, prescribed medicines and other medical expenses, and condition files. The person file has one record for each of the 17,123 responding eligible persons with data describing the person's demographic characteristics, health care coverage, employment, income, and usual source of care; numbers of visits, hospital admissions, and other medical events reported for 1980; total charges for each category of care; and limitations and disabilities, including identification of conditions. Data from the other five files, which have more detailed information about events summarized in the person file, can be linked to records in the person file through a unique identification number assigned to each person.

The medical visit file contains one record for every visit reported by people in the person file. A total of 86,594 visits are in the file, which includes visits to providers' offices, hospital outpatient departments, and emergency rooms. Each record contains the identifying number of the person making the visit, the place of visit, type of physician or nonphysician seen, type of services provided, conditions causing or associated with the visit, procedures performed during the visit, associated charges, and sources of payment. Similar data on dental visits and hospital admissions are provided in the dental visit and hospital stay files, respectively.

The prescribed medicines and other medical expenses file contains one record for each purchase of prescribed medications or other medical expense incurred by survey participants during 1980. Data include the identifying number of the person for whom the purchase was made, date of purchase, prescribed medicine codes, codes for conditions leading to the purchase or other expense, and associated charges and sources of payment.

If a medical condition caused any limitation in a person's activities (e.g., staying in bed, staying home from work) or caused the person to seek medical care, then a condition record appears in the condition file. For each condition, the condition file record contains the identifying number of the person, codes from the International Classification of Diseases (World Health Organization, 1977), dates of onset of illness, counts of visit types, prescribed medicines and other medical expenses, associated charges, and, if applicable, the reasons for not seeing a physician.

Modifications to the public use files that were made by the University of Michigan in the course of this analysis are presented in Appendix II.

Human Capital Approach to Estimating Costs of Illness

Estimates of direct and indirect costs of morbidity and mortality in this report are based on the human capital approach to the calculation of the costs of illness (Rice, 1966; Cooper and Rice, 1976; Hu and Sandifer, 1981; Hodgson and Meiners, 1982; Rice et al., 1985). Using this approach, the costs of illness are measured in terms of (1) resources used, or direct costs (i.e., expenditures for goods and services devoted to medical care and other needs of the ill), and (2) resources lost, or indirect costs (i.e., productive capacity lost to society as measured by loss of work time and earnings because of morbidity and premature mortality).

Two criticisms of the human capital approach relate to the estimation of indirect costs. First, it produces incomplete measures of the costs of illness because certain losses attributable to morbidity or mortality that are not readily subject to quantification, e.g., psychological costs, are excluded. Second, the monetary value of lost productivity is dependent on labor force participation and the market evaluation of that participation. It is difficult to assign a dollar value to the lost output of people not in the labor force. Hence, lost volunteer labor is measured imprecisely or not at all. Further, market-determined earnings reflect both market and social imperfections. Therefore, the monetary value of the lost output of working-age white men tends to be higher than that of women, minorities, and older or younger people in the work force (Hodgson and Meiners, 1982).

Estimation of the lost productivity of homemakers because of illness or death presents a case in which measurement of the monetary value of lost output is difficult. Homemakers are traditionally not paid for their services, so estimates are calculated using the market-value approach. Values for housekeeping services are assigned according to the time required to perform the services, based on time-motion studies, and relevant market wages that would be paid to outsiders for those services. The product represents the cost of labor necessary to replace the housekeeping services (Walker and Gauger, 1973; Cooper and Rice, 1976; Peskin, 1983). Again, these estimates do not include nonmarket services, which cannot be quantified easily.

The costs of illness presented in this report are derived from responses to NMCUES. In this respect, these estimates differ substantially from previous estimates of the costs of illness, which relied primarily on reports of providers, such as hospitals and physicians. Although NMCUES allows a much better understanding of how direct costs are distributed among individuals with various demographic characteristics, it entails certain measurement problems. In addition to problems inherent in the human capital approach, estimates in this report are susceptible to error because both direct and indirect costs are calculated on the basis of data reported by household informants and/or statistical estimates of health care charges and earnings. Further, certain direct costs of illness were omitted from these calculations because they were not obtained in NMCUES. For example, the value of services such as transportation, child care, and caregiving provided by family members and others, which should be added to the costs of care, are not included. As a result, actual direct and indirect costs may be higher than those estimated here. Other limitations of NMCUES data are discussed in later sections of this report.

Despite the imperfections inherent in these estimates of the costs of illness, they are good representations of both the absolute and relative magnitudes of direct and indirect costs. Although survey data introduce inaccuracy and bias, the same can be said for financial data collected directly from providers or from such sources as the Internal Revenue Service. The methods and data used in this report permitted a more detailed accounting of the indirect costs associated with illness in such groups as homemakers and the permanently disabled than had been accomplished before. These estimates thus reflect current economic concepts and methods as well as data collected using state-of-the-art survey research techniques.

Analytical strategies appropriate for NMCUES are presented in Appendix III. Sampling errors for estimators used throughout this report can be estimated using procedures outlined in Appendix IV. *Unless stated otherwise, all comparisons highlighted in subsequent sections are statistically significant at the 0.05-percent level.* Methods employed in the estimation of the direct and indirect costs of illness are discussed in Appendix V. Definitions of terms used in this report are listed in Appendix VI.

Direct Costs

Categories of Direct Costs

In the human capital approach, direct costs of illness are estimated on the basis of the market prices for goods and services devoted to the prevention, detection, treatment, and rehabilitation of illness (Scitovsky, 1982; Hodgson and Meiners, 1982). NMCUES includes charges incurred during 1980, as reported by household informants, for inpatient and outpatient hospital care, physician services and the services of other health professionals, dental services, prescribed medications, and selected other medical goods and services.

Costs for hospital inpatient services include all reported charges for hospital stays except physician services. Hospital outpatient services include all emergency room services and hospital outpatient department services for which a nonphysician provider was seen. Inpatient physician services are all physician services provided to hospital inpatients. Outpatient physician services include physician services provided in hospital outpatient departments and at sites other than a hospital such as a private office or clinic. Dental services include all dental care. Professionals classified as "other health professionals" include chiropractors, podiatrists, optometrists, psychologists, social workers, nurses, physical therapists, and others. Prescribed medications do not include over-the-counter drugs. Other medical expenses include eyeglasses, orthopedic appliances, hearing aids, diabetic supplies, and ambulance services.

Limitations of the Data

NMCUES data provide accounts of health care charges as reported by household informants without verification. It is likely that some respondents reported only out-of-pocket expenditures rather than actual charges. Therefore, it is reasonable to assume that estimates reported here represent an underestimation of actual charges. Respondents with public coverage, such as Medicaid, General Assistance, or Veterans' Administration health benefits, probably underreported their actual charges more frequently than others because the reimbursement process may leave these patients uninformed about amounts actually paid by such third parties. (Private insurance companies and Medicare often provide the patient with copies of bills paid directly to providers as a form of verification.) Thus, underestimates of charges for those covered by public programs may be greater than underestimates for individuals covered by private insurance.

Several types of direct costs are omitted from these estimates because of the sample design and focus of NMCUES. The NMCUES sampling frame is limited to the civilian noninstitutionalized population, so medical care charges for nursing home residents, military personnel, and individuals in prisons or mental health facilities, no matter where incurred, are not included. Therefore, national estimates of direct costs based on NMCUES data are not directly comparable with other national estimates such as HCFA's national health expenditures.

Direct-cost estimates by diagnostic category do not include charges for dental services because conditions were not assigned to dental visits or charges in the NMCUES data files. In this report, charges for dental care are included in most total direct-cost estimates but are not included in the totals of estimates reported by diagnostic category. Thus, these latter estimates are lower than the others by the amount spent on dental care.

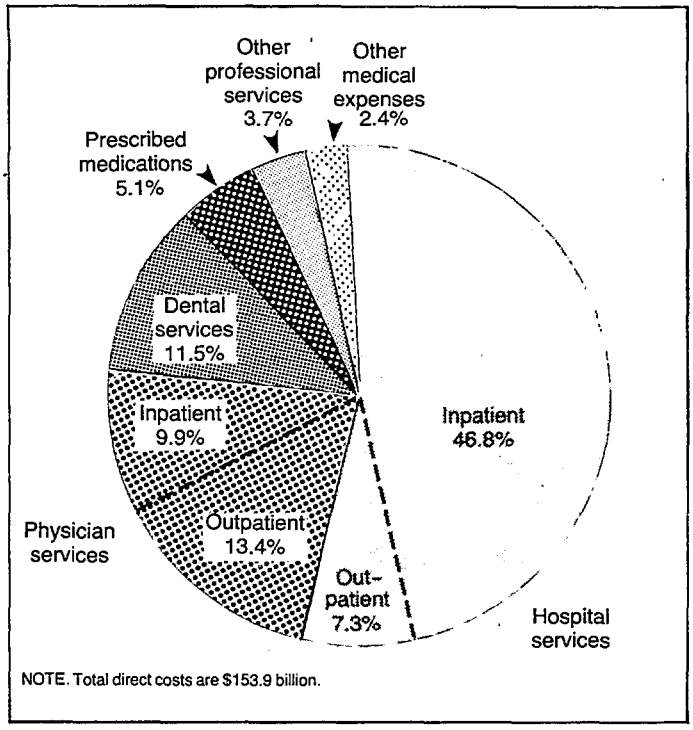
Distribution Among Selected Subgroups

Total direct costs for all health services in 1980 amounted to $153.9 billion. More than half (56.7 percent) of all direct costs were for hospital inpatient care: $72.0 billion (46.8 percent) for hospital services and $15.2 billion (9.9 percent) for inpatient physician services (Figure 1). Outpatient services accounted for more than 20 percent of total direct costs: $11.3 billion for services rendered in hospital outpatient facilities (7.3 percent) and $20.6 billion (13.4 percent) for physician services rendered in a variety of nonhospital settings including private offices. Charges for dental care amounted to $17.7 billion, 11.5 percent of total health care charges; charges for the services of other health professionals amounted to $5.6 billion (3.7 percent). A total of $7.8 billion (5.1 percent of total health charges) was attributable to prescribed medications and $3.7 billion (2.4 percent) to other medical expenses (Table 1).

Direct costs can also be expressed in terms of per capita charges, or average charges per person. Per capita

Figure 1

Percent distribution of direct costs by type of health service: United States, 1980



NOTE. Total direct costs are $153.9 billion.

charges are averaged over all persons in the population, whether they used health services or not, and thus are lower than average charges per user of health services. However, per capita estimates illustrate the burden of costs to society in a more readily understandable form than do estimates of average charges per user. When per capita charges are calculated for various segments of the population (such as males or females), the relative burden of costs, without regard to the distribution of use by the population, can be demonstrated.

In 1980 total direct costs for the civilian noninstitutionalized population amounted to $690 per capita, of which $391 was for inpatient care and $143 for outpatient services. Charges for "other health professionals" were $25 per capita; dental services totaled $79; prescribed medications cost $35; and other medical services such as eyeglasses or ambulance services amounted to $17 (Tables A and 2).

These aggregate figures mask important differences in the distribution of direct health care costs among various segments of the population. Age, sex, race, income, and other demographic characteristics are associated with differential spending patterns for health care services. Striking differences also appear in the distribution of charges for various types of health services for people with varying demographic characteristics.

Table A

Direct costs, percent distribution, and per capita direct costs for all persons by type of health service, according to age: United States, 1980

Age	All direct costs	Hospital services		Physician services		Dental services	Other health professionals[1]	Prescribed medications	Other medical expenses[2]
		Inpatient	Outpatient	Inpatient	Outpatient				
	Amount in millions								
All ages ..	$153,878	$71,955	$11,272	$15,183	$20,605	$17,691	$5,627	$7,831	$3,714
Under 17 years ..	18,875	6,130	2,178	1,095	3,243	4,424	644	723	434
17–44 years	56,118	23,621	4,481	5,670	8,233	8,022	2,665	2,085	1,341
45–64 years	39,721	18,654	2,921	3,789	5,193	3,998	1,363	2,743	1,054
65 years and over	39,164	23,550	1,692	4,629	3,935	1,246	955	2,270	886
	Percent distribution								
All ages ..	100.0	46.8	7.3	9.9	13.4	11.5	3.6	5.1	2.4
Under 17 years ..	100.0	32.5	11.5	5.8	17.2	23.4	3.4	3.9	2.3
17–44 years	100.0	42.1	8.0	10.1	14.7	14.3	4.7	3.7	2.4
45–64 years	100.0	47.0	7.4	9.5	13.1	10.1	3.4	6.9	2.7
65 years and over	100.0	60.1	4.3	11.8	10.0	3.2	2.4	5.8	2.3
	Per capita								
All ages ..	$690	$323	$51	$68	$92	$79	$25	$35	$17
Under 17 years ..	307	100	35	18	53	72	10	12	7
17–44 years	596	251	48	60	87	85	28	22	14
45–64 years	911	428	67	87	119	92	31	63	24
65 years and over	1,669	1,003	72	197	158	53	41	97	38

[1] Includes chiropractors, podiatrists, optometrists, psychologists, social workers, nurses, physical therapists, and others.
[2] Includes eyeglasses, orthopedic appliances, hearing aids, diabetic supplies, and ambulance services.

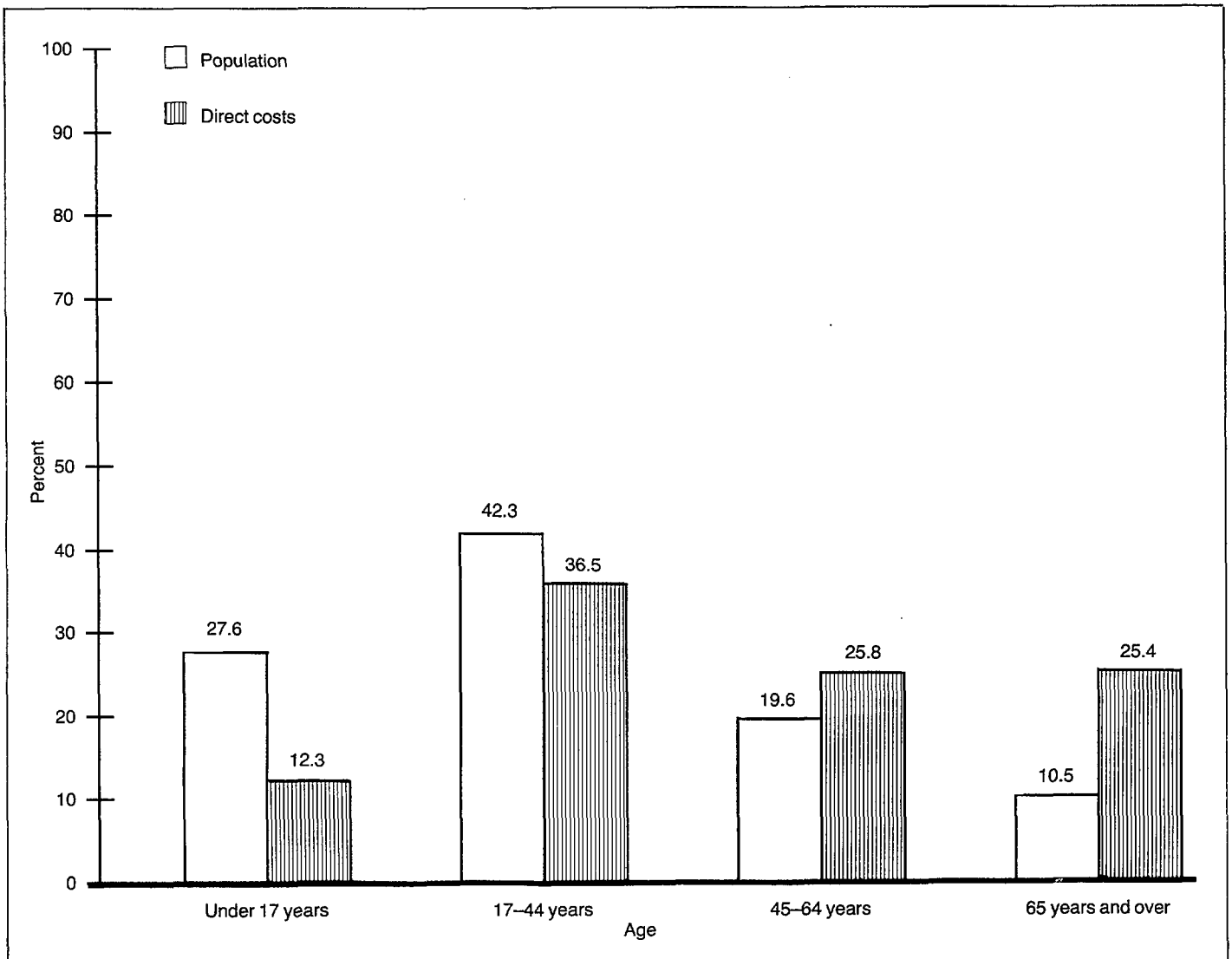
Age—Health care costs grow dramatically with age. Older Americans incur a disproportionately large share of direct health care costs compared with their representation in the population, and young people's costs are disproportionately low. As Figure 2 illustrates, the 10.5 percent of the 1980 civilian noninstitutionalized population who were 65 years of age and over accounted for 25.4 percent of direct health care charges. Persons under 17 years of age constituted 27.6 percent of this population but accounted for only 12.3 percent of charges (Tables 1 and 3). On a per capita basis, older Americans generated $1,669 in charges in 1980; those under 17 years of age generated only $307 in charges, as indicated in Tables A and 2.

People in different age categories also tend to differ in the distribution of total charges for various types of health services. Considering charges for each age category in Table A, it is apparent that the proportion of charges for inpatient care (hospital and physician care combined) increased with each age category (from 38.3 percent in the youngest group to 71.9 percent in the oldest), but the proportion for outpatient care decreased with overall age (from 28.7 percent to 14.3 percent). However, per capita charges for both categories of service increased with age, from $118 to $1,200 for inpatient care and from $88 to $230 for outpatient care. Per capita charges for the services of other health professionals also increased with age, although the percent of total charges incurred for such services declined after 45 years of age (Table 2).

Per capita charges for prescribed medications increased more than eightfold with age (from $12 to $97). Charges incurred for prescribed medications as a percent of all health care charges were highest in the category 45–64 years of age (6.9 percent), but this percent is not significantly different from that for the category

Figure 2

Percent distributions of population and direct costs by age: United States, 1980



NOTE: Total civilian noninstitutionalized population is 222.8 million. Total direct costs are $153.9 billion.

65 years of age and over (5.8 percent). Persons 17–44 years of age show the lowest proportion of charges for prescribed medications, 3.7 percent. Charges for "other medical expenses" represent approximately the same percent for all age categories—2.4 percent of total charges.

Sex—Charges for health services are unevenly distributed by sex. As indicated in Table B, females on average generate greater charges for health care than males do. Per capita charges in 1980 were $748 for females, compared with $629 for males. Differences between per capita charges for males and females are statistically significant for all health services except hospital care. Females comprised 51.8 percent of the population (Table 3), yet accounted for 56.0 percent of total charges; males comprised 48.2 percent of the population and accounted for 44.0 percent of total direct costs. However, charges for inpatient care comprised a larger percent of the total for males (58.8 percent) than for females (54.9 percent).

Health care charges for women are concentrated in the childbearing years, 17–44 years of age. This age category accounted for $34.6 billion (40.1 percent) of total charges for women, compared with $21.6 billion (31.9 percent) for men of the same age. Per capita charges were also substantially higher for this group of women than for men, $711 versus $473. However, hospital care accounted for about the same percent of total charges for both men and women in this age category, and physician care accounted for only a slightly higher percent of total charges for women than for men.

Race—Important differences in health care charges

Table B

Direct costs, percent distribution, and per capita direct costs for all persons by type of health service, according to sex and age: United States, 1980

Sex and age	All direct costs	Hospital services		Physician services	
		Inpatient	Outpatient	Inpatient	Outpatient
			Amount in millions		
Male, all ages	$67,648	$33,249	$5,024	$6,523	$8,033
Under 17 years	9,984	3,399	1,275	634	1,691
17–44 years	21,569	9,184	1,781	1,923	2,720
45–64 years	18,724	9,647	1,226	1,750	2,154
65 years and over	17,372	11,019	743	2,215	1,468
Female, all ages	86,230	38,706	6,248	8,660	12,572
Under 17 years	8,891	2,731	904	461	1,553
17–44 years	34,550	14,437	2,700	3,747	5,513
45–64 years	20,998	9,008	1,695	2,039	3,039
65 years and over	21,792	12,531	949	2,413	2,467
			Percent distribution		
Male, all ages	100.0	49.2	7.4	9.6	11.9
Under 17 years	100.0	34.0	12.8	6.3	16.9
17–44 years	100.0	42.6	8.3	8.9	12.6
45–64 years	100.0	51.5	6.5	9.3	11.5
65 years and over	100.0	63.4	4.3	12.8	8.5
Female, all ages	100.0	44.9	7.2	10.0	14.6
Under 17 years	100.0	30.7	10.2	5.2	17.5
17–44 years	100.0	41.8	7.8	10.8	16.0
45–64 years	100.0	42.9	8.1	9.7	14.5
65 years and over	100.0	57.5	4.4	11.1	11.3
			Per capita		
Male, all ages	$ 629	$ 309	$47	$ 61	$ 75
Under 17 years	316	108	40	20	54
17–44 years	473	201	39	42	60
45–64 years	899	463	59	84	103
65 years and over	1,830	1,161	78	233	155
Female, all ages	748	336	54	75	109
Under 17 years	296	91	30	15	52
17–44 years	711	297	56	77	113
45–64 years	923	396	75	90	134
65 years and over	1,559	896	68	173	177

are also apparent by racial category. As indicated in Figure 3, black persons comprised 11.7 percent of the civilian noninstitutionalized population but accounted for only 9.7 percent of total health care charges. White persons and persons of other races, on the other hand, comprised 88.3 percent of the population and accounted for 90.3 percent of charges. Per capita charges for black persons were substantially less than charges for white and other persons ($573 versus $706), as shown in Table C. This difference is not statistically significant, however.

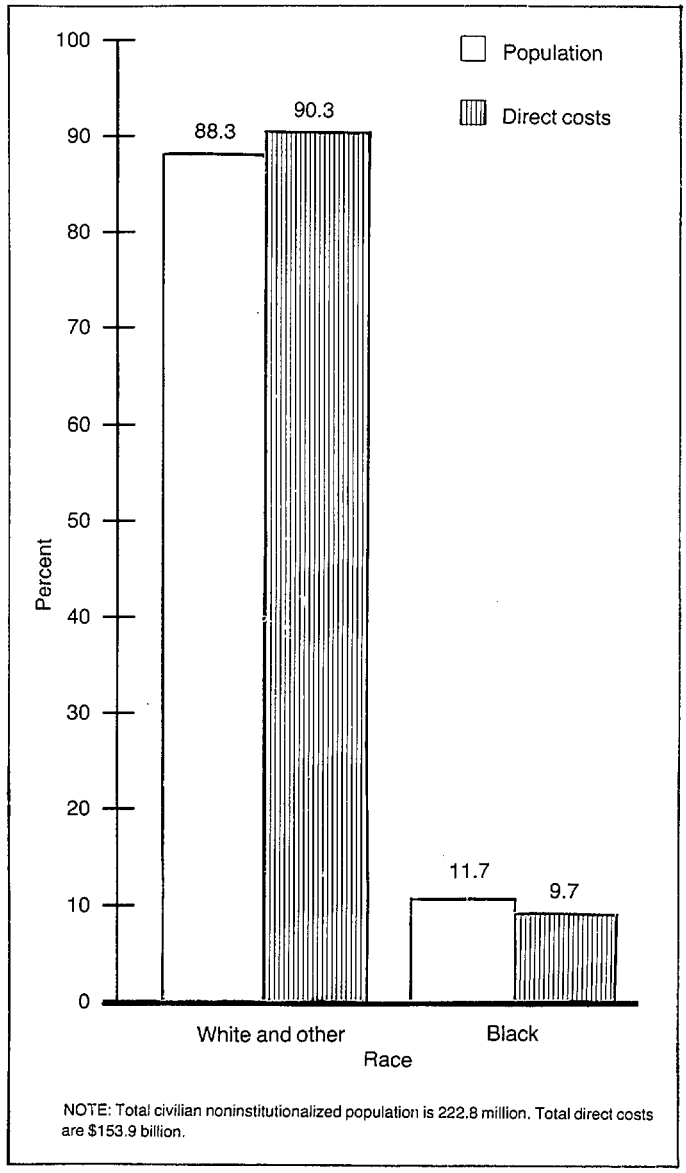
The percent of charges for hospital care is higher for black persons than for white and other persons. Inpatient hospital care, including inpatient physician care, accounted for 60.1 percent of total health care charges for the black population and 56.2 percent for the white and other category. Outpatient physician services accounted for 11.6 percent and outpatient hospital services accounted for 12.1 percent of health care charges for black persons; the comparable figures for white and other persons are 13.6 percent and 6.8 percent. Differences between the racial categories in percent of charges represented by outpatient care are significant for hospital services and nearly significant for physician services. On the whole, these findings suggest greater reliance on the hospital for health care within the black population than within the white and other population.

On a per capita basis, charges for all hospital services were virtually the same for black persons and for white and other persons ($373 and $374, respectively). Per capita charges for all physician care were $168 for white and other persons and $108 for black persons. For all other health care services, per capita charges and percent of total charges were higher for white and other persons than for black persons. The difference is particularly striking for dental services, which accounted for 12.0 percent of the health care charges for white and other persons ($84 per capita) and 7.2 percent of total charges for black persons ($41 per capita).

Education of family head—Charges for health services also vary by other socioeconomic characteristics of the individual, such as education, income level, and poverty status. Although higher educational attainment

Figure 3

Percent distributions of population and direct costs by race: United States, 1980



NOTE: Total civilian noninstitutionalized population is 222.8 million. Total direct costs are $153.9 billion.

Table C

Percent distribution and per capita direct costs for all persons by type of health service, according to race: United States, 1980

Race	All direct costs	Hospital services		Physician services		Dental services
		Inpatient	Outpatient	Inpatient	Outpatient	
	Percent distribution					
Black	100.0	52.8	12.1	7.3	11.6	7.2
White and other	100.0	46.1	6.8	10.1	13.6	12.0
	Per capita					
Black	$573	$303	$70	$42	$66	$41
White and other	706	326	48	72	96	84

and higher income are often associated with one another, it is not always the case that people with high education have high income and vice versa. As a result, slightly different patterns emerge when charges are analyzed separately for each characteristic.

Information about the educational level of NMCUES respondents was reported for each individual 17 years of age and over. However, in this report all respondents are categorized by the educational level of the head of their family. Therefore, in tables reporting level of education, children and other members of the family are assigned to the category that is appropriate for the head of family.

Per capita charges for health care services by educational status follow a reversed J-curve. They fall sharply after the category with the lowest education and continue to decline modestly as educational attainment increases, only to rise slightly in the last category (college graduate). Per capita charges for persons in the category with lowest education, nevertheless, were considerably higher than those for the highest educational category ($862 compared with $651), as shown in Table D.

Inpatient charges accounted for nearly 20 percent more of total health care charges for persons in families whose heads had no education or only elementary school education than they did for persons in families headed by college graduates (66.6 percent versus 47.0 percent). Per capita charges were even more disparate, with the lowest educational category accounting for 87.6 percent more per capita for inpatient care than the highest educational category ($574 versus $306). Outpatient services, on the other hand, accounted for a larger portion of total health care charges for people in more educated families (23.5 percent compared with 17.4 percent). Many people who were 65 years of age and over in 1980 were not educated beyond elementary school.

Table D

Per capita direct costs and percent distribution for all persons by type of health service, according to education of head of family: United States, 1980

Education of head of family	All direct costs	Hospital and physician services	
		Inpatient	Outpatient
		Per capita	
None and elementary	$862	$574	$150
Some high school	696	435	137
High school graduate	647	358	136
Some college	643	320	146
College graduate	651	306	153
		Percent distribution	
None and elementary	100.0	66.6	17.4
Some high school	100.0	62.4	19.7
High school graduate	100.0	55.3	21.1
Some college	100.0	49.8	23.5
College graduate	100.0	47.0	23.5

Therefore, higher per capita charges for the lowest educational level can be partly explained by age and its effects on health status. The larger percent of charges for inpatient care for persons in families with the least education may also be partially attributable to age.

Family income—Health care charges vary more by family income level than by educational level. As with educational level, a disproportionate share of older persons in the lowest family income category account for much of the variation. As shown in Table E, persons in low-income families (less than $5,000 per year) showed extremely high per capita charges ($997) relative to those in higher income brackets Persons in the next lowest family income category ($5,000–$14,999 per year) also incurred charges above the overall average ($800 compared with an average of $690). Per capita charges decreased to $585 for the income level $15,000–$34,999 but rose again, totaling $682 for persons in the highest family income bracket. (However, the difference between $585 and $682 is not statistically significant.)

These variations suggest that health care charges are unevenly distributed among the income categories: the lowest third of the population by income level accounted for over 40 percent of charges. Inpatient care accounted for a larger percent of charges for persons in lower income families than for people in higher income families, although the only statistically significant difference was between the income levels $5,000–$14,999 and $15,000–$34,999. Per capita charges for both inpatient and outpatient care were highest for persons in the lowest income category, but the difference between per capita charges for the two lowest income categories was not statistically significant. Those in the highest income category incurred a greater proportion of health care charges for other services, such as prescribed medications, other professional services, and dental care. The charge differential is most apparent in the disparity between the lowest and highest income categories in the percent of charges for dental services (4.3 percent versus 17.9 percent) and in per capita charges for dental services ($43 versus $122).

Poverty status—Poverty status, another measure of economic status, is designed to take account of a number of relevant variables in addition to income. Age and sex of the head of family and number of persons in the family, in addition to 1980 family income, were used to determine poverty status. A survey participant's 1980 family income was compared with the appropriate nonfarm poverty level threshold (as determined by the U.S. Bureau of the Census) for a family of similar composition to the participant's family. The figure was then converted to a percent. This measure ranges from below poverty level to 9 times poverty level. The construction of poverty status in the NMCUES data files reflects some of the changes made in the Federal definition of poverty status in use since 1982 (e.g., comparison of the incomes of all families to nonfarm thresholds

Table E

Per capita direct costs and percent distribution for all persons by type of health service, according to family income: United States, 1980

Family income	Percent of population	Percent of total direct costs	All direct costs	Hospital and physician services		Dental services
				Inpatient	Outpatient	
			Per capita			
Less than $5,000	7.3	10.5	$997	$649	$197	$43
$5,000–$14,999	26.1	30.2	800	508	151	56
$15,000–$34,999	46.4	39.3	585	307	131	79
$35,000 or more	20.2	20.0	682	340	141	122
			Percent distribution			
Less than $5,000	...	...	100.0	65.1	19.8	4.3
$5,000–$14,999	...	...	100.0	63.5	18.9	7.0
$15,000–$34,999	...	...	100.0	52.5	22.4	13.6
$35,000 or more	...	...	100.0	49.9	20.7	17.9

instead of using separate farm and nonfarm thresholds). However, not all of the changes were incorporated in NMCUES. For example, the current Federal methodology does not use separate thresholds for female-headed households. Rather, it employs a weighted average of thresholds for male-headed and female-headed households. Therefore, while poverty status is a useful tool for assessing real differences in economic status, this particular measure of poverty status is not directly comparable with either the earlier or the current definition employed by the Federal Government (U.S. Bureau of the Census, 1982a).

Examination of the differences in health care charges by poverty status confirms the trends noted in the examination by income level but suggests that measuring only income may obscure some important aspects of the relationship between economic status and health care charges. For example, the lowest one-third of the noninstitutionalized civilian population as gauged by poverty status accounts for about one-third of total charges (Table F), whereas the lowest one-third when gauged by income accounts for over 40 percent (Table E). Per capita charges for the lowest one-third of the civilian noninstitutionalized population by poverty status were $732, compared with $843 for those in the family income categories less than $15,000 per year (Tables 1 and 3). Adjusting for family size, composition, and age of the family head (components of the poverty index) places a somewhat different group of people at the lower end of the economic hierarchy, and these people generate relatively lower health care charges than do those characterized only by low income. Persons in the highest category, 700 percent of poverty level or more, show dramatically higher per capita charges ($902), as well as a larger share of charges relative to their share of the population.

Working-age population—Health care charges attributable to the working-age population (17–64 years of age) are of particular interest because it is this population that produces the major portion of society's economic output. Figure 2, which has already been discussed, depicts the distributions of population and health care charges by age category and shows the relative share of total charges incurred by the working-age population. As a whole, this aggregate represented 61.8 percent of the civilian noninstitutionalized population in 1980 and accounted for 62.3 percent of total charges; that is, health care charges for the working-age population were in proportion to its share of the total civilian noninstitutionalized population. However, within the working-age category, several subcategories differ by employment status, and their health care charges are widely divergent. Analysis of the distribution of charges across employment categories allows a more detailed understanding of the relative burden of illness for each category and for society. In NMCUES, employment for persons 17 years of age and over is categorized as follows:

- Employed:
  - Full year, full time = 48–52 weeks, 35 hours per week or more;
  - Full year, part time = 48–52 weeks, less than 35 hours per week;
  - Part year, full time = 1–47 weeks, 35 hours per week or more;
  - Part year, part time = 1–47 weeks, less than 35 hours per week;
- Unemployed;
- Not in labor force:
  - Retired;
  - Retired because of health;
  - Student;
  - Other.

Individuals were assigned to a single major employment category (employed, unemployed, not in labor force). People employed at any time in 1980 were classified as employed; similarly, only persons who were un-

Table F

Per capita direct costs and percent distribution for all persons by type of health service, according to poverty status: United States, 1980

Poverty status	Percent of population	Percent of total direct costs	All direct costs	Hospital and physician services		Dental services
				Inpatient	Outpatient	
				Per capita		
Below poverty level	11.0	11.1	$697	$432	$152	$40
Poverty level to 199 percent poverty level	20.4	22.2	750	485	143	49
200–499 percent poverty level	51.8	48.1	642	354	131	84
500–699 percent poverty level	10.7	10.7	687	325	160	114
700 percent poverty level or more	6.0	7.9	902	437	198	147
				Percent distribution		
Below poverty level	...	...	100.0	61.9	21.8	5.8
Poverty level to 199 percent poverty level	...	...	100.0	64.6	19.1	6.6
200–499 percent poverty level	...	...	100.0	55.1	20.5	13.2
500–699 percent poverty level	...	...	100.0	47.3	23.3	16.6
700 percent poverty level or more	...	...	100.0	48.5	22.0	16.3

NOTE: Figures do not add to totals because several cost categories are not displayed.

employed or not in the labor force for the entire year were classified as unemployed or not in the labor force.

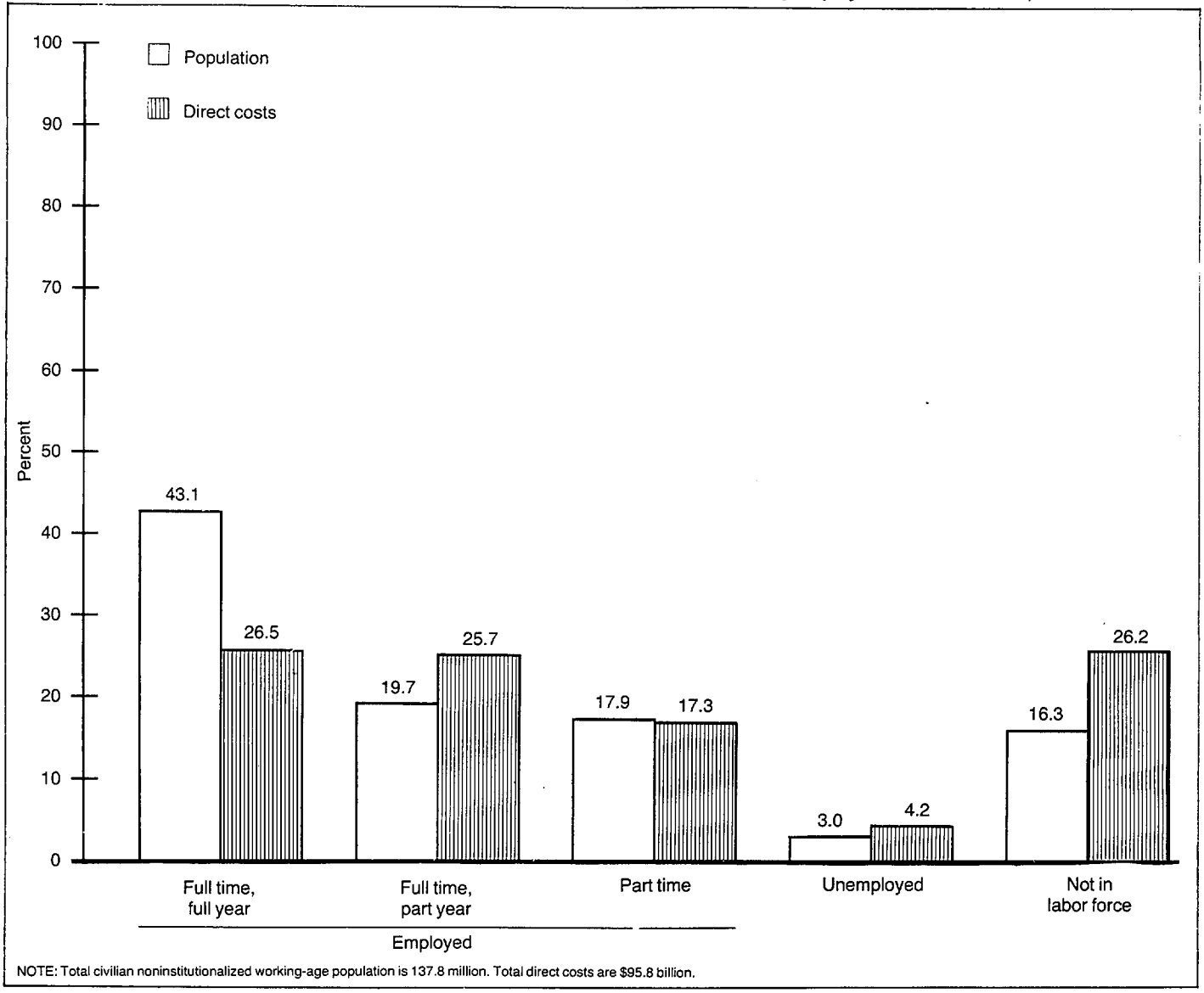
Differences in health care charges across employment categories are shown in Figure 4. Nearly one-half of the working-age population in 1980 (43.1 percent) were employed full time, full year. Health care charges for this category amounted to only 26.5 percent of total charges for the entire working-age population. Full-time, part-year workers represented 19.7 percent of the working-age population but accounted for 25.7 percent of charges. Three percent of the working-age population were unemployed for all of 1980. (The usual figures on the unemployment rate reflect the number of people unemployed at a given point in time and are thus much higher than this figure, which reflects the number of people defined as unemployed for the entire year.) Charges generated by the unemployed category accounted for 4.2 percent of total charges incurred by the working-age population. Persons not in the labor force represented 16.3 percent of the working-age population, yet they accounted for 26.2 percent of all charges. Some explanations for these variations seem intuitively clear. For instance, the employed, and especially full-time workers, are healthier, and those able to work only part of the year or not at all are less healthy. However, closer examination of charges for the working-age population by demographic characteristics reveals interesting patterns (Tables 4 and 5).

Health care charges increase with age within the working-age population, just as they do in the general civilian noninstitutionalized population. Charges are concentrated among persons 45–64 years of age, as illustrated in Table G. This age category comprised 31.6 percent of the working-age population yet accounted for 41.4 percent of charges. Per capita charges were considerably higher in this older age category: $911, compared with $536 for persons 17–24 years of age and $628 for persons 25–44 years of age.

Within each age category, full-time, full-year workers account for a much smaller percent of charges than their representation in the population, as indicated in Table H. However, full-time workers who worked only part of the year (less than 48 weeks) generated proportionately more health care charges. It is likely that some of these part-year workers were unable to work a full year because they were injured or otherwise disabled at some point during the year. Per capita charges for employed people follow a consistent pattern within each age category: lowest charges for full-time, full-year workers ($334–$532); higher charges for part-time workers ($499–$853); and the highest charges for full-time, part-year workers ($656–$1,251). However, pairwise comparisons between employment categories within an age category were not significant in all cases. Within the youngest age category, per capita charges for full-time, full-year workers were not significantly different from those for part-time or unemployed workers. Per capita charges for part-time workers in the categories 17–24 and 25–44 years of age did not differ significantly from those for full-time, part-year workers or the unemployed in the same age categories. Finally, per capita charges for unemployed workers in the oldest age category were not significantly different from those for full-time, full-year or part-time workers. It should be noted that the sample populations for many of the subgroups of part-time and unemployed workers were quite small (n = less than 50); therefore, estimators of charges for these subgroups may not be precise enough to accurately

Figure 4

Percent distributions of population and direct costs for the working-age population by employment: United States, 1980



NOTE: Total civilian noninstitutionalized working-age population is 137.8 million. Total direct costs are $95.8 billion.

Table G

Percent distributions of population and of direct costs and per capita direct costs for the working-age population by age: United States, 1980

Age	Percent of population	Percent of direct costs	Per capita direct costs
17–24 years	23.9	18.4	$536
25–44 years	44.5	40.1	628
45–64 years	31.6	41.4	911

assess statistical significance (Tables 5 and 8). This is particularly important in light of the high variability of NMCUES charge data.

Unemployed persons represent a smaller percent of the working-age population as age increases. However, as can be seen in Table H, total charges for unemployed persons tend to be proportionately higher than their population share. This is particularly evident for persons 17–24 years of age. Per capita charges were also higher for the unemployed than for employed persons in each age category with the exception of the category 45–64 years of age, in which charges for full-time, part-year workers were highest. However, per capita charges for the unemployed did not differ significantly from those for full-time, part-year workers in any age category.

Although employed men and women exhibit far lower charges than unemployed persons or persons not in the labor force, there are still variations among employed persons. Health care charges for full-time, full-year workers of both sexes make up a smaller percent of total health care charges than the proportion of the working-age population represented by these workers. This

Table H

Percent distributions of population and of direct costs and per capita direct costs for the working-age population by employment, according to age: United States, 1980

Age	Total	Employed			Unemployed	Not in labor force
		Full time				
		Full year	Part year	Part time		
		Percent of population				
17–24 years	100.0	29.4	27.3	28.8	5.6	11.7
25–44 years	100.0	51.0	19.1	16.0	2.5	11.3
45–64 years	100.0	42.3	14.7	12.4	1.7	28.8
		Percent of direct costs				
17–24 years	100.0	18.3	33.3	26.8	10.6	8.9
25–44 years	100.0	32.1	27.9	18.7	3.9	17.3
45–64 years	100.0	24.7	20.2	11.6	1.8	41.6
		Per capita direct costs				
17–24 years	$536	$334	$656	$499	$723	$657
25–44 years	628	395	914	735	971	960
45–64 years	911	532	1,251	853	942	1,320

differential is greater for men than for women. As illustrated in Table J, per capita charges for full-time, full-year workers were the lowest among the employment categories for both sexes and were lower for men ($393) than for women ($494). Total charges for part-time workers were higher than charges for full-time, full-year workers for both sexes. Again, per capita charges among part-time workers were higher for women ($706) than for men ($581). Among employed persons, those who worked full time, but for only part of the year, exhibited the highest charges for both sexes, and they accounted for a larger share of charges than of population. This pattern of charges among full-time, part-year workers may be attributable to their separation from the work force by illness or injury. The sex differential in per capita charges for these individuals follows the general pattern: charges were higher for women than for men ($940 versus $881).

Table J

Percent distributions of population and of direct costs and per capita direct costs for the working-age population by sex and employment: United States, 1980

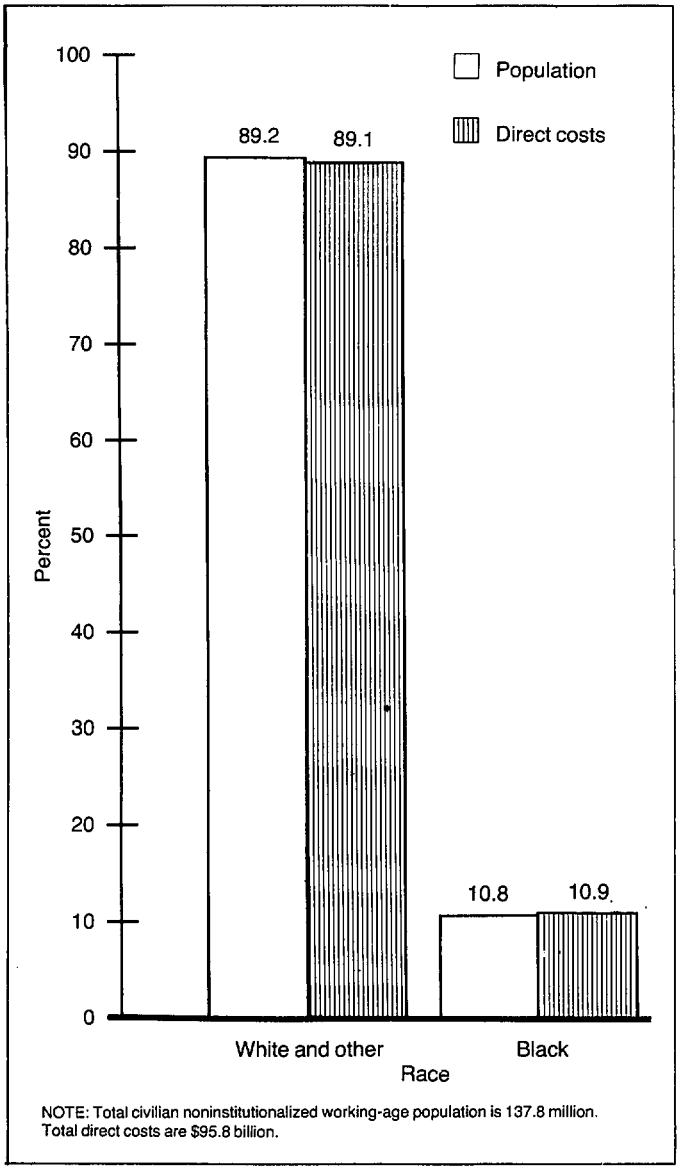
Sex and employment	Percent of population	Percent of direct costs	Per capita direct costs
Total	100.0	100.0	$696
Male	48.2	42.0	607
Full time, full year	28.4	16.0	393
Full time, part year	10.5	13.2	881
Part time	5.1	4.2	581
Unemployed	1.0	1.1	802
Not in labor force	3.3	7.4	1,557
Female	51.8	58.0	778
Full time, full year	14.7	10.5	494
Full time, part year	9.2	12.5	940
Part time	12.9	13.0	706
Unemployed	2.0	3.1	1,076
Not in labor force	13.0	18.9	1,010

The distributions of the civilian noninstitutionalized population and total charges for the working-age population by race are depicted in Figure 5. Comparison with Figure 3 suggests that, when the population in question is limited to persons of working age, the distributions of population and charges at the aggregate level are essentially identical by race. Aggregate per capita charges for the two racial categories also converge, as indicated in Table K: $701 for black persons and $695 for all other persons. The patterns and levels of charges for persons working full time (both full and part year) in the two racial categories are also quite similar. Full-time, full-year workers had the lowest or equal to the lowest per capita charges in both categories ($402 for the black population and $430 for the white and other population), although it should be noted that black part-time workers also had very low per capita charges ($401). Full-time, full-year workers also accounted for a smaller percent of total charges than of the population in both cases. Full-time, part-year workers in both racial categories reflect patterns previously noted; that is, they accounted for a greater percent of total charges than of the population, and their per capita charges tended to be high ($946 for black persons and $904 for white and other persons).

Fairly substantial disparities in charges between the races are apparent in the other three employment categories. Part-time workers represented approximately the same proportion of the working-age population for each racial category. However, white and other part-time workers accounted for a proportion of total charges that

Figure 5

Percent distributions of population and direct costs for the working-age population by race: United States, 1980



NOTE: Total civilian noninstitutionalized working-age population is 137.8 million. Total direct costs are $95.8 billion.

Table K

Percent distributions of population and of direct costs and per capita direct costs for the working-age population by race and employment: United States, 1980

Race and employment	Percent of population	Percent of direct costs	Per capita direct costs
Black	100.0	100.0	$701
Full time, full year	38.4	22.0	402
Full time, part year	22.0	29.7	946
Part time	16.3	9.3	401
Unemployed	7.6	6.4	591
Not in labor force	15.7	32.6	1,447
White and other	100.0	100.0	695
Full time, full year	43.7	27.1	430
Full time, part year	19.4	25.2	904
Part time	18.1	18.3	700
Unemployed	2.4	4.0	1,173
Not in labor force	16.3	25.5	1,083

equaled their share of the population, but black part-time workers accounted for a much smaller proportion of health care charges than of the reference population (9.3 percent versus 16.3 percent). Per capita charges were also much lower for black part-time workers than for part-time workers in the white and other category ($401 versus $700), although the difference is not statistically significant.

Unemployed persons comprise a larger share of the black civilian noninstitutionalized population than of the white and other population. Unemployed white and other persons represented 2.4 percent of their reference population but generated 4.0 percent of that population's direct health care costs. Unemployed black persons represented 7.6 percent of the black population and generated 6.4 percent of direct health care costs. This might mean that a higher proportion of those unemployed in the white and other category are unemployed because of health reasons than is the case for black persons.

Finally, although persons not in the labor force comprised a comparable portion of the population for both racial categories, black persons not in the labor force accounted for a larger percent (32.6 percent) of charges and had much higher per capita charges ($1,447) than white and other persons in this category had (25.5 percent of charges and $1,083 in per capita charges). The difference between $1,447 and $1,083 in per capita charges is not statistically significant. Again, the high variability of NMCUES charge data and the relatively small sample populations in some employment and racial categories may preclude a precise assessment of statistical significance. Statistical comparisons of the ratios of proportions (i.e., percent of total charges/percent of population) for the various employment and racial categories were not undertaken.

Distribution by Diagnostic Category

Estimation of the direct costs of illness by diagnosis or illness type is useful in identifying the disease groupings associated with various charge levels for the total civilian noninstitutionalized population or for subcategories of the population. These estimates can then be used to rank various diagnostic categories in terms of the direct health care costs associated with them.

When calculated by diagnostic category, total direct costs were $136.2 billion in 1980 (Table 6). As noted earlier, no dental charges are included in this total because condition codes were not assigned to dental services in NMCUES. Therefore, total direct costs listed in this section are less than those listed in other sections by the amount of total dental charges ($17.7 billion). In

addition, a primary diagnosis was not recorded when medical care charges were reported for multiple conditions, so all charges were assigned to the first condition recorded.

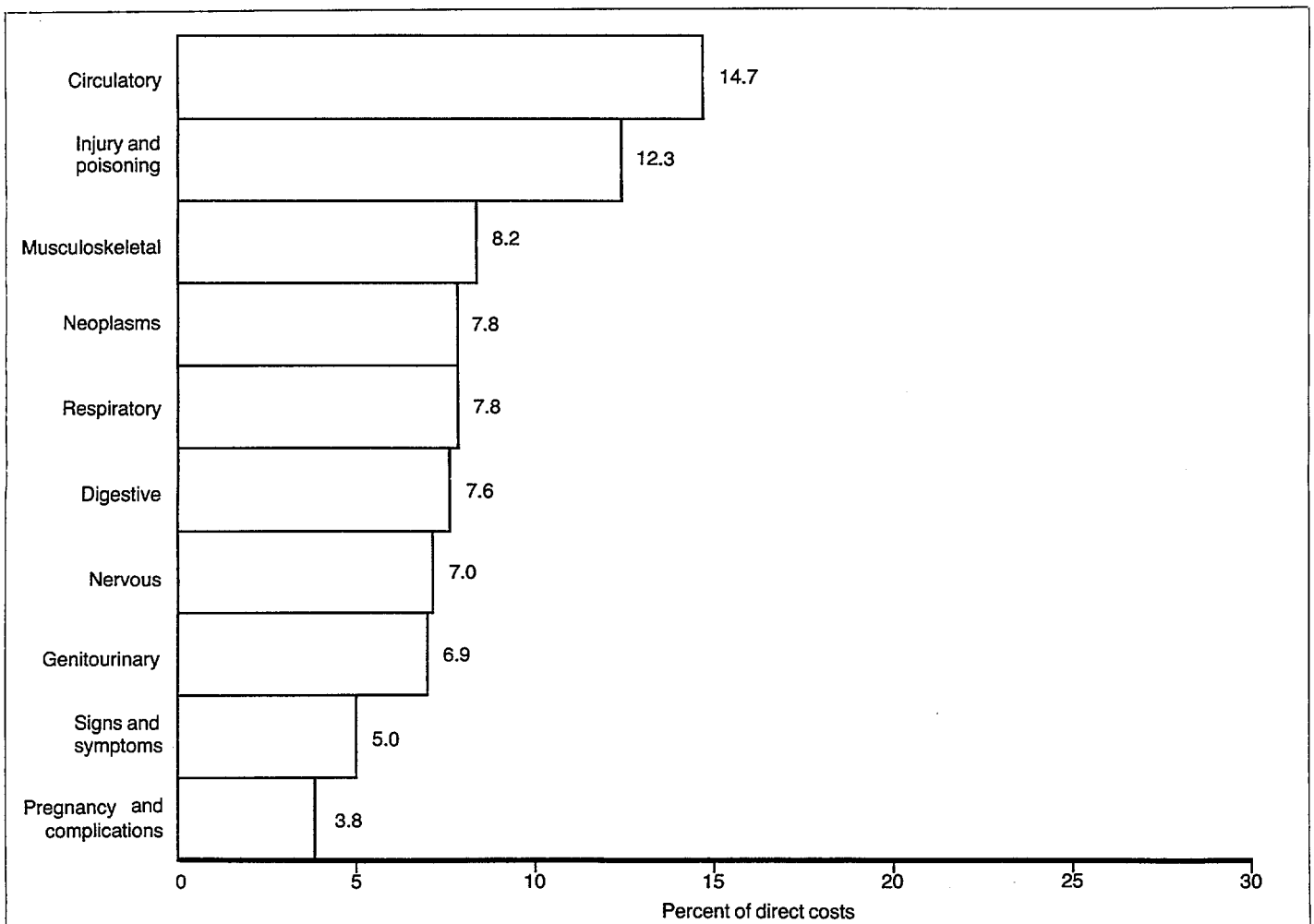
Diagnostic categories employed in NMCUES are consistent with the Ninth Edition of the International Classification of Diseases (World Health Organization, 1977). The specific codes are listed in Table VIII of Appendix V. It should be noted that charges for normal pregnancies are underestimated in these NMCUES figures; some deliveries were recorded in a separate category called "no condition at admission," and those charges are not included in this section. In addition, 8 percent of total charges were attributed to "no diagnosis" or to "unknown diagnosis." They are excluded from the examination of charges by specific diagnosis and from rankings of charges by diagnostic category. It is unlikely that the small number of such cases affects the relative rankings.

The 10 diagnostic categories that accounted for the largest proportions of total charges and that together comprised 81.1 percent of total direct costs are illustrated in Figure 6. Together, the top five categories comprised more than half (50.8 percent) of total health care charges in 1980. Diseases of the circulatory system, representing 14.7 percent of all direct costs, ranked first with $20.0 billion in direct costs. Injuries and poisonings were next at $16.7 billion, or 12.3 percent. Charges for diseases of the musculoskeletal system and connective tissue amounted to 8.2 percent, or $11.2 billion. Neoplasms and diseases of the respiratory system represented 7.8 percent of health care charges, or $10.6 billion, each (Table 6).

Comparison of these findings with the recent study by Rice, Hodgson, and Kopstein (1985) yields interesting contrasts. However, since their methodology was in some respects different from that used for this report, the results may reflect differences in methods rather than actual differences in the relative magnitude of direct costs associated with diagnoses. The rank order and proportion of direct costs for the top 10 diagnostic groups in 1980, as determined by Rice et al., are depicted

Figure 6

Direct costs for the civilian noninstitutionalized population, by diagnostic category: United States, 1980



NOTE: Total excludes direct costs for dental services. Percents are based on total direct costs of $136.2 billion. Code numbers are listed in Appendix V, Table VIII.

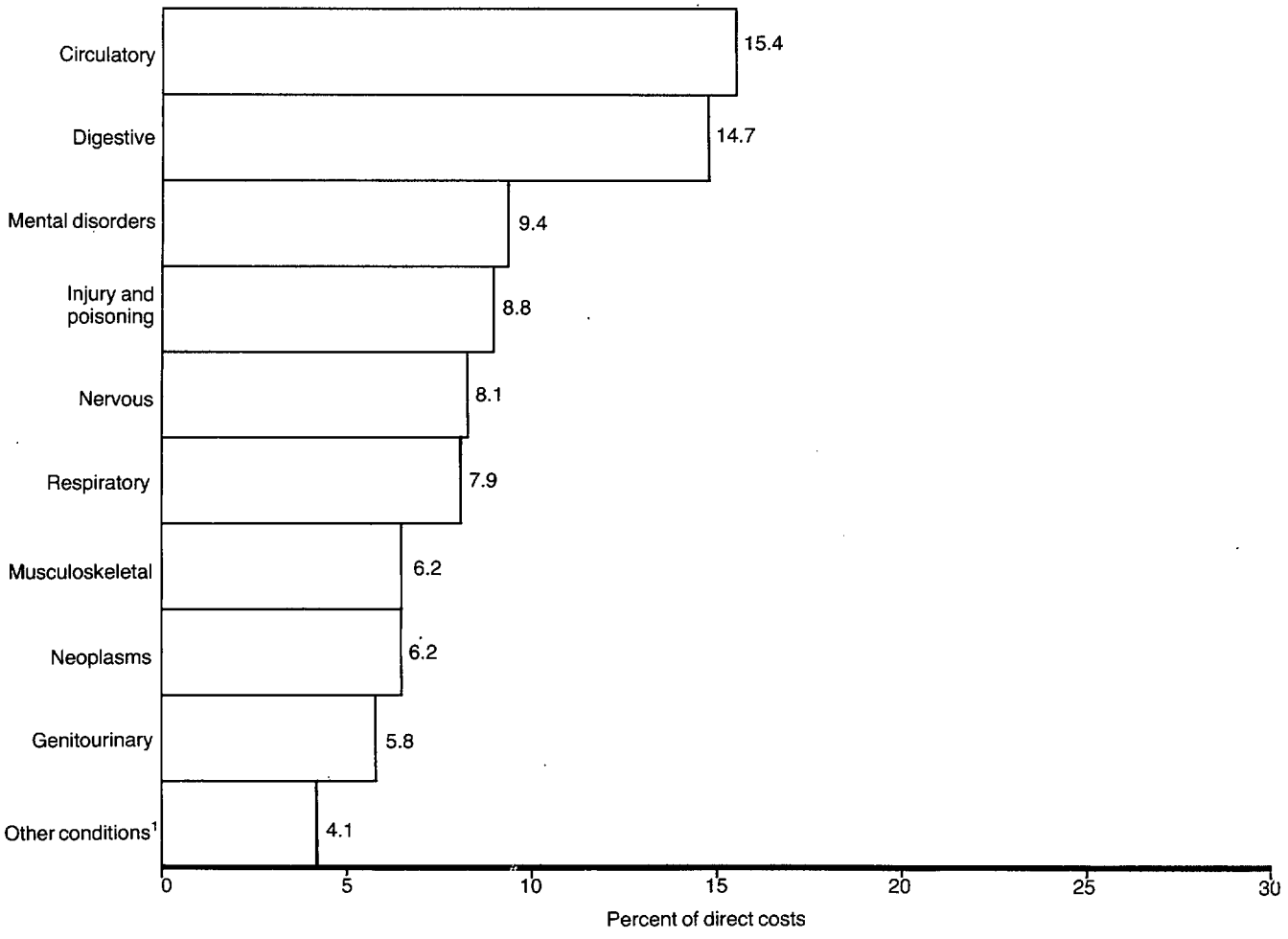
in Figure 7. Some methodological differences that may account for the differences that emerge when Figures 6 and 7 are compared are discussed below.

Diseases of the circulatory system ranked first in both studies, accounting for 15.4 percent of direct costs in the Rice et al. study and 14.7 percent in this study. Diseases of the digestive system, accounting for 14.7 percent of total direct costs, were ranked second by Rice et al. This category, however, includes costs for all dental services, which are excluded from the NMCUES calculations. Mental disorders accounted for 9.4 percent of expenditures in the Rice et al. study and ranked third, although they accounted for only a small percent of charges in NMCUES and ranked near the bottom of all diagnoses in terms of relative direct costs. This difference is not surprising, however. It is attributable to the high prevalence of mental disorder among the institutionalized population, which was included in the Rice et al. study but not in NMCUES. Injuries and poisonings, which ranked second in the NMCUES study, were ranked fourth by Rice et al. Again, this disparity is a result of the exclusion of expenditures for dental care and for the institutionalized population in the NMCUES calculations. If these costs were excluded in the Rice et al. data, diseases of the circulatory system and injuries and poisonings would rank first and second in both studies. Conversely, if these costs were included in the NMCUES data, diseases of the circulatory system and digestive system would rank first and second in both studies.

Age and diagnostic category—The rank ordering of the five most costly diagnoses from NMCUES for each of four different age categories is illustrated in Figure 8. The top five diagnostic categories accounted

Figure 7

Direct costs for all persons, by diagnostic category: United States, 1980



[1]Includes complications of pregnancy, childbirth, and puerperium, and certain conditions originating in the perinatal period.

NOTE: Percents are based on total direct costs of $75.2 billion.

SOURCE: Rice, D. P., Hodgson, T. A., and Kopstein, A. N.: The economic costs of illness: A replication and update. *Health Care Financing Review.* 7(1):61-80, Fall, 1985.

for more than one-half of the charges for each age category. The percent of total charges attributable to the five most costly diagnoses was highest for persons 65 years of age and over (65.2 percent) and lowest for persons 17–44 years of age (52.0 percent). Diseases of the respiratory system constituted the highest cost diagnostic category for the youngest people (under 17 years of age), comprising 17.7 percent of their total charges. For persons 17–44 years of age, however, it is injury and poisoning that constituted the highest direct cost category ($9.0 billion), accounting for 18.7 percent of their total charges. Diseases of the circulatory system accounted for the largest percent of charges for the two oldest age categories. In the category 45–64 years of age, diseases of the circulatory system accounted for 18.8 percent of charges, and in the category 65 years of age and over, these diseases comprised 27.6 percent of total charges.

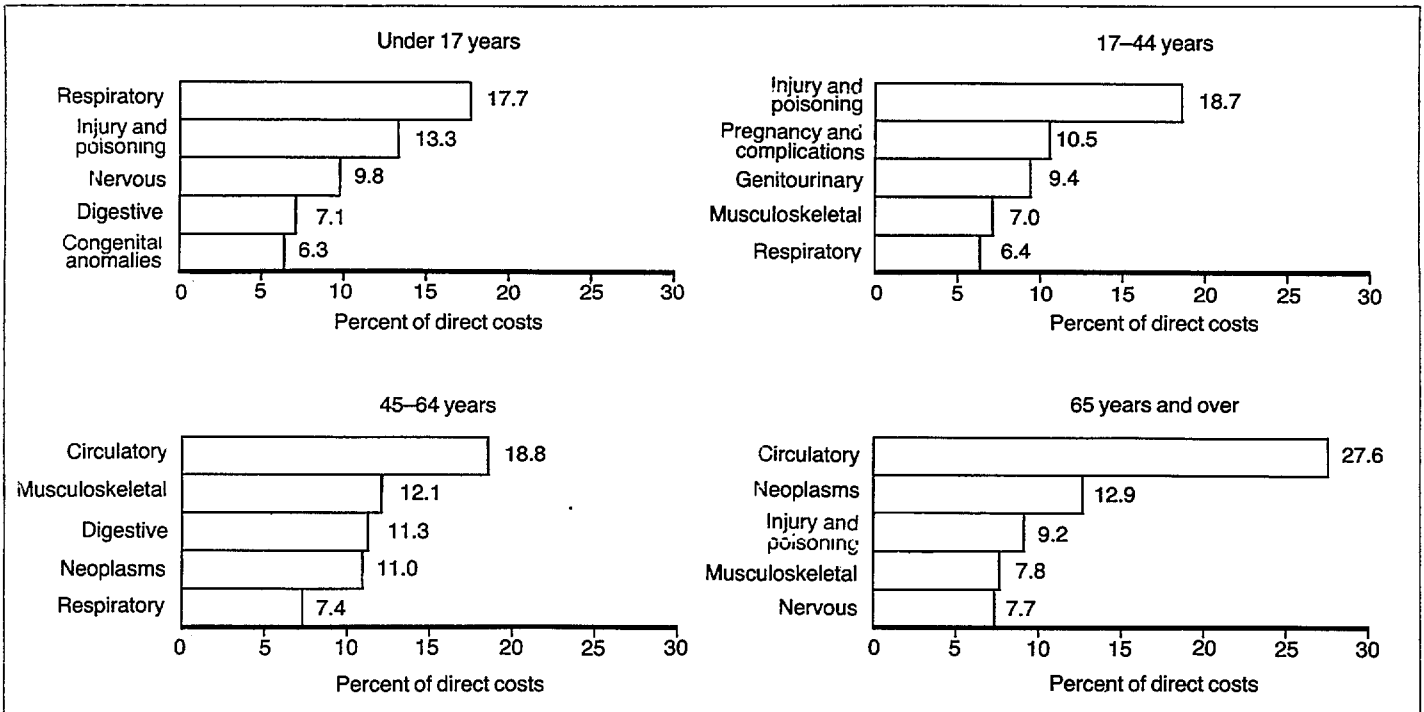
The pervasive impact of respiratory conditions, injuries and poisonings, and musculoskeletal conditions, each of which appeared as one of the five most costly diagnoses in three of the four age categories, is interesting. Also notable are the shift from acute to chronic conditions as age increases, the prominence of pregnancy and its complications during the childbearing years, and the high toll of trauma as represented by injuries and poisonings. It is particularly noteworthy that trauma is not limited to the younger age categories. Indeed, injuries and poisonings ranked third in terms of direct medical cost for the elderly, just below diseases of the circulatory system and neoplasms.

Sex and diagnostic category—As indicated previously, females as a group generate more direct health care costs than males do. However, of the top five diagnostic categories ranked by direct costs, which accounted for 59.2 percent of direct costs for males and 47.2 percent for females, four were the same for both sexes: diseases of the circulatory system, injury and poisoning, diseases of the musculoskeletal system and connective tissue, and neoplasms (Figure 9). The diagnostic categories were also ranked identically except for the third condition group. (Diseases of the genitourinary system accounted for 9.1 percent of total charges for females, and diseases of the respiratory system accounted for 10.1 percent of health care charges for males.) Each of the four diagnostic categories that appear on both the male and female lists accounted for a higher percent of total charges for males than for females. Combined, they represent a higher proportion of direct costs for males (49.1 percent) than for females (38.1 percent).

Race and diagnostic category—Examination of total charges by diagnostic category and race shows that the two most costly diagnostic categories were identical for black persons and for white and other persons, as illustrated in Figure 10. Diseases of the circulatory system and injury and poisoning together accounted for at least one-fourth of charges for each racial category. Diseases of the musculoskeletal system and connective tissue accounted for over 8 percent of charges for both racial classifications, but this diagnostic category ranked third for the white and other population and fifth for the

Figure 8

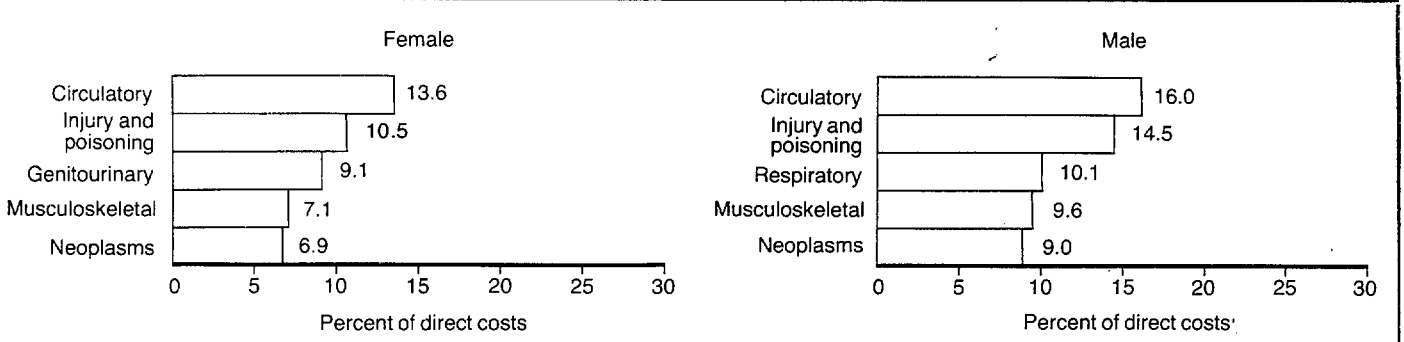
Direct costs for all persons, by age and diagnostic category: United States, 1980



NOTE: Totals exclude direct costs for dental services. Percents for persons under 17 years of age are based on $14.5 billion; for persons 17–44 years of age, $48.1 billion; for persons 45–64 years of age, $35.7 billion; and for persons 65 years of age and over, $37.9 billion. Code numbers are listed in Appendix V, Table VIII.

Figure 9

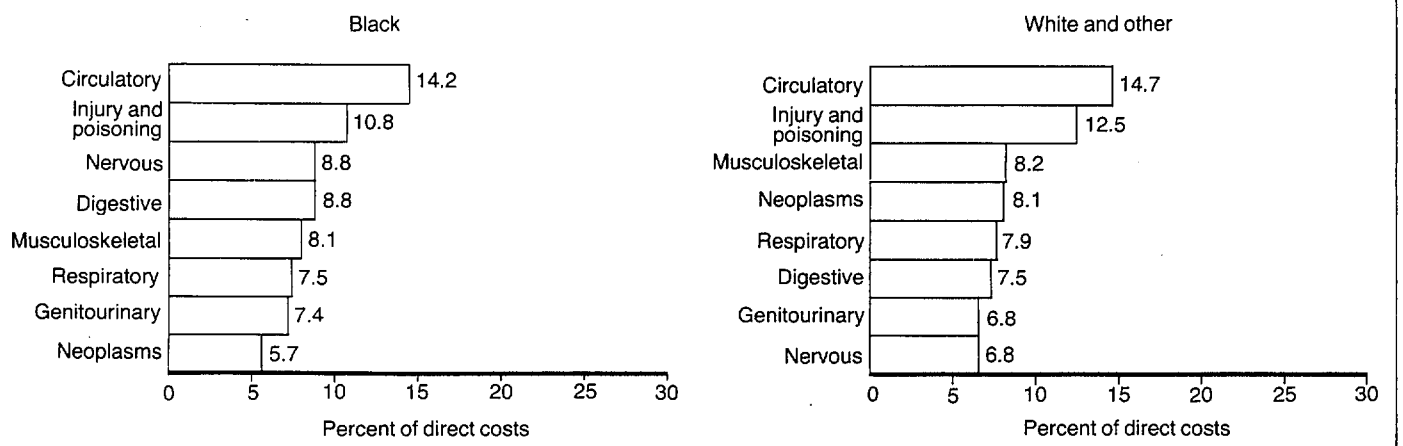
Direct costs for all persons, by sex and diagnostic category: United States, 1980



NOTE: Totals exclude direct costs for dental services. Percents for females are based on $76.6 billion; for males, $59.6 billion. Code numbers are listed in Appendix V, Table VIII.

Figure 10

Direct costs for all persons, by race and diagnostic category: United States, 1980



NOTE: Totals exclude direct costs for dental services. Percents for black persons are based on $13.8 billion; for white persons and persons of other races, $122.4 billion. Code numbers are listed in Appendix V, Table VIII.

black population. Neoplasms and diseases of the respiratory system were fourth and fifth for white and other persons, each accounting for approximately 8 percent of charges. Diseases of the nervous system and digestive system each amounted to 8.8 percent of health care charges for the black population and were ranked third and fourth, respectively. Examination of the top eight diagnostic categories for each racial category suggests that no great differences exist in the rankings or relative distributions of charges for health services among black persons compared with white and other persons.

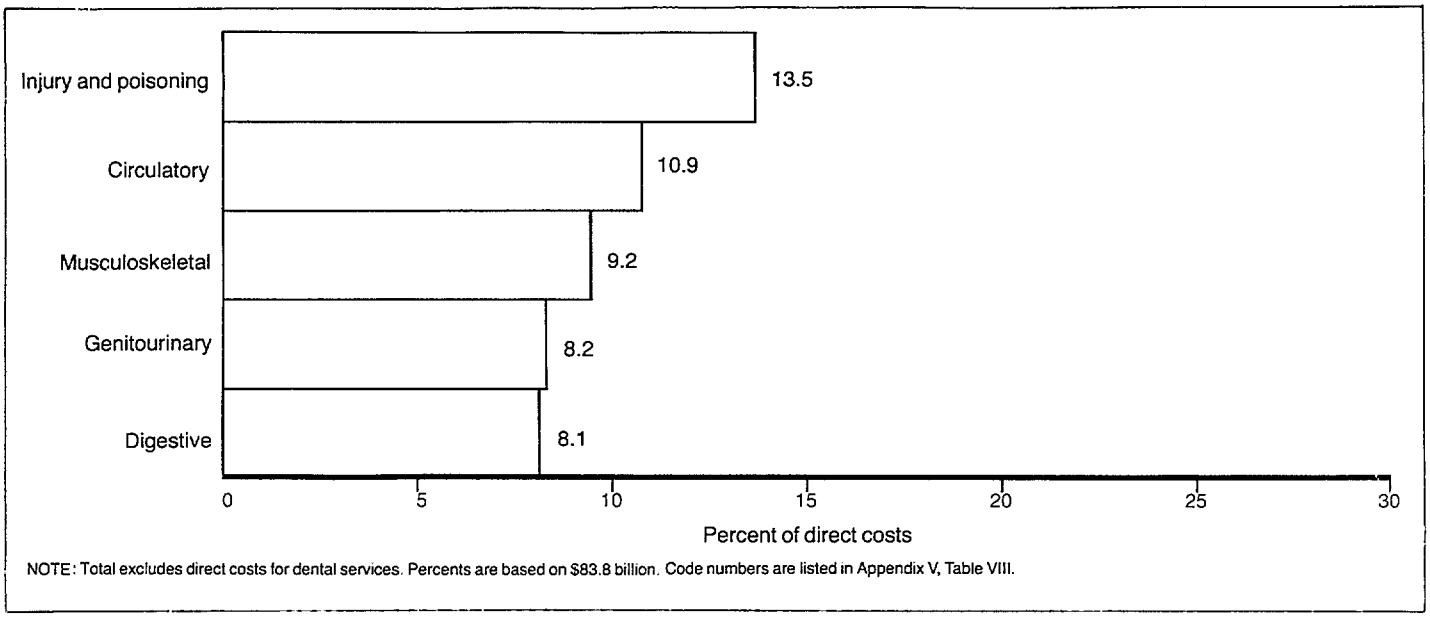
Diagnostic categories for the working-age population—Direct costs for the working-age population (17–64 years of age), when calculated by diagnostic category, amounted to $83.8 billion (Table 7) and accounted for 61.5 percent of total charges. Injuries and poisonings were the most costly conditions for the working-age population ($11.3 billion), with circulatory conditions and musculoskeletal problems being the next most costly ($9.1 billion and $7.7 billion, respectively). The rank order by diagnostic category is illustrated in Figure 11.

Direct costs for diagnostic categories by employment status within the working-age population are shown in Figure 12. Full-time, full-year workers and full-time, part-year workers are similar in that the same five diagnostic categories ranked as the major sources of charges. Although the rank ordering of these conditions differed between the two employment categories, the only substantial difference is that injuries and poisonings accounted for a much greater proportion of direct costs in the full-time, part-year category. Perhaps accidents and injuries caused many of these individuals to leave the work force.

The leading categories of charges for part-time workers were pregnancy and its complications and genitourinary problems. Full-year, part-time employees are more likely to be female (Table 5), and this finding may indicate that childbirth and child care are the reasons

Figure 11

Direct costs for the working-age population, by diagnostic category: United States, 1980



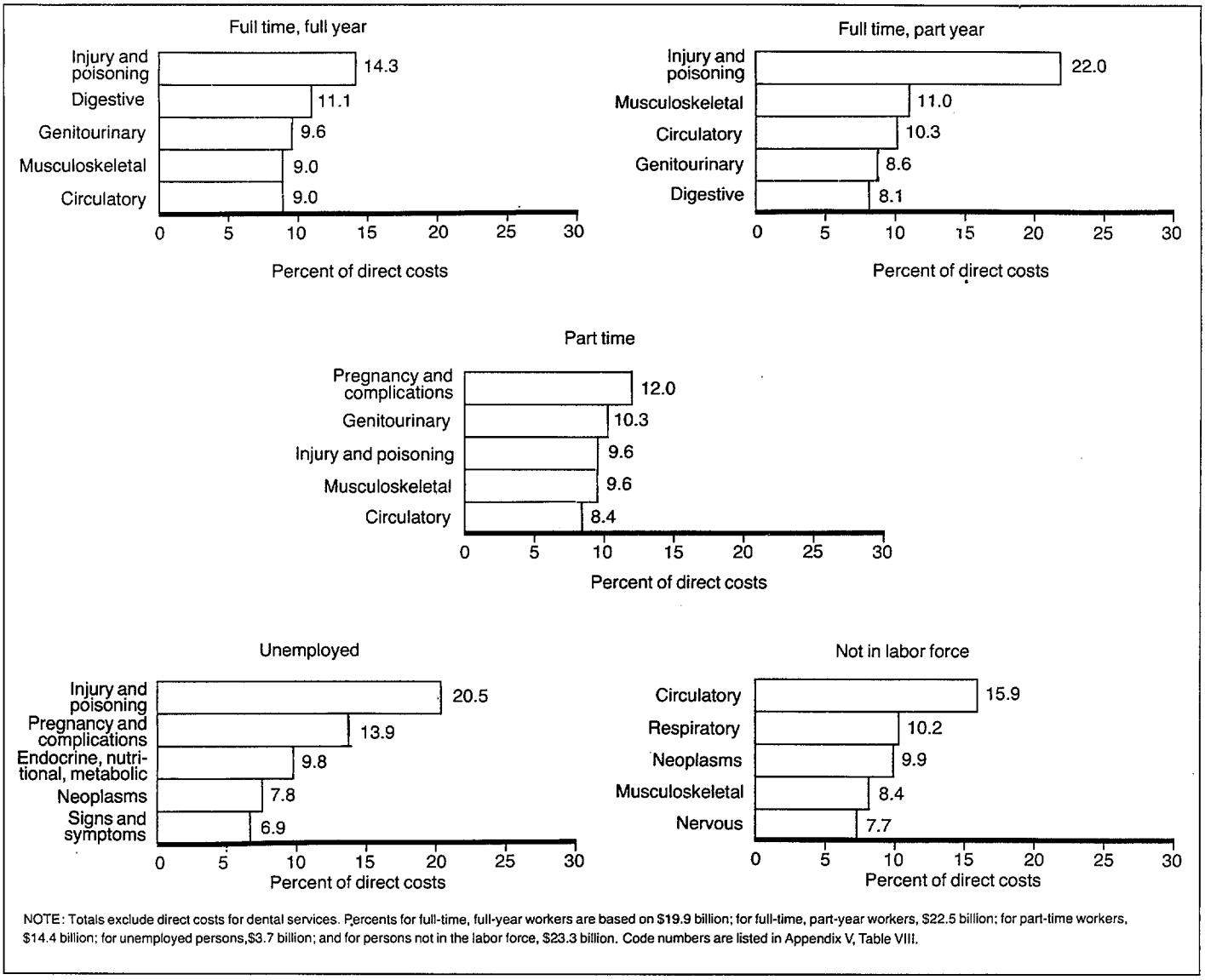
NOTE: Total excludes direct costs for dental services. Percents are based on $83.8 billion. Code numbers are listed in Appendix V, Table VIII.

for part-time employment for many of these individuals. Unemployed individuals incurred a high proportion of charges for injuries and poisonings (20.5 percent) and for pregnancy and its complications (13.9 percent).

Not surprisingly, a high percent of direct health care costs for persons of working age who were not in the labor force was accounted for by chronic conditions, including circulatory problems (15.9 percent) and neoplasms (9.9 percent), and by musculoskeletal problems (8.4 percent), which represent a combination of chronic and acute disabilities. The presence of chronic problems helps to explain why these individuals, who comprised 16.3 percent of the working-age population (Table 5), were out of the work force. It also helps explain why, as a group, they incurred a disproportionate share of the population's health care charges—27.8 percent of total charges (Table 7).

Figure 12

Direct costs for the working-age population, by employment and diagnostic category: United States, 1980



NOTE: Totals exclude direct costs for dental services. Percents for full-time, full-year workers are based on $19.9 billion; for full-time, part-year workers, $22.5 billion; for part-time workers, $14.4 billion; for unemployed persons, $3.7 billion; and for persons not in the labor force, $23.3 billion. Code numbers are listed in Appendix V, Table VIII.

Indirect Costs

The indirect cost of illness and injury is the loss of resources resulting from them. Resource loss is generally calculated as lost productive capacity: the loss of potential economic output because of morbidity and mortality. Indirect costs are usually estimated on the basis of the amount of time by which the individual's productivity is diminished or lost and the monetary value of that lost productive time.

Reports of indirect costs of morbidity or mortality by diagnostic category are not included in this report because of limitations of the NMCUES public use data files. When individuals suffer from multiple conditions and more than one of the conditions is associated with work-loss days, bed-disability days, or restricted-activity days, no primary diagnosis is assigned to those days. Further, all days of disability are assigned to each condition associated with the loss. Thus, each day may be listed several times (once for each associated condition), thereby overstating work loss. Therefore, morbidity costs by diagnosis were not calculated. Indirect costs of mortality by diagnostic category were not calculated because the NMCUES public use data files do not contain information on cause of death.

Methods

Morbidity costs—To quantify the indirect costs of morbidity, it is necessary to estimate productive time lost because of illness or injury. The unit for such calculations is productive person years. Productive years lost, a nonmonetary measure of morbidity costs, is defined as the number of productive days lost because of illness in a year divided by the number of productive days in a year. For this report, lost productive time is calculated for all employed persons, homemakers, and persons unable to work for health reasons.

Persons who were employed at any time in 1980 are classified in the NMCUES data files as employed. Homemakers are defined as persons who were not employed or disabled in 1980 and who claimed "keeping house" as their primary activity in 1979. The unable-to-work category comprises all persons, including homemakers, who were retired or disabled for health reasons for the whole year. Specific definitions of these employment categories are included in Appendixes V and VI. For employed persons, reported work-loss days are divided by 245, the average number of workdays in a year, to determine productive time lost.

In this study, calculations of lost output for homemakers were performed for both bed-disability days and restricted-activity days because the former underestimates and the latter overestimates lost productivity. The appropriate denominator to annualize days lost for either of these calculations is 365 because homemakers can perform their work every day of the year. By performing both sets of calculations, a range of lost productivity with upper and lower bounds can be constructed for homemakers. Estimates in this report are based on the more restrictive unit of measure, bed-disability days. Alternative estimates based on restricted-activity days, which are somewhat higher estimates of lost productivity, are presented in the detailed tables. Measures of lost productive time for employed individuals and homemakers have been weighted and aggregated to produce national estimates of productive person years lost for these two population groups.

Estimates of productive losses for persons unable to work during 1980 are based on the assumption that not all of these individuals would work or keep house, even if they were able to do so (Cooper and Rice, 1976). It is assumed that even if these individuals were able to work, some would be unemployed, some would be retired, and some would be students. It is further assumed that these individuals would be distributed across the various employment categories in a manner that reflects the distribution of employment in the general population in 1980. Therefore, persons classified as unable to work are assigned employment status and lost productive time through a process in which the differential weighting of cases based on the NMCUES sampling design is taken into account. This process is discussed at length in Appendix V.

Estimates of the indirect costs of morbidity in 1980 are calculated by multiplying an individual's reported work-loss time by his or her reported earnings, when available. Reported earnings do not include employee benefits, so earnings are adjusted by a factor of 1.172 to account for the additional value represented by fringe benefits. The adjustment factor is based on the mean percent of earnings represented by employee benefits (17.2 percent) in 1980 (*Survey of Current Business,*

1981). Lost earnings for employed persons whose earnings were not reported are estimated using U.S. Department of Labor 1980 data for mean annual earnings and are specific to the individual's age, sex, race, and employment status (full or part time). Again, figures are adjusted to include the value of employee benefits. Lost productivity for homemakers, whose labor is not reimbursed, is estimated using the market-value approach. The value of lost homemaker services is approximated by estimating the cost of replacing those services with services purchased in the market. The values employed are derived from time-use studies and relevant wage rates (Hodgson and Rice, 1984; Walker and Gauger, 1973). Details of the estimation procedures are presented in Appendix V, along with tables of values used to estimate these costs.

Persons who were unable to work or to keep house because of ill health for all of 1980 are also included in the calculation of indirect costs. The construction of the NMCUES data files does not readily permit delineation of part-year disability, so the categorical definition of the population unable to work does not include respondents who were disabled for only a portion of the year. These individuals are included in the employed category. Thus, only persons prevented by health problems from working or keeping house for the entire year are included in the unable-to-work category. Estimation of the monetary value of lost productivity for this category is accomplished by assigning appropriate monetary losses to composite persons that are constructed to reflect the distribution of the 1980 population across various employment categories. These estimates are derived from the same sources used for employed persons with unreported earnings and for homemakers, as discussed briefly earlier and in detail in Appendix V.

In previous analyses of the indirect costs of illness, specifications of the unable-to-work population differed from those used for this report. Some types of disabled persons were included in this report but not in previous analyses. Disabled homemakers are one such group. It is believed that including the value of output lost by disabled homemakers and other previously excluded persons unable to work for health reasons in the calculation of indirect costs leads to a more accurate estimation of the total costs of illness. As a result, the unable-to-work population is larger, and the indirect costs associated with this category are higher, than previous estimates have suggested.

Single-year mortality costs—Estimates of mortality costs incurred in 1980 (i.e., single-year mortality costs) are calculated for persons 17 years of age and over who were employed, keeping house, or unable to work for health reasons and for persons under 17 years of age who died during 1980. Lost work time or housekeeping time is calculated from the date of death through December 31, 1980. It is multiplied by either reported or estimated monetary values for the individual's usual activity to yield estimates of the value of lost productivity during the year. Both reported and estimated earnings of employed persons are adjusted to include fringe benefits, but this is not done for homemakers. Estimates of losses resulting from the death of individuals in the unable-to-work category are calculated in a similar fashion.

Because earnings data for persons under 17 years of age are not available on the NMCUES public use data files, estimated earnings for persons in that age cohort for 1980 are used for the portion of the year following the respondent's death. Employee benefits are taken into account in the calculations used for this category, so no further adjustment is made (Hodgson and Rice, 1984).

Total mortality cost—When estimating the total economic costs of premature mortality, a lifetime perspective is taken. The total economic cost of mortality is the present value of lifetime earnings lost because of premature mortality. The unit of measure used to calculate such losses is the productive year lost, a nonmonetary measure of costs associated with premature mortality. Years of life lost are determined by comparing an individual's age at death with the sex- and race-specific life expectancy for persons of that age in 1980 (National Center for Health Statistics, 1984). Total productive years lost are measured by summing the weighted number of years lost for all persons who died in 1980.

Imputed values for lost lifetime earnings are based on the assumption that a person who dies represents a loss of productivity to society that equals the remainder of his or her expected stream of earnings. Annual earnings are averaged for each age and sex category and therefore do not reflect any individual's actual earning potential.

To compute the present value of future productivity losses resulting from premature death, it is necessary to discount future earnings. Discounting reflects the economic concept that, at a given time, future earnings are valued less than current earnings are. To place an appropriate value on future earnings lost because of premature death, lost lifetime earnings are converted to their present value by discounting them, ideally at a rate that reflects either social time preference or the expected social productivity rate. Historically, various discount rates have been employed to make this conversion. Calculations for this report employ 6- and 10-percent discount rates. However, an annual productivity increase of 2 percent has already been built into the future earnings figures that have been employed. Therefore, this is equivalent to applying 4- and 8-percent discount rates to earnings that have not been adjusted for changes in productivity (Hodgson and Rice, 1984).

There is no simple, generally accepted discount rate or productivity increment to apply in these calculations. For example, the 2-percent productivity adjustment reflects practices that generally have been used for many years. However, more recent productivity data over the past three decades indicate annual productivity increases

on the order of only 0.9 percent. An analogous situation exists with respect to variations in the discount rate. By employing various discount rates, however, it is possible to estimate ranges for the present value of future earnings losses to show the effects of various assumptions about the appropriate rate of discount. In this discussion, estimates of lifetime losses are discounted by 6 percent. Alternative estimates, discounted by 10 percent, are presented in the detailed tables.

Estimated future earnings are not adjusted for estimated future consumption expenditures because the objective of this study is to estimate the cost of illness to society. Economists generally agree that it is not merely the individual's *net* contribution to society (net productivity, or the productive contribution of an individual in excess of his or her own consumption) that is valued. Rather, the premature loss of the individual is itself a loss to society (gross productive contribution). Hence, individual consumption is not deducted (Mishan, 1971; Warner and Luce, 1982).

Findings

This section is divided into four subsections. First, the indirect costs of morbidity in 1980 are discussed, both in terms of productive years lost because of sickness and injury and the monetary value ascribed to them. Next, economic losses associated with mortality for the single year 1980 are discussed, together with morbidity costs for that year and total direct costs, to arrive at a total cost estimate using the single-year perspective. The value of lifetime losses from mortality is then added to morbidity costs incurred in 1980 to generate a total indirect cost estimate. This value is added to the direct costs of illness for 1980 to arrive at the total costs of illness for 1980. There is no single best method of estimating total costs that is consensually accepted, so several different estimates are generated by varying certain critical assumptions in the calculation.

Morbidity costs—In estimating the indirect costs of morbidity for 1980, the number of years of productive activity lost by individuals because of illness or injury is first calculated. Because this is a measure of lost productivity, the convention is to count only persons 17 years of age and over who were working or keeping house at the time of their illness or injury or who were unable to engage in these activities because of illness or injury. Individuals who were not in the work force (students, retirees, and so forth) are not part of the population "at risk" in these calculations.

The 144.5 million people in the relevant population accounted for 8.0 million productive person years lost because of illness in 1980. A disproportionate share of these lost productive years is accounted for by people in the unable-to-work category, as shown in Table L. These individuals, all of whom were disabled by illness for the entire year, accounted for 66.7 percent of the lost productive years but for only 5.5 percent of the population at risk. The major subset of the population, employed persons, represented nearly 80 percent of the population but less than 30 percent of the losses. Homemakers accounted for only a small percent of lost productive time (4.2 percent), but it should be noted that homemakers who were unable to work for all of 1980 were included in the unable-to-work category (Tables 8 and 9).

There is some uncertainty about how to assess lost productive time for homemakers. Work-loss days are not available for this category, and it is not clear whether lost time should be defined as restricted-activity days or bed-disability days. Estimates of the monetary value of lost productive time using both measures are presented in Table M. The total cost of morbidity for the population at risk ranges from $104.9 billion using the more conservative bed-disability measure to $109.1 billion using restricted-activity days. All of the difference occurs among homemakers, whose morbidity costs range from a low of $2.4 billion to a high of $6.7 billion depending on which of the two measures is used. Persons unable to work accounted for $67.3 billion in morbidity costs, over 60 percent of total morbidity costs using either measure for homemakers (Table 10).

The distribution of morbidity costs by employment status shows that, except among the youngest members of the population at risk (17–44 years of age), the

Table L

Percent distributions of population and of lost productivity as a result of morbidity and productive person years lost for persons 17 years of age and over in potential work force by employment: United States, 1980

Employment	Number of persons in thousands	Percent of population	Productive person years lost in thousands	Percent of lost productivity
Total	144,515	100.0	7,996	100.0
Employed	115,520	79.9	2,328	29.1
Homemaker	21,110	14.6	[1]332	4.2
Unable to work	7,885	5.5	5,337	66.7

[1]Calculated using bed-disability days as the measure of lost productivity.

NOTE: Employed refers to those persons employed at any time during 1980; homemakers refers to those who did not work for all of 1980, but were not disabled, and claimed homemaking as their major activity in 1979; unable to work refers to those who did not work at all in 1980 for health reasons, including disabled homemakers.

Table M

Estimated value and percent distribution of lost productivity as a result of morbidity by employment — comparison of use of bed-disability days and restricted-activity days as the measure of lost productivity for homemakers: United States, 1980

Employment	Bed-disability days	Restricted-activity days
	Amount in millions	
Total	$104,860	$109,127
Employed	35,139	35,139
Homemaker	2,430	6,697
Unable to work	67,290	67,290
	Percent distribution	
Total	100.0	100.0
Employed	33.5	32.2
Homemaker	2.3	6.1
Unable to work	64.2	61.7

NOTE: Employed refers to those persons employed at any time during 1980; homemakers refers to those who did not work for all of 1980, but were not disabled, and claimed homemaking as their major activity in 1979; unable to work refers to those who did not work at all in 1980 for health reasons, including disabled homemakers.

unable-to-work category accounts for an extremely high percent of morbidity costs during the year (Table N). This is particularly striking for people in families whose head had little education and for those in the lowest economic categories, defined either as family income less than $15,000 or below 200 percent of the poverty level. In all of these cases, persons unable to work account for nearly three-fourths, and often substantially more, of the total morbidity costs for the relevant category. There is a clear relationship between the inability to work and having a low family income or being near the poverty level, as shown in Table N. However, it is also evident that a high percent of morbidity costs are incurred by people unable to work whose family heads had little education. This is probably an indication that this category comprises a high proportion of elderly people (Table 8). For the youngest category (17–44 years of age), the best educated category, and the high family income category, the majority of indirect morbidity costs (62-72 percent) are incurred by employed persons, and

Table N

Percent distribution of estimated value of lost productivity as a result of morbidity by employment, according to selected characteristics: United States, 1980

Characteristic	Total	Employed	Homemaker[1]	Unable to work
Total	100.0	33.5	2.3	64.2
Age				
17–44 years	100.0	62.4	3.2	34.4
45–64 years	100.0	18.7	1.2	80.1
65 years and over	100.0	10.9	9.2	79.9
Sex				
Male	100.0	36.4	†0.1	63.5
Female	100.0	29.2	5.7	65.1
Race				
Black	100.0	24.3	2.9	72.7
White and other	100.0	35.1	2.2	62.7
Education of head of family				
None and elementary	100.0	12.7	2.1	85.2
Some high school	100.0	26.3	2.5	71.1
High school graduate	100.0	39.9	2.2	57.9
Some college	100.0	54.3	2.5	†43.1
College graduate	100.0	69.1	2.7	†28.2
Poverty status				
Below poverty level	100.0	5.3	3.2	91.5
Poverty level to 199 percent poverty level	100.0	20.1	2.3	77.6
200–499 percent poverty level	100.0	40.6	2.2	57.2
500–699 percent poverty level	100.0	71.2	1.9	‡26.9
700 percent poverty level or more	100.0	72.4	1.0	‡26.7
Family income				
Less than $5,000	100.0	4.4	3.1	92.5
$5,000–$14,999	100.0	24.3	2.5	87.7
$15,000–$34,999	100.0	42.7	2.3	54.9
$35,000 or more	100.0	67.3	1.7	†31.0

[1]Calculated using bed-disability days as the measure of lost productivity.

NOTE: Employed refers to those persons employed at any time during 1980; homemakers refers to those who did not work for all of 1980, but were not disabled, and claimed homemaking as their major activity in 1979; unable to work refers to those who did not work at all in 1980 for health reasons, including disabled homemakers.

one-third or less of the costs are borne by those unable to work.

The economic costs of morbidity incurred by various subsets of the population are presented in Table O. The 144.5 million people in the population at risk generated total morbidity costs of $104.9 billion. People 45–64 years of age, comprising 28.4 percent of this population, accounted for 60.1 percent of these losses. Individuals in the youngest age category (17–44 years of age) and those in the oldest age category (65 years of age and over) each accounted for a smaller share of morbidity costs than of the population. It is evident from Table O that males and black persons accounted for a disproportionate share of morbidity costs.

The results consistently indicate that persons at lower socioeconomic levels, whether measured by educational level of the family head, family income, or poverty status, account for a disproportionate share of morbidity costs relative to their share of population (Table P). Individuals in families with higher incomes account for a relatively smaller percent of morbidity costs, even though their earnings are higher. Clearly, the higher economic categories and better educated population have fewer lost productive days because of illness.

Total cost of illness using single-year mortality costs—Although most estimates of indirect costs include mortality losses projected into the future, there is interest in single-year figures, which present mortality losses within the same time frame as morbidity losses. The total costs of illness incurred in 1980, measured by aggregating direct costs, indirect morbidity costs, and indirect mortality costs *incurred only in 1980*, are presented in Table Q.

Using this single-year approach, the total cost of illness for the civilian noninstitutionalized population in 1980 is calculated as $260.8 billion. Of this, $153.9 billion, or 59 percent, were direct costs and $106.9 billion, or 41 percent, were indirect costs. Morbidity costs accounted for 40.2 percent of total costs, and single-year mortality costs accounted for less than 1 percent (Table 11). (The number of deaths that occurred in 1980 listed by demographic characteristics is presented in Table 12.)

Data on the direct and indirect costs of illness for various subcategories of the population clearly show that persons 45–64 years of age accounted for the highest magnitude of costs, nearly 40 percent of the total (Table Q). The major portion of the losses for this age category are indirect morbidity costs, which were fully 1½ times greater than direct costs. Mortality losses for this age category, although minimal in comparison with direct costs and morbidity costs, are much greater than mortality costs for the other age categories. It should be recalled that individuals 65 years of age and over who were retired or otherwise not in the work force (but not because of ill health) are not included in this population.

Although the direct costs of illness are higher for females than for males, the indirect costs of morbidity and mortality for males far exceed those for females. However, the difference between single-year mortality costs for males and those for females is not statistically

Table O

Estimated value and percent distribution of lost productivity as a result of morbidity for persons 17 years of age and over in potential work force and percent distribution of population by age, sex, and race: United States, 1980

Age, sex, and race	Estimated value in millions[1]	Percent of estimated value[1]	Percent of population
Total	$104,860	100.0	100.0
Age			
17–44 years	36,530	34.8	62.0
45-64 years	63,044	60.1	28.4
65 years and over	5,286	5.0	9.5
Sex			
Male	63,307	60.4	46.8
Female	41,553	39.6	53.2
Race			
Black	15,585	14.9	10.2
White and other	89,275	85.1	89.8

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.

Table P

Estimated value and percent distribution of lost productivity as a result of morbidity for persons 17 years of age and over in potential work force and percent distribution of population by education of head of family, poverty status, and family income: United States, 1980

Characteristic	Estimated value in millions[1]	Percent of estimated value[1]	Percent of total population
Total	$104,860	100.0	100.0
Education of head of family			
None and elementary	29,739	28.4	16.6
Some high school	21,869	20.9	15.4
High school graduate	32,361	30.9	34.8
Some college	11,849	11.3	15.8
College graduate	9,043	8.6	17.3
Poverty status			
Below poverty level	18,460	17.6	8.1
Poverty level to 199 percent poverty level	25,600	24.4	17.9
200–499 percent poverty level	46,779	44.6	53.0
500–699 percent poverty level	8,624	8.2	13.2
700 percent poverty level or more	5,398	3.8	7.6
Family income			
Less than $5,000	16,039	15.3	6.6
$5,000–$14,999	29,877	28.5	24.9
$15,000–$34,999	38,944	37.1	45.9
$35,000 or more	15,661	14.9	22.3

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.

Table Q

Direct and indirect costs of morbidity and single-year mortality costs by selected characteristics: United States, 1980

Characteristic	Total costs	Direct costs	Indirect costs	
			Morbidity[1]	Single-year mortality[2]
	Amount in millions			
Total	$260,773	$153,878	$104,860	$2,034
Age				
Under 17 years	18,904	18,875	...	‡29
17–44 years	92,810	56,118	36,530	‡162
45–64 years	104,284	39,721	63,044	†1,518
65 years and over	44,775	39,164	5,286	326
Sex				
Male	132,131	67,648	63,307	1,176
Female	128,642	86,230	41,553	859
Race				
Black	30,849	14,922	15,585	‡342
White and other	229,924	138,956	89,275	1,692
Education of head of family				
None and elementary	62,264	31,880	29,739	†645
Some high school	46,534	24,473	21,869	‡193
High school graduate	83,800	50,514	32,361	†926
Some college	34,387	22,423	11,849	‡116
College graduate	33,787	24,589	9,043	‡155
Poverty status				
Below poverty level	35,106	17,089	18,460	‡260
Poverty level to 199 percent poverty level	60,106	34,151	25,600	†356
200–499 percent poverty level	121,763	74,092	46,779	892
500–699 percent poverty level	25,360	16,403	80,624	‡333
700 percent poverty level or more	17,734	12,143	5,398	‡193
Family income				
Less than $5,000	32,393	16,171	16,039	‡183
$5,000–$14,999	81,522	46,538	34,217	†767
$15,000–$34,999	99,888	60,446	38,944	†499
$35,000 or more	46,970	30,724	15,661	‡586

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.
[2]Estimates are based on a total of 121 deaths in the sample population.

significant. White and other persons accounted for 88.2 percent of total costs and for a similar percent of all components of direct and indirect costs. Black persons accounted for a smaller percent of direct costs (9.7 percent) than their population share (11.7 percent), but they accounted for a disproportionately high share of mortality costs (16.8 percent) and morbidity costs (14.9 percent). Persons in families whose head graduated from high school, the modal population category in terms of education (Table 8), also accounted for the largest losses in all cost categories—total, direct and indirect. In comparison with their proportion of the population, people in families whose head had an elementary school education or none generated a disproportionate burden of total costs, especially in terms of mortality losses. In contrast, morbidity and mortality costs for those in the two highest educational levels were relatively low.

The distribution of costs by the economic status of the individual is also skewed. The subcategories with the largest number of people—those in families at 200–499 percent of poverty level and those in the $15,000–$34,999 family income category—generated the highest costs. However, in comparison with their share of population (Table 8) the categories at the lowest economic status (using either poverty level or income) bore a disproportionate share of the burden of indirect costs, especially morbidity losses. Higher economic categories bore a disproportionately high share of the mortality costs; this is especially evident in the category earning $35,000 or more (Table 11).

Lifetime losses from mortality—For these estimates, mortality losses are conceptualized as continuing until the age that the deceased person would have been expected to attain, based on age-, sex-, and race-specific life-expectancy tables. This method leads to a greatly magnified economic impact of mortality.

It is interesting to note the effects of using a higher or a lower discount rate on the total cost estimates and

on the distribution of costs across different subcategories of the population. Overall, using the higher discount rate (10 percent), which implies that future earnings are less highly valued in the present, produces an estimate of the total value of lost productivity from mortality that is 28.1 percent lower than the estimate obtained using the 6-percent discount rate. However, the 10-percent rate has its biggest impact on earnings expected farther into the future, so the higher rate has the most dramatic effect on the costs of mortality in the younger age categories. The 10-percent rate leads to an estimate that is 64.1 percent lower than the 6-percent rate for those under 17 years of age and 34.0 percent less for those 17–44 years of age (Table 12).

Lifetime losses from mortality for the working-age population are presented in Table 13. Employed individuals, who accounted for 58.8 percent of the deaths in this population, accounted for 63.8 percent of the losses in productive time, 68.1 percent of the monetary losses discounted at 6 percent, and 66.3 percent of the losses discounted at 10 percent. Lost productive years for homemakers were approximately proportionate to their share of deaths (22.3 percent); however, the share of monetary losses from mortality incurred by this category was somewhat lower (19.0 percent). For the unable-to-work category, losses attributed to deaths represented a smaller share of the total in each category than was true for actual deaths. Children under 17 years of age, those not in the work force (but able to work), and many retirees were not included in the population used in these calculations.

Total cost of illness using lifetime mortality losses—The present value of expected lifetime losses from mortality, based on a 6-percent discount rate, is added to single-year morbidity costs and direct costs to estimate the 1980 present value of direct and indirect costs of morbidity and mortality, the total cost of illness in 1980, as shown in Tables R and 14. Other estimates of the

Table R

Present value of direct and indirect costs of morbidity and mortality discounted at 6 percent, by selected characteristics: United States, 1980

Characteristic	Total costs[1]	Direct costs	Indirect costs	
			Morbidity[1]	Mortality[2]
	Amount in millions			
Total	$381,758	$153,878	$104,860	$123,019
Age				
Under 17 years	27,904	18,875	...	9,029
17–44 years	146,269	56,118	36,530	53,620
45–64 years	153,684	39,721	63,044	50,918
65 years and over	53,901	39,164	5,286	9,451
Sex				
Male	200,733	67,648	63,307	69,778
Female	181,024	86,230	41,553	53,241
Race				
Black	61,916	14,922	15,585	31,409
White and other	319,841	138,956	89,275	91,610
Education of head of family				
None and elementary	84,959	31,880	29,739	23,340
Some high school	74,835	24,473	21,869	28,493
High school graduate	129,745	50,514	32,361	46,871
Some college	38,429	22,423	11,849	4,158
College graduate	53,790	24,589	9,043	20,158
Poverty status				
Below poverty level	61,429	17,089	18,460	25,880
Poverty level to 199 percent poverty level	80,665	34,151	25,600	20,915
200–499 percent poverty level	167,338	74,092	46,779	46,467
500–699 percent poverty level	45,307	16,403	8,624	20,280
700 percent poverty level or more	27,019	12,143	5,398	9,478
Family income				
Less than $5,000	44,919	16,171	16,039	12,709
$5,000–$14,999	120,866	46,538	34,217	40,112
$15,000–$34,999	148,263	60,446	38,944	48,874
$35,000 or more	67,709	30,724	15,661	21,324

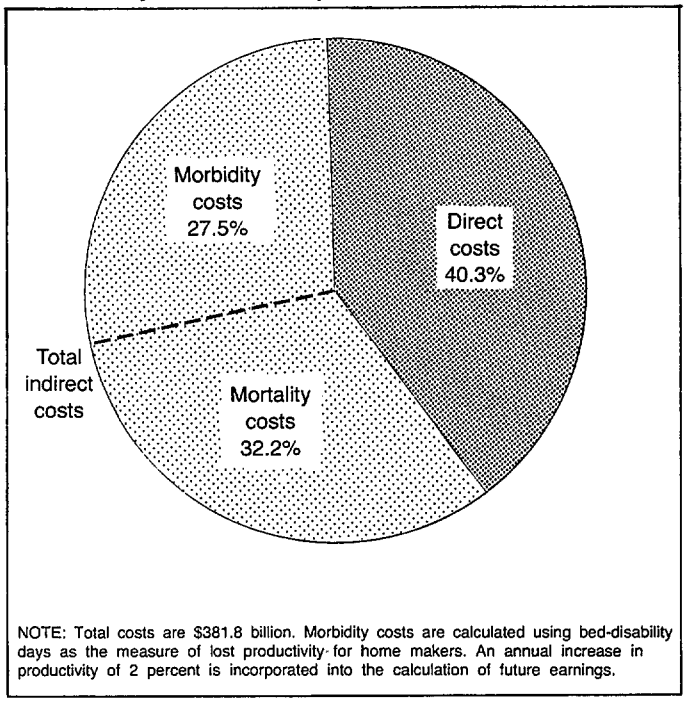
[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.
[2]Present value discounted at 6 percent. An annual increase in productivity of 2 percent is incorporated into the calculation of future earnings. Estimates are based on a total of 121 deaths in the sample population.

costs of illness, using the 6-percent discount rate and restricted-activity days as the measure of lost productivity for homemakers and using the 10-percent discount rate and each of the two measures of lost output for homemakers, are presented in Tables 14 and 15.

The total cost of illness in 1980 was $381.8 billion: $153.9 billion in direct costs and $227.9 billion in indirect costs. Direct costs represented 40.3 percent and indirect costs 59.7 percent of the total costs (Figure 13). Within indirect costs, morbidity costs accounted for $104.9 billion (27.5 percent of the total), and mortality costs for $123.0 billion (32.2 percent).

Figure 13

Present value of direct and indirect costs of morbidity and mortality discounted at 6 percent: United States, 1980



NOTE: Total costs are $381.8 billion. Morbidity costs are calculated using bed-disability days as the measure of lost productivity for home makers. An annual increase in productivity of 2 percent is incorporated into the calculation of future earnings.

The relationship between direct and indirect costs varies greatly by population characteristics, reflecting different incidences of morbidity and the effects of variations in the present value of mortality costs. For the civilian noninstitutionalized population as a whole, direct costs accounted for 40.3 percent of the total costs of illness and injury. However, that percent was only 33.7 percent for males but 47.6 percent for females (Table S). The differences are even larger when black persons are compared with white and other persons. Direct costs accounted for 43.4 percent of the total costs of illness among white and other persons but for only 24.1 percent among black persons.

Direct costs accounted for more than two-thirds of total costs for persons under 17 years of age and for persons 65 years of age and over (67.6 and 72.7 percent, respectively). Direct costs represented less than 40 percent of total costs for persons in the two middle age categories, 17–44 and 45–64 years of age (38.4 and

cational category were not as pronounced, they were still large. Thus, for individuals in families whose head had some high school education, direct costs represented 32.7 percent of the total costs of illness; for individuals in families whose head had some college education, direct costs were 58.3 percent of the total.

When the relationship of direct and total costs is considered by the economic status of the individual, whether in terms of family income level or poverty status, the differences are smaller but are still present. For individuals at the lower end of the economic spectrum, those in families with income less than $5,000, direct costs comprised 36.0 percent of total costs. For individuals at the other end of the economic scale, those in families with income of $35,000 or more, direct costs were 45.4 percent of total costs.

Mortality losses were highest ($53.6 billion) for those 17–44 years of age, and these losses are proportionate to the population percent they represented (42.3 percent of the population and 43.6 percent of mortality costs). The economic costs of mortality were nearly the same for persons 45–64 years of age, who, as a category, experienced 2.6 times more deaths during the year. The age category 45–64 years comprised only 19.6 percent of the civilian noninstitutionalized population, yet its mortality losses accounted for 41.4 percent of total mortality costs. The costs of mortality for those 65 years of age and over only slightly exceeded those of persons under 17 years of age, even though the older group experienced an estimated 899,000 deaths, and the younger group experienced only 40,000 (Tables 12 and 14).

The distribution of the total cost of illness and injury by age category closely resembles the distribution of mortality costs with one exception: The high direct costs generated by persons 65 years of age and over increased their portion of the total cost estimate to 14.1 percent.

Mortality losses for females represented 43.3 percent of total mortality costs, and losses for males accounted for 56.7 percent. Higher morbidity costs for males and higher direct costs for females reduce the proportional difference in the total cost estimate: Females accounted for 47.4 percent and males for 52.6 percent of the total costs of illness and injury.

Black persons, who comprised 11.7 percent of the population, accounted for 25.5 percent of mortality costs and 16.2 percent of total costs. The disproportionately high percent of mortality costs represented by the black population suggests that black persons die at a younger age than white and other persons. However, this estimate is based on such a small number of black deaths in the sample population (n = 17) that it must be considered unstable.

The distribution of mortality costs by socioeconomic status (education of family head, family income, and poverty status) indicates that persons in the lower two levels of each category accounted for a greater percent of these costs (about 40 percent) than their representation

Table S

Percent distribution of total costs of illness and injury discounted at 6 percent by cost components, according to selected characteristics: United States, 1980

Characteristic	Total costs	Direct costs	Indirect costs	
			Morbidity[1]	Mortality[2]
	Percent distribution			
Total	100.0	40.3	27.5	32.2
Age				
Under 17 years	100.0	67.6	...	32.4
17–44 years	100.0	38.4	25.0	36.6
45–64 years	100.0	25.8	41.0	33.1
65 years and over	100.0	72.7	9.8	17.5
Sex				
Male	100.0	33.7	31.5	34.8
Female	100.0	47.6	23.0	29.4
Race				
Black	100.0	24.1	25.2	50.7
White and other	100.0	43.4	27.9	28.6
Education of head of family				
None and elementary	100.0	37.5	35.0	27.5
Some high school	100.0	32.7	29.2	38.1
High school graduate	100.0	38.9	24.9	36.1
Some college	100.0	58.3	30.8	10.8
College graduate	100.0	45.7	16.8	37.5
Poverty status				
Below poverty level	100.0	27.8	30.1	42.1
Poverty level to 199 percent poverty level	100.0	42.3	31.7	25.9
200–499 percent poverty level	100.0	44.3	27.9	27.8
500–699 percent poverty level	100.0	36.2	19.0	44.8
700 percent poverty level or more	100.0	44.9	20.0	35.1
Family income				
Less than $5,000	100.0	36.0	35.7	28.3
$5,000–$14,999	100.0	38.5	28.3	33.2
$15,000–$34,999	100.0	40.8	26.3	33.0
$35,000 or more	100.0	45.4	23.1	31.5

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.
[2]Present value discounted at 6 percent. An annual increase in productivity of 2 percent is incorporated into the calculation of future earnings. Estimates are based on a total of 121 deaths in the sample population.

in the population (about 30 percent). This is a function of the relatively high percent of older persons in the lowest levels (some or no elementary school education of the family head, less than $5,000 family income, or below poverty level). This finding also reflects poor health status because each of these categories includes a substantial proportion of the population unable to work (Table 8). The lower socioeconomic categories also account for a disproportionately high percent of the total costs of illness. The highest education and income categories, on the other hand, account for less than their share.

Discussion

The total costs of illness and injury for the U.S. civilian noninstitutionalized population in 1980 amounted to $381.8 billion. In current dollars, this represents 14.5 percent of the 1980 gross national product (GNP) and 2½ times the 5.8 percent of the GNP represented by the direct health care costs of the civilian noninstitutionalized population. These estimates based on NMCUES data differ from other estimates of the total economic costs of illness (Rice, Hodgson, and Kopstein, 1985) and from estimates of the direct costs of illness in the national health accounts (NHA) compiled by HCFA (Gibson and Waldo, 1982). To appreciate the policy implications of some of the major findings in this study, it is useful to put the estimates based on NMCUES data into perspective by considering the reasons for the differences among the several estimates.

The difference between the Rice et al. estimate of the total economic costs of illness and injury ($415.9 billion) and the estimate based on NMCUES data ($381.8 billion), when both estimates of indirect costs are calculated using the same 4-percent net effective discount rate, is $34.1 billion. The NMCUES-based estimate, therefore, is 8.2 percent less than the estimate of Rice et al. This difference is attributable to two factors:

- Differences exist in the population bases and data collection methods. In NMCUES the population base is the civilian noninstitutionalized population, and in Rice et al. it is the total U.S. population, including those who are institutionalized or in the military. Data for NMCUES were collected by household interviews; a variety of provider data sources were employed in the Rice et al. study.
- Methods employed to estimate the indirect costs of morbidity differ. The NMCUES estimate includes in the unable-to-work population persons who were retired for health reasons in 1979 and 1980, disabled homemakers, and other persons who were disabled for the entire year 1980 but were not retired for health reasons in 1979; the Rice et al. estimate does not include the last two categories.

When both sets of estimates, NMCUES and Rice et al., are disaggregated into their direct and indirect cost components, it is clear that the primary differences occur in the estimates of direct costs and morbidity

Table T

Comparison of Rice et al. and National Medical Care Utilization and Expenditure Survey (NMCUES) estimates of total costs of illness and injury discounted at 4 percent net effective rate, by cost components: United States, 1980

Cost component	Rice et al.	NMCUES	Difference	
			Amount	Percent
	Amount in billions			
Total	$415.9	$381.8	$-34.1	-8.2
Direct costs	211.1	153.9	-57.2	-27.1
Indirect costs	204.7	227.9	+23.2	+11.3
Morbidity	67.8	104.9	+37.1	+54.7
Mortality	136.9	123.0	-13.9	-10.2

SOURCE: Rice, D. P., Hodgson, T A., and Kopstein, A. N.: The economic costs of illness: A replication and update. *Health Care Financing Review.* Health Care Financing Administration. To be published.

costs as indicated in Table T. Estimates of direct costs employed by Rice et al. are based on the NHA estimate of $219.4 billion and are reduced by the $8.3 billion in expenditures that could not be allocated to the major diagnostic categories used in the Rice et al. study. The resulting difference between the NMCUES and NHA estimates of personal health expenditures ($65.5 billion) used by Gibson and Waldo (1982) and the difference between the NMCUES and Rice et al. estimates of direct costs ($57.2 billion) are essentially attributable to the different population bases and data collection methods of the two estimates.

Inclusion of the institutionalized civilian population in the NHA estimates adds $20.8 billion in nursing home costs in 1980, as well as an undetermined amount of expenditures by the institutionalized for acute hospital and physician care. Expenditures by the Department of Defense, the Veterans' Administration, State and local governments and other public programs, not otherwise offset by other revenues, represent $16.0 billion in the NHA estimate. Only a small portion of these expenditures is captured by respondent reports of charges in NMCUES. The same holds true for expenditures for Workers' Compensation.

Methodological sources of variation between NHA

and NMCUES estimates of direct costs arise from the use of different data sources and reporting methods. NMCUES estimates are based on health care charges reported by household informants. The Rice et al. study relied on reports of direct costs by both private and public providers of health services. Although it is assumed that the consumer-based NMCUES computations underestimate direct costs, no monetary value has been assigned to this source of variation. A further methodological source of variance is NHA use of the category "drugs and medical sundries," which includes both prescription medications and over-the-counter purchases and amounts to $18.5 billion in the 1980 NHA. Only prescription medications, amounting to $7.8 billion, are included in the 1980 NMCUES data.

When adjustments are made for differences attributable to different population bases and data collection methods, the total difference between the NHA and NMCUES estimates of direct costs is reduced to $12.4 billion, or 5.7 percent of the NHA estimate. The source of the remaining difference is not known. The standard error of the direct cost estimate is $4.1 billion, or 2.7 percent of the NMCUES estimate. Therefore, the true value may be as high as $158.0 billion. Differences in excess of that may be attributable to underreporting by NMCUES respondents of charges paid by third parties and/or to NHA inclusion in personal health expenditures of the costs of certain nonpersonal health services such as State and local government public health activities and food supplementation programs.

Item	Amount in billions
NMCUES direct cost estimate	$153.9
Plus omitted costs:	
Nursing home care	20.8
Defense Department, Veterans' Administration, other	16.0
Workers' compensation	4.6
Other public	4.0
Over-the-counter drugs and sundries	7.7
Adjusted NMCUES	207.0
NHA – adjusted NMCUES: $219.4 – $207.0 = $12.4 (5.7 percent)	
Rice et al. – adjusted NMCUES: $211.1 – $207.0 = $4.1 (1.9 percent)	

Thus, the principal difference between the NMCUES and the Rice et al. estimates of the direct economic costs of illness in 1980 stems from the divergent estimates of direct costs employed by HCFA in constructing the NHA data and those employed in NMCUES. As indicated above, this difference can be resolved. When adjusted for the effects of their different population bases and data collection methods, the two estimates are within 2.0 percent of each other, a difference that equals the range of the standard error of the NMCUES estimate.

The difference between estimates of indirect mortality costs from NMCUES ($123.0 billion) and Rice et al. ($136.9 billion) is also attributable to their different population bases: The inclusion of the institutionalized and military population in the Rice et al. study accounts for its higher estimate of mortality costs.

The major disparity resulting from somewhat different estimation methods is in the estimates of the indirect costs of morbidity, $104.9 billion in NMCUES and $67.8 billion in Rice et al. Here there are two basic factors at play: The definition of the population whose lost earnings are to be estimated and the nature of the earnings data used to calculate the economic value of lost productive person years. Included in the NMCUES population unable to work are all individuals disabled for the entire year of 1980, including persons who were retired for health reasons in 1979 and 1980, disabled homemakers, and persons disabled in 1980 who were not retired for health reasons in 1979. These last two categories are not included in the Rice et al. unable-to-work population or estimates. The NMCUES estimate, then, is higher because more people who were disabled all year are included in the calculation of indirect morbidity costs. A less important source of variation is that NMCUES estimates are based primarily on reported earnings, adjusted for fringe benefits, as the measure of the economic value of lost productive activity; Rice et al. employ mean annual earnings (including fringe benefits) in 1980, adjusted only by age and sex.

Once the indicated adjustments are made and the potential effects of the differential estimation methods are taken into account, the NMCUES estimate of the 1980 total costs of illness and injury and the estimate in the Rice et al. report vary by about 5 percent, with the NMCUES estimate being $23.2 billion higher. It should be noted, however, that this reconciliation of the estimates of total costs masks the major sources of the difference between the NMCUES and Rice et al. estimates. The much larger morbidity cost estimate based on NMCUES data ($104.9 billion as opposed to $67.8 billion estimated by Rice et al.) is offset by the higher mortality cost estimated by Rice et al. ($136.9 billion as opposed to $123.0 billion estimated using NMCUES data). The explanation of the difference may be straightforward, however. Morbidity cost estimates based on NMCUES are higher because of the higher number of estimated years lost, especially among persons unable to work. Rice et al. estimate higher mortality costs because their estimate is based on the actual count of 1,989,841 deaths in 1980, compared with the NMCUES estimate of 1,537,000 deaths in the civilian noninstitutionalized population. The larger difference in deaths (29.4 percent) than in mortality cost estimates (11.3 percent) is expected because NMCUES omits the institutionalized population. Death rates are high in this group, on the whole, but deaths occur at more advanced ages and thus imply lower indirect mortality costs resulting from the loss of productive years. It is notable that the major difference results from the higher NMCUES estimate of indirect morbidity costs.

Cost component	NMCUES	Rice et al.
	Amount in billions	
Direct	$211.1	$211.1
Indirect:		
Morbidity	104.9	67.8
Mortality	123.0	136.9
Total	439.0	415.8

Difference = $23.2 billion, or + 5.6 percent

The economic significance of indirect morbidity costs is indicated by the fact that the working-age population, persons 17–64 years of age, account for 95 percent of morbidity costs, and they do so in both sets of estimates. In NMCUES, however, the estimate of morbidity costs for this population is $99.5 billion — $34.5 billion greater than the estimate by Rice et al. This raises both policy and research issues. If previous and different methodologies underestimate the indirect costs of morbidity, they undervalue the potential benefits to be gained from prevention strategies aimed at the working-age population.

The principal NMCUES findings on the total costs of illness and injury reinforce the importance of considering distributional effects. Examination of the patterns of direct and indirect costs for various subpopulations can provide information valuable in the development and implementation of health care programs and policies.

The direct costs of illness and injury are current expenditures, representing the current use of resources devoted to the diagnosis, treatment, and management of illness and injury in the civilian noninstitutionalized population. For that population as a whole, direct costs constitute 40.3 percent of the total cost of illness and injury. Indirect costs include the economic costs of morbidity and premature mortality. The relationship between direct and indirect costs depends on a complex set of institutional, societal, and epidemiological factors. The incidence of morbidity and mortality, the economic value assigned by the markets to productive contributions, and the institutional characteristics of the medical care sector shape the relative magnitudes of both direct and indirect costs. To the extent that different population groupings, (whether by sex, age, race, or income) are affected differentially by one or more of those factors that influence the relative magnitudes of direct and indirect costs, the relationships of these costs will differ as well. The data show this to be true.

The elderly noninstitutionalized population provides an excellent example. Persons 65 years of age and over comprise only 10.5 percent of the total noninstitutionalized population, but they generate 25.5 percent of total direct costs and 14.1 percent of total costs. Thus, about one-tenth of the noninstitutionalized population generates one-fourth of direct medical costs, even though the most severely disabled and the potentially most sick are excluded because they are in nursing homes. The institutionalized population 65 years of age and over includes a larger percent of the "old-old," those 85 years of age and over, and they experience more ill health than those who are not institutionalized. Evidence of the relative good health of the noninstitutionalized population 65 years of age and over is provided by the indirect costs of mortality, which reflect lost earnings, generated by that population. It is notable that this age category represents 10.5 percent of the NMCUES population and accounts for 7.7 percent of the total costs of premature mortality. This indicates that a significant proportion of noninstitutionalized individuals 65 years of age and over are still working full or part time.

The NMCUES data also indicate that black persons comprise 11.7 percent of the noninstitutionalized civilian population but account for 16.2 percent of the total costs of illness and injury. Although the black population accounts for only 9.7 percent of direct costs, it accounts for fully 25.5 percent of indirect mortality costs. Because the sample size used to estimate black mortality costs is very small ($n = 17$), the estimator of the difference between "black" and "white and other" proportionate mortality costs is not precise enough to assess statistical significance. Nevertheless, this finding suggests that black persons may die younger than white and other persons, thus generating disproportionate economic costs resulting from lost productive person years.

Direct costs account for only 24 percent of total costs for black persons but are 43 percent of total costs for white and other persons. The finding that direct costs as a proportion of total costs are almost twice as great for white and other persons as they are for black persons raises several questions. Whether the reason for the difference is earlier black mortality, a higher incidence of morbidity, less access to health care resources, perhaps a different attitude about the use of medical services, or some combination of all these factors, is not clear. It is a worthwhile subject for future research. Some possible patterns are discussed in terms of direct costs below.

Differences also exist by sex. Females represent 51.8 percent of the civilian noninstitutionalized population yet account for only 41.6 percent of the indirect costs resulting from mortality and morbidity. Even though the estimates in this report include disabled homemakers, females still represent only 39.6 percent of total morbidity costs and 43 percent of mortality costs. It would not be appropriate to conclude on the basis of these findings that females are healthier than males. The share of the direct costs of illness generated by females (56.0 percent) is larger than their proportion of the population (51.8 percent).

A definitive explanation of these results (i.e., that females account for a smaller proportion of indirect costs and that indirect costs for females represent a smaller proportion of their total costs than is the case for males) is beyond the scope of this report. The findings, however, raise the issue of inequitable market valuation of work performed by women. To the extent that discrimination

in the labor market results in lower pay for women than for men for comparable work, the lost productivity of females is systematically undervalued using current methodologies. If homemaker services, which are usually performed by women, are valued by estimating the market replacement cost of household work activities, as they are in this report, and if the market value of work performed by women in the labor force is systematically undervalued because of discrimination or other factors, then homemaker services are also systematically undervalued. Even without considering or estimating the effects of discrimination, the market replacement approach excludes, and therefore undervalues, services performed in the homemaker role that are not substitutable by market services.

Paradoxically, the Rice-Hodgson estimates of the market replacement costs of homemaker services for 1980 (Hodgson and Rice, 1984) yield higher values than their estimates of 1980 mean annual earnings of females for all ages up to 50 years of age (Rice, Hodgson, and Kopstein, 1985). This suggests that the market replacement approach does not independently introduce a bias. However, for most age groups, the 1980 mean annual earnings of females used in this report (U.S. Bureau of the Census, 1982b) are somewhat higher than the Rice-Hodgson estimates of the annual mean values of housekeeping services. (See Tables X and XI in Appendix V.) An alternative method for valuating household work is by assessing its opportunity cost; that is, by estimating the wage the housekeeper could earn in the labor market. This method may produce a higher estimate of the value of household work than the methods currently employed, but the effects of discrimination in the marketplace would still tend to deflate the estimate, and therefore the issue would remain unresolved.

If current methods, including those used in this report, systematically undervalue work and homemaker services performed by women, the economic costs to society of morbidity and premature mortality among women are also undervalued. If intervention strategies employing health promotion and disease prevention are to be based at least partially on their potential economic benefits, appropriate policy choices cannot be made based upon systematically biased data. Hence, future research, both methodological and empirical, is indicated to assess the effects of discrimination in the labor market on current methods for valuating work and homemaker services performed by women and to devise improved approaches to such valuation.

Several interesting and policy-relevant patterns were also identified in the distribution of the direct costs of illness among different subsets of the population. Of particular note is the distribution of direct costs by race and employment status.

It was noted that, at the aggregate level, the black population accounted for a disproportionately low percent of direct health care costs in comparison with their representation in the population (11.7 percent of the population and 9.7 percent of direct costs). Black persons have been shown in a number of studies (including NMCUES) and on a wide range of health status measures to experience more ill health than do white and other persons. Therefore, these findings indicate that black persons in 1980 were still confronting more barriers (financial and otherwise) to the receipt of health services than were white and other persons. An indication of these access problems is the fact that black persons were more likely than white and other persons to receive ambulatory care from a hospital outpatient department or emergency room than from a private physician or other freestanding source of care. In addition, a higher percent of the charges generated by black persons than by white and other persons were for inpatient care. These data indicate that other types of outpatient care (for example, dental care) were not as available to black people as to others and that they entered the medical care system only after they became sick enough to require hospitalization. Significant gaps in access may still exist.

When direct costs for the black working-age population are compared with those for the white and other working-age population, further trends become apparent. Per capita total health care charges for black persons and for white and other persons in this age category (17–64 years of age) are virtually identical. This suggests that the major differences in direct health care costs for these two racial categories occur at the two age extremes (under 17 years of age, 65 years of age and over). Despite the presence of public financing programs, especially Medicare for the old, access to health care for the black population may still be insufficient.

Within the working-age population, several different cost patterns between the two racial categories emerge. Per capita charges for black compared with white and other full-time, full-year workers are not significantly different. In contrast, charge patterns for persons who are unemployed or not in the labor force appear to be quite different for the two racial categories. These charge differentials were not statistically significant, although the high variability of NMCUES charge data and the relatively small sample populations in some of these categories limited the potential for establishing statistical significance. The differentials are, nevertheless, so large (up to 92 percent) that further research is indicated to determine if and why working-age persons of different races experience markedly different health and health care cost patterns when they are not employed.

Examination of the diagnoses that generated the greatest aggregate charges for various subsets of the population reveals several policy-relevant trends. Most interesting is the similarity in the most costly diagnoses for males and females and for the black population and the white and other population. Four of the five leading diagnoses for men and women are identical. The only difference is found in the third-ranked diagnostic category—respiratory diseases for males and genitourinary problems for females. This probably reflects the fact

that cigarette smoking became prevalent among women much later than among men. Given recent increases in lung cancer in females as a result of increased smoking behavior, these two lists may completely converge in the near future.

The two most costly diagnoses are the same for black persons and for white and other persons. The next six categories include the same diagnostic groups for both racial categories, although the relative cost rankings differ (Figure 10). In all cases, however, the greatest difference in the percent of direct costs represented by any one of these six diagnostic categories for one racial category relative to the other is less than 2.5 percent. These findings suggest that there is little real difference between the racial categories in terms of direct costs attributable to diagnostic categories.

The most striking and policy-relevant finding in the analysis of charges by diagnostic category is the high ranking of injury and poisoning on the lists of diagnostic categories generating high charges for almost all subsets of the population. Injury and poisoning ranked second in frequency for the entire civilian noninstitutionalized population and accounted for $16.7 billion in charges in 1980, or 12.3 percent of diagnosis-specific charges. Injury and poisoning were the leading generator of direct costs for individuals in one age category (17–44 years of age) and three employment categories (full-time, full-year workers; full-time, part-year workers; and the unemployed). This diagnostic category was the second leading generator of charges for males, females, the black population, the white and other population, and children under 17 years of age. It ranked third in magnitude of charges generated for part-time workers and for individuals 65 years of age and over. The specific causes of injury and poisoning are not available from NMCUES data. However, it is reasonable to assume that motor vehicle accidents, industrial accidents, household accidents, and violence are among the major causative factors for different segments of the population. In the aggregate, injury and poisoning were second only to diseases of the circulatory system as a leading generator of charges in the United States in 1980.

The role of injury and poisoning is particularly noteworthy from the perspective of disease prevention and health promotion, as well as in the context of cost-containment efforts. Injury and poisoning are likely to be readily responsive to preventive interventions. Unlike preventive efforts for heart disease or cancer, whose effects are detectable only much later, such efforts can yield dramatic improvements within relatively short time periods. Given the very high direct costs associated with injury and poisoning, they are high priority candidates for public and private intervention.

The findings in this report suggest several major research and cost-containment priorities. Public policy should encourage the scientific investigation of health care costs of population subcategories that generate costs disproportionate to their respective shares of the population. Categories of interest include the black population, the elderly, the poor, the unemployed and/or uninsured, and disabled workers and homemakers (including those disabled for only a portion of the year). Such investigations would yield useful information about the factors that account for these disproportionate costs and thus could suggest new strategies and policies to improve health and to contain costs.

Current methods of valuating lost productivity should be reassessed. The findings suggest that, to the extent that discrimination in the labor force results in the systematic undervaluation of work and homemaker services performed by women, the economic costs to society of morbidity and premature mortality among women are also undervalued. Therefore, research designed to assess the effects of discrimination on current methods for valuating the lost productivity of women and to devise improved methods should be undertaken.

Prevention efforts aimed at the reduction of injury and poisoning should be increased. These efforts should include both public and private programs that address potential hazards that are site specific and specific to the young, the old, and the working-age population.

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List of Detailed Tables

Table 1

Direct costs, by type of health service and selected characteristics: United States, 1980

Characteristic	All direct costs	Hospital services		Physician services		Dental services	Other health professionals[1]	Prescribed medications	Other medical services[2]
		Inpatient	Outpatient	Inpatient	Outpatient				
	Amount in millions								
Total	$153,878	$71,955	$11,272	$15,183	$20,605	$17,691	$5,627	$7,831	$3,714
Age									
Under 17 years	18,875	6,130	2,178	1,095	3,243	4,424	644	728	434
17–44 years	56,118	23,621	4,481	5,670	8,233	8,022	2,665	2,085	1,341
45–64 years	39,721	18,654	2,921	3,789	5,193	3,998	1,363	2,748	1,054
65 years and over	39,164	23,550	1,692	4,629	3,935	1,246	955	2,270	886
Sex and age									
Male, all ages	67,648	33,249	5,024	6,523	8,033	8,014	2,198	3,014	1,593
Under 17 years	9,984	3,399	1,275	634	1,691	2,082	326	395	182
17–44 years	21,569	9,184	1,781	1,923	2,720	3,514	1,116	703	628
45–64 years	18,724	9,647	1,226	1,750	2,154	1,898	514	1,115	420
65 years and over	17,372	11,019	743	2,216	1,468	520	241	802	363
Female, all ages	86,230	38,706	6,248	8,660	12,572	9,677	3,429	4,817	2,121
Under 17 years	8,891	2,731	904	461	1,553	2,342	318	333	252
17–44 years	34,550	14,437	2,700	3,747	5,513	4,508	1,549	1,383	713
45–64 years	20,998	9,008	1,695	2,039	3,039	2,100	849	1,634	634
65 years and over	21,792	12,531	949	2,413	2,467	727	714	1,468	523
Race									
Black	14,922	7,881	1,811	1,084	1,724	1,081	331	698	311
White and other	138,956	64,074	9,461	14,099	18,881	16,610	5,296	7,133	3,403
Education of head of family									
None and elementary	31,880	18,096	2,107	3,127	3,445	1,710	802	1,936	658
Some high school	24,273	12,685	2,008	2,594	2,811	1,950	554	1,319	551
High school graduate	50,514	23,283	3,578	4,634	7,055	6,189	2,112	2,420	1,242
Some college	22,423	8,949	1,872	2,220	3,213	3,635	904	1,050	581
College graduate	24,589	8,943	1,706	2,608	4,081	4,207	1,255	1,106	683

Table 1 – continued

Direct costs, by type of service and selected characteristics: United States, 1980

Characteristic	All direct costs	Hospital services		Physician services		Dental services	Other health professionals[1]	Prescribed medications	Other medical services[2]
		Inpatient	Outpatient	Inpatient	Outpatient				
Poverty status									
Below poverty level	17,089	9,421	1,810	1,157	1,916	991	509	962	323
Poverty level to 199 percent poverty level	34,151	18,735	2,463	3,332	4,056	2,243	820	1,765	736
200-499 percent poverty level	74,092	33,263	4,891	7,579	10,265	9,749	2,763	3,767	1,186
500-699 percent poverty level	16,403	5,935	1,309	1,828	2,503	2,723	849	782	474
700 percent poverty level or more	12,143	4,602	800	1,287	1,864	1,985	686	556	365
Family income									
Less than $5,000	16,171	9,240	1,456	1,285	1,741	696	472	969	313
$5,000–$14,999	46,538	25,233	3,289	4,326	5,516	3,280	1,322	2,546	1,025
$15,000–$34,999	60,446	25,301	4,650	6,429	8,882	8,209	2,473	2,957	1,545
$35,000 or more	30,724	12,181	1,877	3,143	4,467	5,505	1,360	1,360	831

[1]Includes chiropractors, podiatrists, optometrists, psychologists, social workers, nurses, physical therapists, and others.
[2]Includes eyeglasses, orthopedic appliances, hearing aids, diabetic supplies, and ambulance services.

Table 2

Per capita direct costs, by type of health service and selected characteristics: United States, 1980

Characteristic	All direct costs	Hospital services		Physician services		Dental services	Other health professionals[1]	Prescribed medications	Other medical services[2]
		Inpatient	Outpatient	Inpatient	Outpatient				
Total	$690	$323	$51	$68	$92	$79	$25	$35	$17
Age									
Under 17 years	307	100	35	18	53	72	10	12	7
17–44 years	596	251	48	60	87	85	28	22	14
45–64 years	911	428	67	87	119	92	31	63	24
65 years and over	1,669	1,003	72	197	168	53	41	97	38
Sex and age									
Male, all ages	629	309	47	61	75	75	20	28	15
Under 17 years	316	108	40	20	54	66	10	13	6
17–44 years	473	201	39	42	60	77	24	15	14
45–64 years	899	463	59	84	103	91	25	54	20
65 years and over	1,830	1,161	78	233	155	55	25	84	38
Female, all ages	748	336	54	75	109	84	30	42	18
Under 17 years	296	91	30	15	52	78	11	11	8
17–44 years	711	297	56	77	113	93	32	28	15
45–64 years	923	396	75	90	134	92	37	72	28
65 years and over	1,559	896	68	173	177	52	51	105	37
Race									
Black	573	303	70	42	66	41	13	27	12
White and other	706	326	48	72	96	84	27	36	17

[1]Includes chiropractors, podiatrists, optometrists, psychologists, social workers, nurses, physical therapists, and others.
[2]Includes eyeglasses, orthopedic appliances, hearing aids, diabetic supplies, and ambulance services.

Table 3

Estimated population and percent distribution, by selected characteristics: United States, 1980

Characteristic	Number of persons in thousands	Percent distribution
Total	222,824	100.0
Age		
Under 17 years	61,575	27.6
17–44 years	94,202	42.3
45–64 years	43,578	19.6
65 years and over	23,469	10.5
Sex and age		
Male, all ages	107,481	48.2
Under 17 years	31,585	14.2
17–44 years	45,576	20.5
45–64 years	20,828	9.3
65 years and over	9,491	4.2
Female, all ages	115,343	51.8
Under 17 years	29,990	13.5
17–44 years	48,626	21.8
45–64 years	22,750	10.2
65 years and over	13,978	6.3
Race		
Black	26,046	11.7
White and other	196,778	88.3
Education of head of family		
None or some elementary	36,976	16.6
Some high school	35,152	15.8
High school graduate	78,063	35.0
Some college	34,849	15.6
College graduate	37,784	17.0
Poverty status		
Below poverty level	24,514	11.0
Poverty level to 199 percent poverty level	45,509	20.4
200–499 percent poverty level	115,464	51.8
500–699 percent poverty level	23,872	10.7
700 percent poverty level or more	13,464	6.0
Family income		
Less than $5,000	16,225	7.3
$5,000–$14,999	58,157	26.1
$15,000–$34,999	103,400	46.4
$35,000 or more	45,043	20.2

Table 4

Direct costs for persons 17–64 years of age, by employment and selected characteristics: United States, 1980

Characteristic	All direct costs	Employed				Unemployed	Not in labor force
		Full time		Part time			
		Full year	Part year	Full year	Part year		
	Amount in millions						
Total	$95,840	$25,408	$24,656	$4.297	$12,268	$4,067	$25,143
Age							
17–44 years	17,642	3,233	5,879	1,094	3,630	1,872	1,934
25–44 years	38,477	12,360	10,737	1,809	5,403	1,494	6,672
45–64 years	39,721	9,816	8,039	†1,394	3,235	701	16,537
Sex							
Male	40,292	15,381	12,694	1,438	2,630	1,073	7,076
Female	55,547	10,027	11,962	2,859	9,638	2,994	18,067
Race							
Black	10,431	2,298	3,095	198	772	672	3,395
White and other	85,409	23,110	21,561	4,099	11,497	3,396	21,748
Family income							
Less than $5,000	8,471	†80	1,738	†114	663	1,883	3,993
$5,000–$14,999	23,348	3,856	6,424	728	3,402	756	8,182
$15,000–$34,999	40,535	12,980	10,258	1,933	5,046	1,099	9,219
$35,000 or more	23,486	8,492	6,236	1,522	3,156	‡330	3,750

Note: Employed refers to those persons employed at any time during 1980; unemployed refers to those unemployed for all of 1980; not in labor force refers to those who were not in the labor force for all of 1980.

Table 5

Estimated population for persons 17–64 years of age, by employment and selected characteristics: United States, 1980

Characteristic	All direct costs	Employed				Unemployed	Not in labor force
		Full time		Part time			
		Full year	Part year	Full year	Part year		
		Number in thousands					
Total	137,780	59,394	27,133	8,920	15,786	4,121	22,425
Sex and age							
Male, all ages	66,404	39,115	14,409	2,658	4,340	1,337	4,545
17–24 years	15,752	5,661	4,985	1,204	2,654	†586	661
25–44 years	29,824	20,949	6,007	915	934	†410	†608
45–64 years	20,828	12,505	3,417	†539	751	†341	3,276
Female, all ages	71,376	20,279	12,723	6,262	11,446	2,783	17,880
17–24 years	17,134	4,008	3,982	1,587	4,022	1,251	2,283
25–44 years	31,492	10,322	5,733	2,786	5,178	1,129	6,343
45–64 years	22,750	5,949	3,008	1,889	2,246	†403	9,254
Race							
Black	14,885	5,710	3,271	772	1,649	1,137	2,345
White and other	122,895	53,684	23,862	8,148	14,137	2,984	20,080
Family income							
Less than $5,000	7,797	†421	1,640	†413	1,266	1,165	2,891
$5,000–$14,999	32,029	10,246	7,662	2,001	3,832	1,468	6,820
$15,000–$34,999	65,538	31,328	12,558	4,095	7,207	1,178	9,173
$35,000 or more	32,416	17,399	5,273	2,412	3,481	‡310	3,541

Note: Employed refers to those persons employed at any time during 1980; unemployed refers to those unemployed for all of 1980; not in labor force refers to those who were not in the labor force for all of 1980.

Table 6

Direct costs for all persons, by age, sex, race, and diagnostic category: United States, 1980

Diagnostic category [1]	All direct costs [2]	Age				Sex		Race	
		Under 17 years	17-44 years	45-64 years	65 years and over	Male	Female	Black	White and other
	Amount in millions								
Total	$136,216	$14,455	$48,104	$35,732	$37,925	$59,644	$76,571	$13,845	$122,371
Infectious and parasitic diseases	2,157	646	880	424	206	984	1,172	323	1,834
Neoplasms	10,650	235	1,584	3,946	4,884	5,392	5,258	787	9,862
Endocrine, nutritional and metabolic diseases, and immunity disorders	4,003	142	1,221	1,543	1,097	1,230	2,773	522	3,480
Diseases of the blood and blood-forming organs	971	51	74	203	642	638	333	44	927
Mental disorders	3,680	363	2,451	677	189	1,794	1,886	356	3,325
Diseases of the nervous system and sense organs	9,495	1,418	2,915	2,254	2,908	4,303	5,192	1,217	8,278
Diseases of the circulatory system	19,961	348	2,434	6,715	10,465	9,558	10,403	1,969	17,992
Diseases of the respiratory system	10,644	2,553	3,097	2,639	2,354	6,010	4,634	1,037	9,607
Diseases of the digestive system	10,412	1,032	2,803	4,020	2,558	5,381	5,031	1,215	9,197
Diseases of the genitourinary system	9,387	424	4,522	2,357	2,085	2,387	7,000	1,026	8,361
Complications of pregnancy, childbirth, and the puerperium	5,227	159	5,067	1	1	...	5,227	573	4,655
Diseases of the skin and subcutaneous tissue	2,058	434	795	313	516	816	1,242	198	1,860
Diseases of the musculoskeletal system and connective tissue	11,173	543	3,352	4,330	2,948	5,729	5,444	1,117	10,056
Congenital anomalies	1,310	911	141	59	199	361	949	17	1,293
Certain conditions originating in the perinatal period	573	572	1	–	–	553	20	9	564
Signs, symptoms, and ill-defined conditions	6,800	732	1,921	1,940	2,207	2,358	4,441	706	6,094
Injury and poisoning	16,745	1,926	9,009	2,332	3,478	8,675	8,070	1,494	15,251
No or unknown diagnosis	10,969	1,966	5,837	1,980	1,187	3,475	7,494	1,236	9,733

[1] For a listing of code numbers, see Table V in Appendix IV.
[2] Total does not include charges for dental services.

Note: Sample populations for diagnostic categories are unknown because of multiple responses. Therefore, unstable estimates cannot be identified.

Table 7

Direct costs for persons 17–64 years of age, by employment and diagnostic category: United States, 1980

Diagnostic category[1]	All direct costs[2]	Employed				Unemployed	Not in labor force
		Full time		Part time			
		Full year	Part year	Full year	Part year		
	Amount in millions						
Total	$83,836	$19,931	$22,497	$3,426	$10,937	$3,729	$23,315
Infectious and parasitic diseases	1,304	358	420	67	119	19	321
Neoplasms	5,530	849	1,135	453	493	292	2,308
Endocrine, nutritional and metabolic diseases, and immunity disorders	2,764	414	435	131	438	367	978
Diseases of the blood and blood-forming organs	277	36	16	2	11	15	197
Mental disorders	3,128	737	892	184	599	215	501
Diseases of the nervous system and sense organs	5,169	1,565	774	243	599	181	1,808
Diseases of the circulatory system	9,148	1,786	2,309	160	1,052	139	3,703
Diseases of the respiratory system	5,736	1,516	1,174	209	365	85	2,387
Diseases of the digestive system	6,823	2,207	1,819	309	650	223	1,615
Diseases of the genitourinary system	6,879	1,920	1,940	215	1,265	116	1,422
Complications of pregnancy, childbirth, and the puerperium	5,068	395	1,292	145	1,586	518	1,132
Diseases of the skin and subcutaneous tissue	1,108	481	215	50	136	42	184
Diseases of the musculoskeletal system and connective tissue	7,682	1,787	2,473	197	1,180	94	1,950
Congenital anomalies	200	52	9	5	104	2	28
Certain conditions originating in the perinatal period	1	—	—	—	1	—	—
Signs, symptoms, and ill-defined conditions	3,861	901	774	141	242	258	1,545
Injury and poisoning	11,341	2,841	4,961	474	909	763	1,393
No or unknown diagnosis	7,817	2,085	1,860	442	1,188	399	1,843

[1]For a listing of the code numbers, see Table V in Appendix IV.
[2]Total does not include charges for dental services.

Note: Employed refers to those persons employed at any time during 1980; unemployed refers to those unemployed for all of 1980; not in labor force refers to those who were not in the labor force for all of 1980. Sample populations for diagnostic categories are unknown because of multiple responses. Therefore, unstable estimates cannot be identified.

Table 8

Estimated population, by employment and selected characteristics: United States, 1980

Characteristic	All persons	Under 17 years	Employed	Unemployed	Not in labor force: Homemaker	Not in labor force: Unable to work	Not in labor force: Other
	Number in thousands						
Total	222,824	61,575	115,520	2,714	21,102	7,885	14,028
Age							
Under 17 years	61,575	61,575	...	...	...	...	...
17–44 years	94,202	...	80,928	2,012	7,925	885	2,451
45–64 years	43,578	...	30,304	†431	6,721	4,017	2,105
65 years and over	23,469	...	4,288	‡271	6,456	2,984	9,470
Sex							
Male	107,481	31,585	63,040	1,468	†353	4,176	6,859
Female	115,343	29,990	52,482	1,246	20,748	3,708	7,169
Race							
Black	26,046	9,182	11,889	700	1,722	1,153	1,399
White and other	196,778	52,393	103,630	2,014	19,379	6,731	12,629
Education of head of family							
None and elementary	36,976	8,082	14,795	†640	5,688	3,530	4,242
Some high school	35,152	10,121	16,567	†556	3,958	1,663	2,287
High school graduate	78,063	23,483	41,945	827	6,529	1,820	3,460
Some college	34,849	9,629	20,014	†443	2,389	†537	1,837
College graduate	37,784	10,261	22,201	‡248	2,538	†334	2,202
Poverty status							
Below poverty level	24,514	9,854	5,859	948	3,981	1,938	1,934
Poverty level to 199 percent poverty level	45,509	15,145	18,010	758	5,427	2,427	3,742
200–499 percent poverty level	115,464	31,269	64,438	871	9,202	3,016	6,668
500–699 percent poverty level	23,871	3,570	17,416	‡111	1,483	‡266	1,025
700 percent poverty level or more	13,464	1,738	9,797	‡26	1,008	‡237	658
Family income							
Less than $5,000	16,224	3,830	4,091	699	3,561	1,893	2,150
$5,000–$14,999	58,157	14,815	25,792	1,148	7,272	3,149	5,982
$15,000–$34,999	103,400	31,758	56,649	691	7,499	2,284	4,519
$35,000 or more	45,043	11,172	28,990	‡176	2,769	†558	1,378

Note: Employed refers to persons employed at any time during 1980; unemployed refers to persons unemployed for all of 1980 who did not claim homemaking as their major activity in 1979; homemakers refers to persons who did not work for all of 1980, but were not disabled, and claimed homemaking as their major activity in 1979; unable te work refers to persons who did not work at all in 1980 for health reasons, including disabled homemakers; others not in labor force were not employed for all of 1980 and were not seeking work.

Table 9

Productive person years lost as a result of morbidity for persons 17 years of age and over in potential work force, by employment and selected characteristics: United States, 1980

Characteristic	All persons		Homemaker			
	Bed disability[1]	Restricted activity[2]	Employed	Bed disability[1]	Restricted activity[2]	Unable to work
	Person years in thousands					
Total	7,996	8,653	2,328	332	989	5,337
Age						
17–44 years	2,399	2,522	1,512	100	223	787
45–64 years	4,139	4,334	736	89	284	3,314
65 years and over	1,458	1,797	79	143	482	1,236
Sex						
Male	3,493	3,508	1,262	†13	†27	2,219
Female	4,503	5,145	1,066	319	961	3,118
Race						
Black	1,266	1,328	329	61	123	877
White and other	6,730	7,325	1,999	271	865	4,460
Education of head of family						
None and elementary	2,676	2,982	314	117	368	2,245
Some high school	1,664	1,787	428	67	190	1,169
High school graduate	2,242	2,400	852	80	238	1310
Some college	810	881	398	38	110	†373
College graduate	604	657	336	30	83	†239
Poverty status						
Below poverty level	1,612	1,758	120	81	227	1,411
Poverty level to 199 percent poverty level	2,136	2,330	469	92	286	1,575
200–499 percent poverty level	3,406	3,662	1,260	133	390	2,013
500–699 percent poverty level	515	553	303	19	57	‡193
700 percent poverty level or more	328	350	176	6	28	‡145
Family income						
Less than $5,000	1,509	1,677	98	80	248	1,331
$5,000–$14,999	2,796	3,056	641	126	385	2,030
$15,000–$34,999	2,735	2,905	1,082	96	266	1,557
$35,000 or more	956	1,016	507	29	90	†420

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.
[2]Calculated using restricted-activity days as the measure of lost productivity for homemakers.

Note: Employed refers to those persons employed at any time during 1980; homemakers refers to those who did not work for all of 1980, but were not disabled, and claimed homemaking as their major activity in 1979; unable to work refers to those who did not work at all in 1980 for health reasons, including disabled homemakers.

Table 10

Estimated value of lost productivity as a result of morbidity for persons 17 years of age and over, by employment and selected characteristics: United States, 1980

Characteristic	All persons		Homemaker			
	Bed disability[1]	Restricted activity[2]	Employed	Bed disability[1]	Restricted activity[2]	Unable to work
	Amount in millions					
Total	$104,860	$109,127	$35,139	$2,430	$6,697	$67,290
Age						
17–44 years	36,530	37,995	22,784	1,169	2,634	12,577
45–64 years	63,044	64,714	11,782	775	2,444	50,488
65 years and over	5,286	6,419	574	486	1,619	4,226
Sex						
Male	63,307	63,380	23,016	†71	†144	40,220
Female	41,553	45,747	12,123	2,359	6,553	27,071
Race						
Black	15,585	16,003	3,798	456	875	11,330
White and other	89,275	93,124	31,341	1,974	5,822	55,960
Education of head of family						
None and elementary	29,739	30,994	3,777	621	1,876	25,341
Some high school	21,869	22,590	5,757	553	1,247	15,539
High school graduate	32,361	33,727	12,920	717	2,083	18,724
Some college	11,849	12,341	6,437	299	791	†5,113
College graduate	9,043	9,475	6,249	241	673	†2,553
Poverty status						
Below poverty level	18,460	19,395	976	595	1,530	16,888
Poverty level to 199 percent poverty level	25,600	26,650	5,135	597	1,648	19,867
200–499 percent poverty level	46,779	48,606	18,980	1,019	2,847	26,779
500–699 percent poverty level	8,624	8,909	6,141	166	451	‡2,316
700 percent poverty level or more	5,398	5,567	3,907	52	220	‡1,439
Family income						
Less than $5,000	16,039	16,934	711	498	1,394	14,829
$5,000–$14,999	29,877	35,552	7,259	748	2,082	26,210
$15,000–$34,999	38,944	40,462	16,628	915	2,433	21,401
$35,000 or more	15,661	16,179	10,541	270	788	†4,850

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.
[2]Calculated using restricted-activity days as the measure of lost productivity for homemakers.

Note: Employed refers to those persons employed at any time during 1980; homemakers refers to those who did not work for all of 1980, but were not disabled, and claimed homemaking as their major activity in 1979; unable to work refers to those who did not work at all in 1980 for health reasons, including disabled homemakers.

Table 11

Direct and indirect costs of morbidity and single-year mortality costs, by selected characteristics: United States, 1980

Characteristic	Total costs		Direct costs	Indirect costs		
				Morbidity		
	Bed disability[1]	Restricted activity[2]		Bed disability[1]	Restricted activity[2]	Single-year mortality
	Amount in millions					
Total	$260,773	$265,040	$153,878	$104,860	$109,127	$2,034
Age						
Under 17 years	18,904	18,904	18,875	...	...	‡29
17–44 years	92,810	94,275	56,118	36,530	37,995	‡162
45–64 years	104,284	105,593	39,721	63,044	64,714	†1,518
65 years and over	44,775	45,908	39,164	5,286	6,419	326
Sex						
Male	132,131	132,203	67,648	63,307	63,380	1,176
Female	128,642	132,837	86,230	41,553	45,747	859
Race						
Black	30,849	31,268	14,922	15,585	16,003	‡342
White and other	229,924	233,772	138,956	89,275	93,124	1,692
Education of head of family						
None and elementary	62,264	3,519	31,880	29,739	30,994	†645
Some high school	46,534	47,256	24,473	21,869	22,590	‡193
High school graduate	83,800	85,167	50,514	32,361	33,727	†926
Some college	34,387	34,879	22,423	11,849	12,341	‡116
College graduate	33,787	34,219	24,589	9,043	9,475	‡155
Poverty status						
Below poverty level	35,106	36,744	17,089	18,460	19,395	‡260
Poverty level to 199 percent poverty level	60,106	61,157	34,151	25,600	26,650	†356
200–499 percent poverty level	121,763	123,591	74,092	46,779	48,606	892
500–699 percent poverty level	25,360	25,645	16,403	8,624	8,909	‡333
700 percent poverty level or more	17,734	17,902	12,143	5,398	5,567	‡193
Family income						
Less than $5,000	32,393	33,289	16,171	16,039	16,934	‡183
$5,000–$14,999	81,522	82,856	46,538	34,217	35,552	†767
$15,000–$34,999	101,406	99,888	60,446	38,944	40,462	†499
$35,000 or more	46,970	47,489	30,724	15,661	16,179	‡586

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.
[2]Calculated using restricted-activity days as the measure of lost productivity for homemakers.

Table 12

Lifetime losses from mortality, by selected characteristics: United States, 1980

Characteristic	All deaths	Productive person years lost	Present value of lost productivity discounted at[1]	
			6 percent	10 percent
	Number in thousands		Amount in millions	
Total[2]	1,537	27,340	$123,019	$88,494
Age				
Under 17 years	‡40	‡2,662	‡9,029	‡3,237
17–44 years	‡166	‡7,019	‡53,620	‡35,394
45–64 years	†432	†9,119	†50,918	†41,685
65 years and over	899	8,540	9,451	8,180
Sex				
Male	853	13,603	69,778	50,975
Female	685	13,737	53,241	37,520
Race				
Black	‡221	‡6,152	‡31,409	‡21,524
White and other	1,316	21,188	91,610	66,971
Education of head of family				
None and elementary	†480	†6,566	†23,340	†18,036
Some high school	‡290	‡6,073	‡28,493	‡20,228
High school graduate	†427	†9,094	†46,871	†32,459
Some college	‡167	‡2,056	‡4,158	‡3,517
College graduate	‡173	‡3,551	‡20,158	‡14,255
Poverty status				
Below poverty level	‡175	‡4,777	‡25,880	‡17,539
Poverty level to 199 percent poverty level	†333	†5,248	†20,914	†14,360
200–499 percent poverty level	679	11,173	46,467	33,451
500–699 percent poverty level	‡156	‡3,654	‡20,280	‡15,304
700 percent poverty level or more	‡193	‡2,488	‡9,478	‡7,840
Family income				
Less than $5,000	‡134	‡2,409	‡12,709	‡9,409
$5,000–$14,999	†625	†10,298	†40,112	†28,929
$15,000–$34,999	†510	†10,329	†48,874	†32,919
$35,000 or more	‡268	‡4,304	‡21,324	‡17,237

[1] An annual increase in productivity of 2 percent is incorporated into the calculation of future earnings.
[2] Estimates are based on a total of 121 deaths in the sample population.

Table 13

Lifetime losses from mortality for persons 17–64 years of age, by employment: United States, 1980

Employment	All deaths	Productive person years lost	Present value of lost productivity discounted at[1]	
			6 percent	10 percent
	Number in thousands		Amount in millions	
Total[2]	†520	†14,111	†$92,199	†$67,953
Employed	‡306	‡9,006	‡$62,833	‡$45,049
Homemaker	‡116	‡3,264	‡17,473	‡12,850
Unable to work	‡98	‡1,841	‡11,893	‡10,054

[1]An annual increase in productivity of 2 percent is incorporated into the calculation of future earnings.
[2]Estimates are based on a total of 46 deaths in the working-age sample population.

Note: Employed refers to those persons employed at any time during 1980; homemakers refers to those who did not work for all of 1980, but were not disabled, and claimed homemaking as their major activity in 1979; unable to work refers to those who did not work at all in 1980 for health reasons, including disabled homemakers.

Table 14

Present value of direct and indirect costs of morbidity and mortality discounted at 6 percent, by selected characteristics: United States, 1980

Characteristic	Total costs		Direct costs	Indirect costs		
				Morbidity		
	Bed disability[1]	Restricted activity[2]		Bed disability[1]	Restricted activity[2]	Mortality[3]
	Amount in millions					
Total	$381,758	$386,025	$153,878	$104,860	$109,127	$123,019
Age						
Under 17 years	27,904	27,904	18,875	...	...	‡9,029
17–44 years	146,269	147,733	56,118	36,530	37,995	‡53,620
45–64 years	153,684	155,353	39,721	63,044	64,714	†50,918
65 years and over	53,901	55,033	39,164	5,286	6,419	9,451
Sex						
Male	200,733	200,806	67,648	63,307	63,380	69,778
Female	181,024	185,219	86,230	41,553	45,747	53,241
Race						
Black	61,916	62,335	14,922	15,585	16,003	‡31,409
White and other	319,841	323,690	138,956	89,275	93,124	91,610
Education of head of family						
None and elementary	84,959	86,214	31,880	29,739	30,994	†23,340
Some high school	74,835	75,556	24,473	21,869	22,590	†28,493
High school graduate	129,745	131,111	50,514	32,361	33,727	†46,871
Some college	38,429	38,922	22,423	11,849	12,341	‡4,158
College graduate	53,790	54,222	24,589	9,043	9,475	‡20,158
Poverty status						
Below poverty level	61,429	62,364	17,089	18,460	19,395	‡25,880
Poverty level to 199 percent poverty level	80,665	81,715	34,151	25,600	26,650	†20,915
200–499 percent poverty level	167,338	169,166	74,092	46,779	48,606	46,467
500–699 percent poverty level	45,307	45,592	16,403	8,624	8,909	‡20,280
700 percent poverty level or more	27,019	27,187	12,143	5,398	5,567	‡9,478
Family income						
Less than $5,000	44,919	45,815	16,171	16,039	16,934	‡12,709
$5,000–$14,999	120,866	122,201	46,538	34,217	35,552	†40,112
$15,000–$34,999	148,263	149,782	60,446	38,944	40,462	†48,874
$35,000 or more	67,709	68,227	30,724	15,661	16,179	‡21,324

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.
[2]Calculated using restricted-activity days as the measure of lost productivity for homemakers.
[3]Present value discounted at 6 percent. An annual increase in productivity of 2 percent is incorporated into the calculation of future earnings. Estimates are based on a total of 121 deaths in the sample population.

Table 15

Present value of direct and indirect costs of morbidity and mortality discounted at 10 percent, by selected characteristics: United States, 1980

Characteristic	Total costs		Direct costs	Indirect costs		
				Morbidity		
	Bed disability[1]	Restricted activity[2]		Bed disability[1]	Restricted activity[2]	Mortality[3]
	Amount in millions					
Total	$347,233	$351,500	$153,878	$104,860	$109,127	$88,494
Age						
Under 17 years	22,112	22,122	18,875	...	...	‡3,237
17–44 years	128,042	129,507	56,118	36,530	37,995	‡35,394
45–64 years	144,450	146,119	39,721	63,044	64,714	†41,685
65 years and over	52,629	53,762	39,164	5,286	6,419	8,180
Sex						
Male	181,929	182,002	67,648	63,307	63,380	50,975
Female	165,303	169,498	86,230	41,553	45,747	37,520
Race						
Black	52,031	52,450	14,922	15,585	16,003	‡21,524
White and other	295,202	299,050	138,956	89,275	93,124	66,971
Education of head of family						
None and elementary	79,655	80,910	31,880	29,739	30,994	†18,036
Some high school	66,569	67,291	24,473	21,869	22,590	†20,228
High school graduate	115,334	116,700	50,514	32,361	33,727	†32,459
Some college	37,788	38,281	22,423	11,849	12,341	‡3,517
College graduate	47,887	48,319	24,589	9,475	9,043	‡14,255
Poverty status						
Below poverty level	53,088	54,023	17,089	18,460	19,395	‡17,539
Poverty level to 199 percent poverty level	74,110	75,161	26,650	25,600	26,650	†14,360
200–499 percent poverty level	154,322	156,150	74,092	46,779	48,606	33,451
500–699 percent poverty level	40,331	40,616	16,403	8,624	8,909	‡15,304
700 percent poverty level or more	25,382	25,550	12,143	5,398	5,567	‡7,840
Family income						
Less than $5,000	41,619	42,515	16,171	16,039	16,934	‡9,409
$5,000–$14,999	109,684	111,019	46,538	34,217	35,552	†28,929
$15,000–$34,999	132,308	133,827	60,446	38,944	40,462	†32,919
$35,000 or more	63,621	64,140	30,724	15,661	16,179	‡17,237

[1]Calculated using bed-disability days as the measure of lost productivity for homemakers.
[2]Calculated using restricted-activity days as the measure of lost productivity for homemakers.
[3]Present value discounted at 10 percent. An annual increase in productivity of 2 percent is incorporated into the calculation of future earnings. Estimates are based on a total of 121 deaths in the sample population.

Appendixes

Contents

List of Appendix Figures

List of Appendix Tables

Appendix I. Sample Design, Data Collection, and Processing

Introduction

The National Medical Care Utilization and Expenditure Survey (NMCUES) was designed to collect data about the U.S. civilian noninstitutionalized population during 1980. Because of the complexity of the survey, the analyst must be familiar with a range of design features, both to determine appropriate analytic methods and to investigate the impact that the design may have on a particular analysis. Several topics are addressed in this appendix: The overall design of NMCUES, the survey background, sampling methods, data collection methods, weighting, and compensation procedures for missing data. In these descriptions, the NMCUES data are presented essentially as they are available to the user of the public use data tape. This appendix draws heavily from a paper in the Proceedings of the 19th National Meeting of the Public Health Conference on Records and Statistics (Casady, 1983).

Survey Background

During the course of NMCUES, information was obtained on health, access to and use of medical services, associated charges and sources of payment, and health care coverage. The survey was cosponsored by the National Center for Health Statistics (NCHS) and the Health Care Financing Administration (HCFA). Data collection was provided under contract by the Research Triangle Institute (RTI) and its subcontractors, National Opinion Research Center (NORC) and SysteMetrics, Inc.

The basic survey plan for NMCUES drew heavily on two previous national surveys: The National Health Interview Survey (NHIS), which is conducted by NCHS, and the National Medical Care Expenditure Survey (NMCES), which was cosponsored by the National Center for Health Services Research and NCHS.

NHIS is a continuing multipurpose health survey first conducted in 1957. The primary purpose of NHIS is to collect information on illness, disability, and the use of medical care. Although some information on medical charges and insurance payments has been collected in NHIS, the cross-sectional nature of the NHIS survey design is not well suited for providing annual data on charges and payments.

NMCES was a panel survey in which sample households were interviewed six times over an 18-month period in 1977 and 1978. NMCES was designed specifically to provide comprehensive data on how health services were used and paid for in the United States in 1977.

NMCUES is similar to NMCES in survey design and question wording, so that analysis of change during the years between 1977 and 1980 is possible. Both NMCUES and NMCES are similar to NHIS in terms of question wording in areas common to the three surveys. Together they provide extensive information on illness, disability, use of medical care, costs of medical care, sources of payment for medical care, and health care coverage at two points in time.

Sample Design

General plan—The NMCUES sample of housing units and group quarters, hereafter jointly referred to as dwelling units, is a concatenation of two independently selected national samples, one provided by RTI and the other by NORC. The sample designs used by RTI and NORC are quite similar with respect to principal design features: Both can be characterized as stratified, multistage area probability designs. The principal differences between the two designs are the type of stratification variables and the specific definitions of sampling units at each stage.

Target population—All persons living in a sample dwelling unit at the time of the first interview became part of the national sample. Unmarried students 17–22 years of age who lived away from home were included in the sample if their parent or guardian was included in the sample. In addition, persons who died or were institutionalized between January 1 and the date of first interview were included in the sample if they were related to persons living in the sampled dwelling units and were living in the sample dwelling before their death or institutionalization. All of these persons were considered "key" persons, and data were collected for them for the full 12 months of 1980 or for the portion of time that they were part of the U.S. civilian noninstitutionalized population. In addition, children born to key persons during 1980 were considered key persons, and data were collected for them from the time of birth.

Relatives from outside the original population (i.e., institutionalized, in the Armed Forces, or outside the United States from January 1 up to the first interview) who moved in with key persons after the first interview were also considered key persons, and data were collected for them from the time they joined the key person. Relatives who moved in with key persons after the first interview but were part of the civilian noninstitutionalized population on January 1, 1980, were classified as "nonkey" persons. Data were collected for nonkey persons for the time that they lived with a key person; but because they had a chance of selection in the initial sample, their data are not used for general analysis of persons. However, data for nonkey persons are used in an analysis of families because they contribute to the family's utilization of and charges for health care during the time they are part of the family. Family analysis is not part of this investigation, though, and will not be discussed further.

Persons included in the sample were grouped into "reporting units" for data collection purposes. Reporting units were defined as all persons related to each other by blood, marriage, adoption, or foster care status who lived in the same dwelling unit. The combined NMCUES sample consisted of approximately 7,200 reporting units, of which nearly 6,600 agreed to participate in the survey. In total, complete data were obtained on 17,123 key persons. The RTI sample yielded approximately 8,300 respondents and the NORC sample 8,800.

Research Triangle Institute Sample Design

Primary sampling units (PSU's)—A PSU was defined as a county, a group of contiguous counties, or parts of counties with a combined minimum 1970 population size of 20,000. A total of 1,686 nonoverlapping RTI PSU's cover the entire land area of the 50 States and Washington, D.C. The PSU's were classified as one of two types. The 16 largest standard metropolitan statistical areas (SMSA's) were designated as self-representing PSU's, and the remaining 1,670 PSU's in the primary sampling frame were designated as non-self-representing PSU's.

Stratification of PSU's—PSU's were grouped into strata whose members tend to be relatively alike within strata and relatively unlike between strata. PSU's derived from the 16 largest SMSA's were of sufficient 1970 population size to be treated as primary strata. The 1,659 non-self-representing PSU's from the continental United States were stratified into 42 approximately equal-sized primary strata. Each primary stratum had a 1970 population size of about 3.3 million. One supplementary primary stratum of 11 PSU's, with a 1970 population size of about 1 million, was added to the RTI primary frame to include Alaska and Hawaii.

First-stage selection of PSU's—The total RTI primary sample consisted of 59 PSU's, of which 16 were self-representing. The non-self-representing PSU's were obtained by selecting 1 PSU from each of the 43 non-self-representing primary strata. These PSU's were selected with probability proportional to 1970 population size.

Secondary stratification—In each of 59 sample PSU's, the entire PSU was divided into nonoverlapping smaller area units called secondary sampling units (SSU's). Each SSU consisted of one or more 1970 census-defined enumeration districts (ED's) or block groups (BG's). Within each PSU the SSU's were ordered and then partitioned to form approximately equal-sized secondary strata. Two secondary strata were formed in the non-self-representing PSU drawn from Alaska and Hawaii, and four secondary strata were formed in each of the remaining 42 non-self-representing PSU's. Thus, the non-self-representing PSU's were partitioned into a total of 170 secondary strata. In a similar manner the 16 self-representing PSU's were partitioned into 144 secondary strata.

Second-stage selection of SSU's—One SSU was selected from each of the 144 secondary strata covering the self-representing PSU's, and two SSU's were selected from each of the remaining secondary strata. All second-stage sampling was with replacement and with probability proportional to the SSU's total noninstitutionalized population in 1970. The total number of sample SSU's was $2 \times 170 + 144 = 484$.

Third-stage selection of areas and segments—Each SSU was divided into smaller nonoverlapping geographic areas, and one area within the SSU was selected with probability proportional to the 1970 total number of housing units. Next, one or more nonoverlapping segments of at least 60 housing units (HU's) were formed in the selected area. One segment was selected from each SSU with probability proportional to the segment HU count. In response to the sponsoring agencies' request that the expected household sample size be reduced, a systematic sample of one-sixth of the segments was deleted from the household sample. Thus, the total third-stage sample was reduced to 404 segments.

Fourth-stage selection of housing units—All dwelling units within the segment were listed, and a systematic sample of dwelling units was selected. The procedures used to determine the sampling rate for segments guaranteed that all dwelling units had an approximately equal probability of selection. All reporting units within the selected dwelling units were included in the sample.

National Opinion Research Center Sample Design

Primary sampling units (PSU's)—The land area of the 50 States and Washington, D.C., was divided into nonoverlapping PSU's. A PSU consisted of SMSA's, parts of SMSA's, counties, parts of counties, or independent cities. Grouping of counties into a single PSU occurred when individual counties had a 1970 population of less than 10,000.

Zoning of PSU's—The PSU's were classified into two groups according to metropolitan status (SMSA or not SMSA). These two groups were individually ordered and then partitioned into zones with a 1970 census population size of 1 million persons.

First-stage zone selection of PSU's—A single PSU was selected within each zone with a probability proportional to its 1970 population. It should be noted that this procedure allows a PSU to be selected more than one time. For instance, an SMSA PSU with a population of 3 million may be selected at least twice and possibly as many as four times. The full general-purpose sample contained 204 PSU's, which were systematically allocated to 4 subsamples of 51 PSU's. The final set of 76 sample PSU's was chosen by randomly selecting 2 complete subsamples of 51 PSU's; 1 subsample was included in its entirety, and 25 PSU's in the other subsample were selected systematically for inclusion in NMCUES.

Second-stage zone selection of SSU's—Each PSU selected in the first stage was partitioned into a nonoverlapping set of SSU's defined by BG's, ED's, or a combination of the two types of census units. SSU's were selected from the ordered list of these SSU's. The cumulative number of households in the second-stage frame for each PSU was divided into 18 zones of equal width. An SSU could be selected more than once, as was the case in the PSU selection. If a PSU had been hit more than once in the first stage, then the second-stage selection process was repeated as many times as there were first-stage hits. Some 405 SSU's were identified by selecting 5 SSU's from each of the 51 PSU's in the subsample that was included in its entirety and 6 SSU's from each of the 25 PSU's in the subsample for which one-half of the PSU's were included.

Third-stage selection of segments—The selected SSU's were subdivided into area segments with a minimum size of 100 housing units. One segment was then selected with probability proportional to the estimated number of housing units.

Fourth-stage selection of housing units—Sample selection at this level was essentially the same as for the RTI design.

Data Collection

Field operations for NMCUES were performed by RTI and NORC under specifications established by the cosponsoring agencies. Persons in the sample dwelling units were interviewed at approximately 3-month intervals beginning in February 1980 and ending in March 1981. The core questionnaire was administered during each of the five interview rounds to collect data on health, health care, health care charges, sources of payment, and health care coverage. A summary of responses was used to update information reported in previous rounds. Supplements to the core questionnaire were used during the first, third, and fifth interview rounds to collect data that did not change during the year or that were needed only once. Approximately 80 percent of the third- and fourth-round interviews were conducted by telephone; all remaining interviews were conducted in person. The respondent for the interview was required to be a household member 17 years of age and over. A nonhousehold proxy respondent was permitted only if all eligible household members were unable to respond because of health, language, or mental condition.

Weighting

For the analysis of NMCUES data, sample weights are required to compensate for unequal probabilities of selection, to adjust for the potentially biasing effects of failure to obtain data from some persons or reporting units (RU's) (i.e., nonresponse), and failure to cover some portions of the population because the sampling frame did not include them (i.e., undercoverage).

Basic sample design weights—Development of weights reflecting the sample design of NMCUES was the first step in the development of weights for each person in the survey. The basic sample design weight for a dwelling unit is the product of four components that correspond to the four stages of sample selection. Each of the four weight components is the inverse of the probability of selection at that stage when sampling was without replacement, or the inverse of the expected number of selections when sampling was with replacement, and multiple selection of the sample unit was possible.

Two-sample adjustment factor—As previously discussed, the NMCUES sample is composed of two independently selected samples. Each sample, together with its basic sample design weights, yields independent unbiased estimates of population parameters. Because the two NMCUES samples were of approximately equal size, a simple average of the two independent estimators was used for the combined sample estimator. This is equivalent to computing an adjusted basic sample design weight by dividing each basic sample design weight by 2. In the subsequent discussion, only the combined sample design weights are considered.

Total nonresponse and undercoverage adjustment—A weight adjustment factor was computed at the RU level to compensate for RU-level nonresponse and undercoverage. Because every RU within a dwelling unit is included in the sample, the adjusted basic sample design weight assigned to an RU is simply the adjusted basic sample design weight for the dwelling unit in which the RU is located. An RU was classified as responding if members of the RU initially agreed to participate in NMCUES and as nonresponding otherwise.

Initially, 96 RU weight-adjustment cells were formed by cross-classifying the following variables: Race of RU head (white or all other), type of RU head (female,

male, or husband-wife), age of RU head (four levels), and size of RU (four levels). These cells were then collapsed to 63 cells so that each cell contained at least 20 responding RU's. Within each cell an adjustment factor was computed so that the sum of adjusted basic sample design weights would equal the March 1980 Current Population Survey estimate for the same population. The weight for nonresponse and undercoverage was computed for each RU as the product of the adjusted basic sample design weight and the nonresponse-undercoverage adjustment factor for the cell containing the RU.

Poststratification adjustment—Once the nonresponse–undercoverage adjusted RU weights were computed, a poststratification adjusted weight was computed at the person level. Because each person within an RU is included in the sample, the nonresponse and undercoverage adjusted weight for a sample person is the nonresponse–undercoverage adjusted weight for the RU in which the person resides. Each person was classified as responding or nonresponding, as discussed subsequently in the section on attrition imputation.

Sixty poststrata were formed by cross-classifying age (15 levels), race (2 levels), and sex (2 levels). One poststratum (black males 75 years of age and over) had fewer than 20 respondents, so it was combined with an adjacent poststratum (black males 65–74 years of age), resulting in 59 poststrata.

Estimates based on population projections from the 1980 census were obtained from the Bureau of the Census for the U.S. civilian noninstitutionalized population by age, race, and sex poststrata for February 1, May 1, August 1, and November 1, 1980. The mean of these midquarter population estimates for each of the poststrata was computed and used as the 1980 average target population for calculating the poststrata adjustment factors.

Survey-based estimates of the average poststrata population were developed using the nonresponse and undercoverage adjusted weights. First, a survey-based estimate of the target population of each poststratum for each quarter was computed by summing the nonresponse and undercoverage adjusted weights for respondents eligible for the survey on the midquarter date. Then the survey-based estimate of the 1980 average population was computed as the mean of the four midquarter estimates. Finally, the poststratification adjustment factor in each poststratum was computed as the ratio of the 1980 average target population (obtained from Bureau of the Census data) to the NMCUES 1980 average population. The poststratified weight for each respondent was then computed as the product of the nonresponse and undercoverage adjusted weight and the poststratification adjustment factor for the poststratum containing the respondent.

Thus, the weighting procedure is composed of three steps: Development of base sample design weights for each RU, adjustment for RU-level nonresponse and undercoverage, and adjustment for person-level nonresponse and undercoverage. A further adjustment for the number of days a person was an eligible member of the U.S. civilian noninstitutionalized population was made, but this adjustment affects only certain types of estimates from NMCUES and is discussed in Appendix III.

Survey Nonresponse

Nonresponse in panel surveys such as NMCUES occurs when sample individuals refuse to participate in the survey (total nonresponse), when initially participating individuals drop out of the survey (attrition nonresponse), or when data for specific items on the questionnaire are not collected (item nonresponse). Response rates for RU's and persons in NMCUES were high, with approximately 90 percent of the sample RU's agreeing to participate in the survey and approximately 94 percent of the individuals in the participating RU's supplying complete information. Even though the overall response rates are high, survey-based estimates of means and proportions may be biased if nonrespondents tend to have different health care experiences than respondents or if there is a substantial response rate differential across subgroups of the target population. Furthermore, annual totals tend to be underestimated unless allowance is made for the loss of data attributable to nonresponse.

Two methods commonly used to compensate for survey nonresponse are data imputation and adjustment of sampling weights. For NMCUES, data imputation was used to compensate for attrition and item nonresponse, and weight adjustment was used to compensate for total nonresponse. The calculation of the weight adjustment factors was discussed in the previous section.

Attrition Imputation

A special form of the sequential hot-deck imputation method (Cox, 1980) was used for attrition imputation. First, each sample person with incomplete annual data (referred to as a "recipient") was linked to a sample person with similar demographic and socioeconomic characteristics who had complete annual data (referred to as a "donor"). Second, the time periods for which the recipient had missing data were divided into two categories: Imputed eligible days and imputed ineligible days. Imputed eligible days were those days for which the donor was eligible (i.e., in scope), and imputed ineligible days were those days for which the donor was ineligible (i.e., out of scope). The donor's medical care experiences, such as medical provider visits, dental visits, and hospital stays, during the imputed eligible days were imputed into the recipient's record for eligible days. Finally, the results of the attrition imputation were used to make the final determination of a person's respondent status. If more than two-thirds of the person's total

eligible days (both reported and imputed) were imputed eligible days, then the person was considered a total nonrespondent, and the data for the person were removed from the data file.

Item Nonresponse and Imputation

Persons classified as respondents may fail to provide information for some or many items in the questionnaire. In NMCUES, item nonresponse was particularly a problem for health care charges, income, and other sensitive topics. The extent of missing data varied by question, and imputation for all items in the data file would have been expensive. Imputations were made for missing data on key demographic, economic, and charge items across five of the six data files in the public use data tape (all except the condition file). Table I illustrates the extent of the item nonresponse problem for selected survey measures that received imputations in four data files used in this report.

Demographic items tend to require the least amount of imputation. Some, such as age, sex, and education, had insignificant levels of imputation. Income items had higher levels of nonresponse. Nearly one-third of the persons required imputation for at least one component of total personal income, which is a cumulation of earned income and 11 sources of unearned income. The bed-disability days, work-loss days, and cut-down days have levels of imputation between those for the demographic and income items.

Table I

Percent of data imputed for selected survey items in 4 of the NMCUES public use data files: United States, 1980

Tape location	Description	Percent imputed
	Person file (n = 17,123)	
P54	Age	0.1
P57	Race	[1]20.0
P59	Sex	0.1
P62	Highest grade attended	0.1
P67	Perceived health status	0.8
P592	Functional limitation score	3.2
P125	Number of bed-disability days	7.9
P128	Number of work-loss days	8.9
P135	Number of cut-down days	8.2
P399	Wages, salary, business income	9.7
P434	Pension income	3.5
P445	Interest income	21.6
P462	Total personal income	[2]30.4
	Medical visit file (n = 86,594)	
M117	Total charge	25.9
M123	First source of payment	1.8
M125	First source of payment amount	11.6
	Hospital stay file (n = 2,946)	
H252	Nights hospitalized	3.1
H124	Total charge	36.3
H130	First source of payment	2.2
H132	First source of payment amount	17.6
	Medical expenses file (n = 58,544)	
E117	Total charge	19.4
E123	First source of payment	2.8
E125	First source of payment amount	10.0

[1]Race for children under 17 years of age imputed from race of head of reporting unit.
[2]Cumulative across 12 types of income.

The highest levels of imputation occurred for the important charge items on the various visit, hospital stay, and medical expenses files. Total charges for medical visits, hospital stays, and prescribed medicines and other medical expenses were imputed for 25.9 percent, 36.3 percent, and 19.4 percent of the events, respectively. Among the source-of-payment data, the imputation rates for the source of payment were small, but the rates for the amount paid by the first source of payment were generally subject to high rates of imputation. The number of nights hospitalized on the hospital stay file was imputed at a rate comparable to that for first source of payment.

The methods used to impute for missing items were diverse and tailored to the measure requiring imputation. Three types of imputation predominate: Edit or logical imputations, a sequential hot deck, and a weighted sequential hot deck. The edit or logical imputations were used to eliminate missing data that could reasonably be determined from other data items that provided overlapping information for the given item. The sequential hot deck was used primarily for small numbers of imputations for the demographic items; the weighted sequential hot deck was used more extensively and for virtually all other items for which imputations were made.

The edit or logical imputation is a process in which the value of a missing item is deduced from other available information in the data file. For example, race was not recorded for children under 17 years of age during the survey. Instead, a logical imputation was made during data processing that assigned the race of the head of the reporting unit to the child. Similarly, extensive editing was performed for the charge data before any imputations were made. If first source of payment was available, only one source of payment was given; and if total charge was missing, the value of the first source of payment amount was assigned to the total charge item.

In the sequential hot-deck procedure, the data are grouped within imputation classes formed by variables thought to be correlated with the item to be imputed. An additional sorting within imputation classes by variables also thought to be correlated with the imputed item is typically used. An initial value, such as the mean of the nonmissing cases for the item, is assigned as a "cold-deck" value. The first record in the file is then examined. If it is missing, the "cold-deck" value replaces the missing data code; if it is real (not missing), the real value replaces the "cold-deck" value and becomes a "hot-deck" value. Then the next record is examined. Again, the "hot-deck" value is used to replace missing

data; if the value is real, it becomes the "hot-deck" value. The process continues sequentially through the sorted file. The weighted hot deck, a modification of the sequential hot deck, uses weights to determine which real values are used to impute for a particular record needing imputation.

The imputation process will be described for two items to illustrate the nature of imputation for NMCUES. For Hispanic origin, two different imputation procedures were used: Logical and sequential hot deck. Because Hispanic origin was not recorded during the interview for children under 17 years of age, a logical imputation was made by assigning to the child the Hispanic origin of the wife of the head of the reporting unit, if present, and the origin of the head of the reporting unit otherwise. For the remaining cases that were not assigned a value by this procedure, the data were grouped into classes by observed race of the head of the reporting unit; within classes, the data were sorted by reporting unit identification number, primary sampling unit, and segment. An unweighted sequential hot deck was used to impute values of Hispanic origin for the remaining cases with missing values.

The imputations for medical visit total charge were made after extensive editing had been done to eliminate as many inconsistencies as possible between sources of payment and total charges. The medical visit records were then separated into three types: emergency room, hospital outpatient department, and doctor visits. Within each type, the records were classed and sorted by several measures, which differed across visit types, prior to a weighted hot-deck imputation. For example, the records for doctor visits were classified by reason for visit, type of doctor seen, whether work was done by a physician, and age of the individual. Within the groups formed by these classification variables, the records were then sorted by type of health care coverage and month of visit. Finally, the weighted hot-deck procedure was used to impute for missing total charge, sources of payment, and source-of-payment amounts for the classified and sorted data file.

Because imputations were made for missing items for a large number of the important items in NMCUES, they can be expected to influence the results of the survey in several ways. In general, the weighted hot deck is expected to preserve the means of the nonmissing observations when those means are for the total sample or classes within which imputations were made. However, means for other subgroups, particularly small subgroups, may be changed substantially by imputation. In addition, sampling variances can be substantially underestimated when imputed values are used in the estimation process. For a variable with one-quarter of its values imputed, for instance, sampling variances based on all cases will be based on one-third more values than were actually collected in the survey for the given item. That is, the variance would be too small by a factor of at least one-third. Finally, the strength of relationships between measures that received imputations can be substantially attenuated by the imputation. A more complete discussion of these issues can be found in Lepkowski, Stehouwer, and Landis (1984).

Appendix II. Data Modifications to Public Use Files

During the preparation of this report, a number of problems were discovered in the NMCUES public use files that required modification of the data. Eight sets of problems were identified:

(1) Sampling weights for 68 newborns (i.e., persons born in 1980) were in error.

(2) Six respondents had extremely high hospital stay charges.

(3) Forty-seven respondents had health care coverage categories inconsistent with source of payment for some medical events.

(4) For 173 respondents, fewer bed-disability days than hospital nights were reported. (Length-of-stay data were recorded in terms of the number of nights—as opposed to days—spent in the hospital.)

(5) Four respondents had extremely long lengths of stay in the hospital as a result of incorrect hospital admission dates.

(6) Four respondents had poverty status categories that were inconsistent with their poverty status level.

(7) Nine respondents were coded as deliveries in the hospital file but had inconsistent values for other hospital stay data.

(8) One respondent had duplicate hospital stay records.

Details of the changes made to correct these problems may be obtained from NCHS. Detailed descriptions of the specific changes are provided in the NMCUES series report by Lepkowski et al. (to be published). General information on the problems and changes is outlined below.

(1) Records for 68 newborns were incorrectly coded as eligible for the entire survey period (all 366 days) although born after January 1, 1980. These errors were corrected by changing the eligible time-adjustment factor and the person time-adjusted weight for each of the 68 records.

(2) After careful examination, the University of Michigan and NCHS determined that six hospital stay records, each with charges of at least $90,000, were incorrect and should be changed. These six records and related information in the person file (e.g., hospital stay charges, total charges) were changed to conform with records in the Medicare best estimate file or with other information about each of the six respondents' hospitalizations contained in the hospital stay file.

(3) Discrepancies between source of payment and health care coverage were noted in the course of analysis. All of the discrepancies involved Medicare coverage. Forty-seven respondents reporting Medicare as a source of payment in the medical visit, hospital stay, or prescribed medicine file were not properly coded as covered by Medicare. Health care coverage for these respondents was reclassified strictly according to source-of-payment data. Respondents originally coded as covered by private insurance but whose records did not show private insurance as a source of payment for any services were coded as having Medicare and private insurance coverage. When reassignment based on imputed data for source of payment would conflict with real data for health care coverage, the real data were used in preference to the imputed data.

(4) For 173 cases, the value for hospital nights was greater than the value for bed-disability days. According to interviewer instructions for the NMCUES questionnaire, hospital nights should be included in bed-disability days, except for newborns. Therefore, the value of bed-disability days was adjusted to equal hospital nights for these 173 cases, a procedure used in Health Interview Survey processing. However, this adjustment does not fully compensate for the errors in recording or computing bed-disability days. It is likely that bed-disability days are still underestimated for these 173 cases after the edit. The edit was performed without regard to the imputation status of either bed-disability days or hospital nights.

(5) Four cases with discrepancies between bed-disability days and hospital nights also had improperly coded hospital admission dates, which led to the recording of excessively long lengths of stay. In these cases, the admission dates and hospital nights were corrected, and the bed-disability days edit was not necessary.

(6) Comparison of the continuous and the categorical poverty status variables on the public use file identified four respondents whose categorical poverty status was inconsistent with their continuous poverty status value. The categorical variable was changed to correspond to their poverty status on the continuous variable.

(7) A variety of problems were discovered on nine records coded as deliveries in the hospital stay file.

(a) Two deliveries were attributed to male respondents. Examination of the data files suggested that the sex variable was incorrectly coded in these two cases; the sex was therefore recoded to female. A third delivery attributed to a male was actually that of the respondent's spouse. In this case, the hospital record was reassigned and appropriate changes made in the person file for both respondents.

(b) Four hospitalizations for newborns were incorrectly coded as deliveries. These were recoded in the hospital stay file. A fifth newborn's hospital record was attributed to its mother. In this case, the hospital record was transferred to the newborn, and appropriate changes were made in the person file for both respondents.

(c) One delivery was attributed to a 74-year-old woman. Following an NCHS recommendation, the response was recoded to reflect signs, symptoms, and ill-defined conditions as the admitting condition.

(8) Two sets of duplicate records (four records in total) in the hospital stay file were discovered for one respondent. The two duplicates were deleted in the hospital stay file, and necessary changes were made in the person file. Three of the four records had been imputed to another respondent for reasons of attrition. No changes were made in the records for the respondent receiving the attrition-imputed records.

Appendix III.
Analytical Strategies

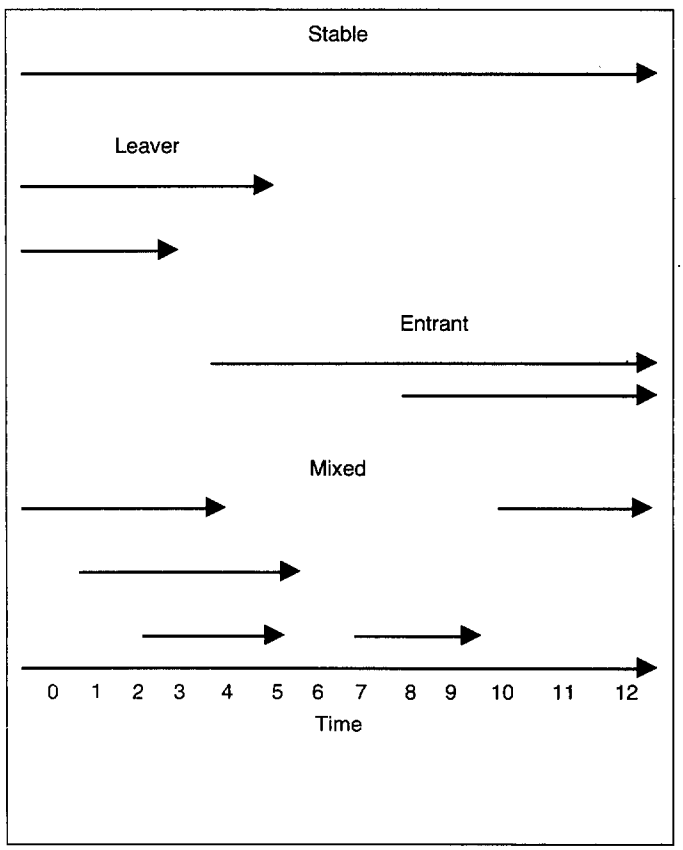
Notion of an Average Population

NMCUES was a panel survey in which members of the population were followed during the panel period (calendar year 1980). The nature of a dynamic population over time influences the rules used to determine who should be followed and for how long. It also has significant implications for the form of estimators for characteristics of the population during the panel period. Before discussing estimation strategies for NMCUES data, it is useful to review the nature of a dynamic population over time.

The nature of a longitudinal population as members move in and out of eligibility is illustrated in Figure I. Stable members of the population appear at the beginning and at every time point during the life of the longitudinal time period. Even though these persons are termed "stable," they may, of course, change residence during the panel period and may be quite difficult to trace. Leavers are persons who are eligible at the beginning of a time period but become ineligible at some later time. Leaving may occur through events such as death, institutionalization, or moving outside the geographic boundary of the population. At the same time, new members (entrants) may enter the population through births or through returns from institutions or from outside the geographic boundary of the population. Finally, there also will be mixed population elements that are both entrants and leavers from the population during different time periods. The majority of the population typically will be stable in nature, but it is the entrants and leavers, persons who may be experiencing major changes in their lives, who are often of particular interest to analysts of panel survey data. In order to assure adequate coverage of all elements in the dynamic population considered over the entire time period, NMCUES followup rules were carefully specified to include entrants, leavers, and mixed population elements properly.

Figure I

Dynamic population for 12 time period panel survey



As an illustration, consider a person who was in the Armed Forces on January 1, 1980, and was discharged on June 1, 1980, thus becoming a key person (i.e., one to be followed for the rest of the year while eligible) in the NMCUES panel. Because NMCUES was designed to provide information about the civilian population, medical care use and charges during the first 5 months of 1980 for this person are outside the scope of the survey. Data about health care use and charges were not collected unless they occurred after June 1. At the same time, this person was eligible for only 7 months of the year, and he was also "at risk" of incurring health care use or charges for only 7 of the 12 months. This person thus contributes only 7/12 or 0.58 of a year of eligibility (person year) to the study. This quantity is referred to as the "time-adjustment factor" in the documentation and throughout these appendixes.

For readers not familiar with the concept of "person years of risk," it may be useful to consider briefly the rules that were used to determine eligibility for a given person at a given moment during 1980. There were essentially two ways of becoming eligible for or entering

the NMCUES eligible population. One way was to be a member of the U.S. civilian noninstitutionalized population on January 1, 1980, and hence a member of the original or base cohort about which inferences were to be made. The second way was to enter after January 1 through birth or through rejoining the civilian noninstitutionalized population during the year by returning from an institution, from the Armed Forces, or from outside the United States. There were also several ways by which persons who were eligible members of the population could become ineligible. Death obviously removes a person from further followup, as does institutionalization, joining the Armed Forces, or moving to a residence outside the United States. Information was collected to monitor the exact number of days that each person selected for NMCUES was eligible during the year. These eligibility periods are summarized by the time-adjustment factor on each record.

The use of "person years" to form sample estimates requires careful assessment of the characteristic to be estimated. Estimates that use only data collected from persons during periods of eligibility (e.g., total number of doctor visits, total charges for health care) do not need to account for time adjustments. Estimates for person characteristics (e.g., total population, proportion of the population in a given subgroup) must be based on person years to obtain estimates that correspond to those for health care estimates. Some estimates require the use of the time-adjustment factor in the denominator but not in the numerator. For example, an estimate of the mean total charge for health care during 1980 must use the total charges for health care as a numerator without time adjustment, but the denominator must be the number of person years that the U.S. population was exposed to the risk of such charges during 1980, a time-adjusted measure. The mean in this case is actually a rate of health care charges per person year of exposure for the eligible population in 1980.

When making estimates in which person years are important, the effect of the time-adjustment factor will vary depending on the subpopulation of interest (Table II). A cross-sectional cohort of N persons selected from the U.S. population on January 1, 1980, and followed for the entire year will contribute a total number of person years for 1980 that is smaller than N because of removals (i.e., deaths, institutionalization, and so on). If entrants are added to the initial cohort during the year, the person years contributed by the initial cohort and the entrants may well exceed N, but it will still be less than the number of original cohort members plus the number of entrants.

The difference between persons and person years will vary by subgroups as well. Females 25–29 years of age on January 1 constitute a cohort for which few additions are expected because of entrants from institutions, the Armed Forces, or living abroad. Few removals are expected because of death, institutionalization, joining the Armed Forces, or moving abroad. On the other hand, males 80 years of age and over on January 1 will contribute a much smaller number of person years to the population than the total number of persons in the cohort at the beginning of the year, because a large number of the cohort will die during the year.

Role of Weights and Imputation

Estimated means and sampling errors from NMCUES for bed-disability days, work-loss days, work-loss days in bed, cut-down days, and restricted-activity days are presented in Table III. For each survey measure, separate estimates were computed using all data (i.e., both real and imputed) and using only the real data. The unweighted and weighted mean, unweighted and weighted simple random sampling standard error of the mean, and the weighted complex standard error, which accounts for the stratified, multistage nature of the design, are presented.

For each measure, the weighted means computed using all the data and using only the real data are quite similar. This similarity is not unexpected given that the weighted hot deck imputation procedure is designed to preserve the weighted mean for overall sample estimates. The simple random sampling standard errors, however, are smaller when all data are used simply because the simple random sampling variance is inversely related to the sample size. For the complex standard error, three of the five measures have smaller standard errors when all data are used, and the other two measures show the opposite relationship. Weighting and imputation for the disability measures have little or no effect on estimated means or their standard errors for the total

Table II

Effect of person-year adjustment on counts and sampling weights, by 4 population groups: United States, 1980

Population group	Sample size	Person years	Sum of sampling weights	
			Basic weight in thousands	Adjusted weight in thousands
Total population	17,123	16,862.84	226,368	222,824
Females, 25–29 years of age	702	699.39	9,529	9,494
Males, 80 years of age and over	113	104.05	1,384	1,274
All persons born during 1980	251	121.02	3,560	1,713

Table III

Sample size, means, and standard errors for 5 disability measures, by all and real data subgroups: United States, 1980

Disability measure and data type	Sample size	Unweighted estimates		Weighted estimates		
		Mean	Simple random sampling standard error	Mean	Simple random sampling standard error	Complex standard error
Bed-disability days						
All data	17,123	5.303	0.1279	5.268	0.1269	0.1540
Real data	15,777	5.253	0.1326	5.228	0.1319	0.1599
Work-loss days						
All data	13,069	3.614	0.1221	3.696	0.1220	0.1629
Real data	11,537	3.510	0.1284	3.574	0.1277	0.1716
Work-loss days in bed						
All data	13,069	1.516	0.0508	1.568	0.0518	0.0592
Real data	10,970	1.530	0.0556	1.578	0.0568	0.0652
Cut-down days						
All data	17,123	6.831	0.1681	6.881	0.1697	0.3343
Real data	15,724	6.609	0.1721	6.639	0.1735	0.3322
Restricted-activity days						
All data	17,213	13.746	0.2559	13.805	0.2573	0.4716
Real data	14,049	13.036	0.2732	13.064	0.2742	0.4658

Table IV

Sample size, means, standard errors, and element variance for total charge for a hospital outpatient department visit, by data type: United States, 1980

Data type	Sample size	Unweighted estimates		Weighted estimates			Element variance ($\times 10^{-3}$)
		Mean	Simple random sampling standard error	Mean	Simple random sampling standard error	Complex standard error	
All data	9,529	51.86	1.030	51.61	1.018	1.914	9.87
Real data only	4,688	52.28	1.436	52.27	1.430	2.936	9.59
Imputed data	4,841	51.45	1.476	50.98	1.447	1.600	10.14
Real data							
Not donor	929	47.83	2.108	48.53	2.117	3.935	4.17
Donor once	2,789	55.85	2.016	55.76	1.982	3.386	11.00
Donor twice	841	48.61	3.525	49.37	3.579	4.879	10.78
Donor 3–5 times	120	29.45	7.340	28.97	7.987	11.64	7.66

population because the amount of missing data for these measures is small (approximately 7 or 8 percent).

For other measures that have larger amounts of missing data, imputation has larger effects. Consider the means and standard errors for total charge for a hospital outpatient department visit shown in Table IV. Of 9,529 hospital outpatient department visits (real visit records plus those generated from the attrition imputation process), 4,841 have a total charge that was imputed from one of the other hospital outpatient department visit records. Thus, more than one-half of the total charges were missing for this particular medical event. Despite the large amount of missing data, the weighted means using all the data and using only real values are quite similar; weighting does not affect the estimated means. However, sampling errors are changed substantially when imputed values are added to real values to form an estimate. The weighted and unweighted simple random sampling standard errors are markedly smaller for all data than for the real data.

To investigate whether this decrease in sampling error is caused by changes in sample size, changes in the element variance, or both, the element or total variances were estimated by multiplying the weighted simple random sampling variances by the sample sizes. Inspection of Table IV suggests that the element variances are quite similar using all data and real data; the differences in standard error when all data and only real

data are used can be attributed mostly to the loss in sample size when going from all data to real data.

Not all of the real data were used as donors for imputation, and some of the real data were used as donors several times. Table IV also suggests that those real values not used as donors have a lower mean total charge than those used as donors, but values used as donors more than twice tend to have even-smaller mean total charges. The means for donors used once, twice, or more frequently are a function of the use of imputation classes, within which the mean total charge and the amount of missing data varied.

The difference in complex standard errors between all data and the real data in Table IV illustrates the large effects of imputation. However, neither the complex standard error computed using all the data nor that computed using only the real data is the correct standard error for the weighted mean estimated using all the data. The mean computed using all data includes 4,841 values that were actually subsampled with replacement from the 4,688 real values. In addition, imputations were made across the primary sampling units and strata used in both the sample selection process and the variance estimation procedure. It is assumed in the variance estimation procedure that the observations were selected independently from primary sampling units and strata. That assumption is incorrect in this case. Hence, the complex standard error for all data shown in Table IV fails to account for two sources of variability: the double sampling used to select values for imputation and the correlation between primary sampling units and strata induced by imputation. At the same time, the complex standard error for the weighted mean computed using only the real data is an incorrect estimate of the standard error of the mean based on all the data. The actual sampling

Figure II

Estimated mean charges per hospital outpatient department visit, by 4 family income classes for all and real data: United States, 1980

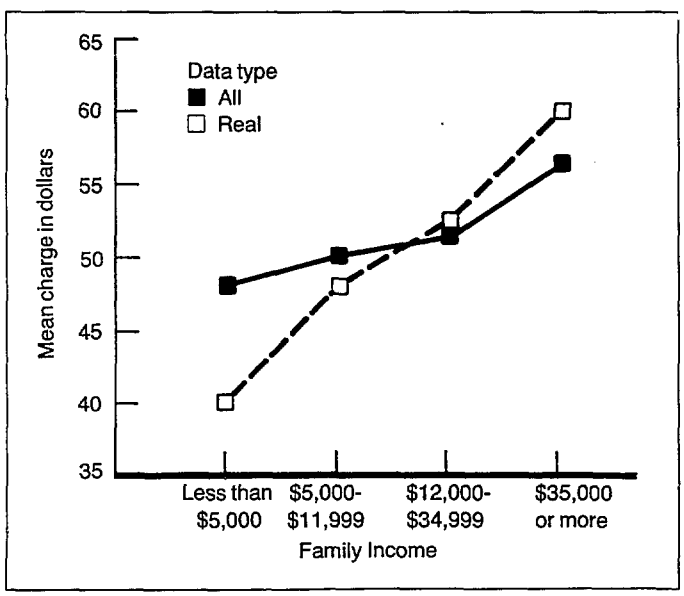
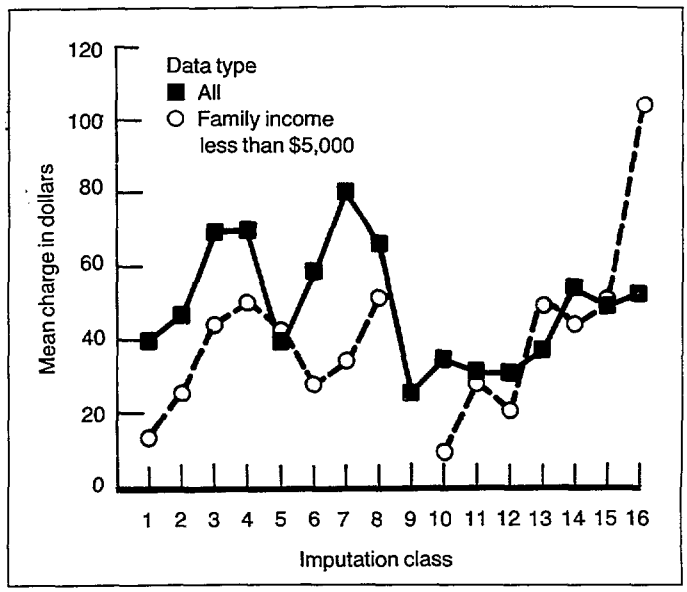


Figure III

Estimated mean charges per hospital outpatient department visit, by 16 imputation classes for all persons and for persons in families with income less than $5,000: United States, 1980



error of the weighted mean for all the data is probably larger than that shown for the mean estimated using all the data; it may even be larger than the sampling error computed using only the real data.

As a final illustration of the effects that imputation can have on survey results, Figure II presents estimated mean charges per hospital outpatient department visit for four family income groups computed using all the data and using only the real data. For the real data, the mean charge per visit increases in a linear fashion as the family income increases. However, when all the data are used to estimate the mean charge per visit, the mean charge does not increase as rapidly with increasing family income. The strong relationship between family income and mean charge per hospital outpatient department visit in the real data has been attenuated by the imputed values.

The reason for this attenuation is shown in Figure III. Sixteen imputation classes were formed for the imputation of total charges for hospital outpatient department visits. Figure III shows mean charge by imputation class for real data for the total sample and for the subgroup with family incomes less than $5,000 in 1980. The low income group has lower mean charges than the total sample. Because family income was not one of the variables used to form imputation classes, low family income persons within an imputation class with missing hospital outpatient department visit total charges were imputed a charge that was, on average, higher than the mean charge for low income persons with real data. This occurs in almost every imputation class. When the real and imputed data are combined for persons with family incomes less than $5,000, the effect of imputation is to increase the mean charge for this

subgroup. Conversely, for persons with family incomes of $35,000 or more, total hospital outpatient department visit charges for persons with real data tend to be larger than values imputed to persons with missing charges. The overall impact of the imputation process on the relationship between charges for hospital outpatient department visits and family income is a regression toward the mean charge for real data for low- and high-income subgroups.

The results in Tables III and IV and Figure II demonstrate the effect that imputation can have on estimated means, on estimated sampling errors, and on relationships between variables. Several strategies for handling imputation in estimation are suggested by these findings. It is beyond the scope of this discussion to evaluate various strategies and indicate the reasons why one was chosen for this report. The strategy used in preparing estimates for this report was to use all the data in all estimates despite the sizable effects caused by imputation. This strategy means that estimated means and totals presented in the report have been adjusted for item nonresponse, but sampling errors and relationships among some variables may be adversely affected by the imputation process. The reader should keep in mind that sampling errors for estimates that are subject to large amounts of item nonresponse may be underestimated, and the strength of relationships between a variable receiving imputed values and a variable that was not used to form imputation classes may be attenuated by the imputation process.

Estimation Procedures

Sample estimators from the NMCUES data, regardless of whether they are totals, means, medians, proportions, or standard errors, must account for the complexity of the sample survey design. Totals, means, and other estimates must include sampling weights to compensate for unequal probabilities of selection, nonresponse, and undercoverage. Stratification, clustering, and weighting must also be accounted for in the estimation of sampling errors. In addition, consideration must be given to time-adjustment factors to account for persons not eligible for the entire year and to imputations that were made to compensate for missing items.

A variety of estimators were used for the descriptive analyses. To illustrate the role of time adjustments, consider the following six specific estimates that were used in the analysis:

- Estimated total charges for a selected subgroup (e.g., the working-age population).
- Estimated total population.
- Mean charge per visit.
- Mean charge per person.
- Proportion of charges that fall in a certain range of charges.
- Proportion of persons whose charges are less than or equal to a fixed level.

To define these estimators, the following notation for these quantities for the ith person is used:

y_i = total charges for health care in 1980;

x_i = total number of medical visits for 1980;

w_i = nonresponse and undercoverage adjusted person weight;

t_i = time-adjustment factor (i.e., the proportion of days in 1980 that the person was an eligible member of the population);

$$d_i = \begin{cases} 1, \text{ if total charges are less than or equal to a fixed value,} \\ 0, \text{ otherwise;} \end{cases}$$

$$e_i = \begin{cases} 1, \text{ if the total charge is between two fixed values,} \\ 0, \text{ otherwise; and} \end{cases}$$

$$\delta_i = \begin{cases} 1, \text{ if the } i\text{th person is a member of a designated subgroup of the population,} \\ 0, \text{ otherwise.} \end{cases}$$

Estimating total charges, or any quantity from NMCUES that was recorded only during periods when the person was a noninstitutionalized civilian in the United States, is a relatively straightforward task requiring only a weighted sum of charge values. In particular,

$$\hat{y} = \sum w_i y_i \delta_i$$

is the estimated total charge for a particular service for a selected subgroup. On the other hand, for estimates of total population, a time-adjusted estimator is required such as

$$\hat{y}' = \sum w_i t_i \delta_i .$$

Thus, $\hat{y}'$ denotes an estimate of the 1980 average subgroup population, and $\hat{y}$ denotes the 1980 charges for a subgroup of the noninstitutionalized civilian population.

Estimated means may or may not need to include a time-adjustment factor in the denominator. For example, to estimate the mean charge *per visit* during 1980, no time adjustment is needed. Hence,

$$\bar{y} = \sum w_i y_i / \sum w_i x_i$$

can be used to estimate mean charge per visit. However, to estimate mean charge *per person,* a time adjustment

is required in the denominator because the denominator is actually an estimate of the total average population in 1980. In particular, the estimator has the form

$$\bar{y}' = \sum w_i y_i / \sum w_i t_i .$$

Estimates of mean charges for subgroups have a similar form, with the indicator variable δ_i included in the numerator and denominator for the appropriate subgroup of interest.

Estimated proportions are means that have an indicator variable in the numerator and a count variable in the denominator. Proportions may have time adjustments not only in the denominator but also in the numerator. For example, to estimate the proportion of persons who had charges less than or equal to a fixed value, an estimate of the form

$$p' = \sum w_i d_i t_i / \sum w_i t_i$$

was used. Appropriate indicator variables were added to the numerator and denominator to make estimates for selected subgroups.

On the other hand, the estimated proportion of total charges between two fixed levels of charges does not require time adjustments in the numerator or the denominator. In particular,

$$p = \sum w_i y_i e_i / \sum w_i y_i$$

is the estimated proportion of all charges for persons that occurred between two levels of charges.

Appendix IV. Sampling Errors

The NMCUES sample was one of a large number of samples that could have been selected from the U.S. civilian noninstitutionalized population using the same sampling procedures. Each possible sample could provide an estimate that might differ from the same estimate from another sample. The variability among the estimates from all possible samples that could have been selected is defined as the standard error of the estimate, or the sampling error. The standard error can be used to assess the precision of the estimate itself by creating a confidence interval. For each interval, there is a specified probability that the average estimate over all possible samples selected from the population using the same sampling procedures will be in the interval.

Preparation of sampling errors for every estimate in this report would be a sizable task, as would be presentation of sampling error estimates for every estimate. Rather than compute and display standard errors for every estimate in this report, standard errors were computed for a subset of estimates. A set of functions was fit to these estimated standard errors to identify a model that would allow computation of a standard error that would be reasonably close to the estimated standard error.

This appendix provides summary formulas derived from the estimated standard errors that can be used to approximate the standard error for any given estimate in the report. The formulas have been designed to allow computation of an estimated standard error using an electronic calculator with basic arithmetic operators and a square root function. The computed estimate will be an average or smoothed estimate of the actual standard error of the estimate.

The formulas for standard error estimates are presented for three types of estimates found in the report:

- Totals or aggregates (e.g., total charges for all health services used in 1980; total person years for males).
- Means (e.g., per capita total charges; per capita charges for inpatient care for females).
- Proportions, percents, and prevalence rates (e.g., proportion of total charges paid for outpatient physician care; percent of the working-age population who were employed full time, full year in 1980).

Comparisons can also be made between point estimates from two different subgroups of the population. Formulas are given for computing standard errors for two types of comparisons:

- Comparisons of two mutually exclusive subgroups (e.g., comparing per capita total charges for males and females, male and female subgroups having no members in common).
- Comparisons between a subgroup and a larger group in which the subgroup is contained (e.g., comparing total hospital stay charges for persons 65 years of age and over with those for all persons in the NMCUES population).

The standard error of a difference is based on the standard error of the totals, means, proportions, percents, or prevalence rates of interest. Certain covariances between estimates, which typically are small relative to the standard errors of the estimates themselves, are ignored.

The standard errors calculated from the formulas in this appendix can be used to form intervals about which confidence statements can be made for estimates from all possible samples drawn in exactly the same way as NMCUES was. The confidence level is determined by multiplying the estimated standard error by a constant derived from the standardized normal probability distribution. In particular, for the estimate $\hat{\theta}$ with estimated standard error $S_{\hat{\theta}}$, the upper limit for a $(1-\alpha) \times 100$-percent confidence interval can be formed by adding $z_{\alpha/2}$ times $S_{\hat{\theta}}$ to $\hat{\theta}$. The lower limit is formed by subtracting $z_{\alpha/2}$ times $S_{\hat{\theta}}$ *from* $\hat{\theta}$. The value of $z_{\alpha/2}$ is obtained from the standard normal probability distribution. For example, a 95-percent confidence interval corresponding to $\alpha = 0.05$ can be formed with $z_{0.025} = 1.96$; a 99-percent confidence interval ($\alpha = 0.01$) uses $z_{0.005} = 2.346$. Illustrations of these calculations are provided in the discussion section for each formula.

Confidence intervals for comparisons of estimates between two subgroups allow inferences to be made about whether the difference is statistically significant. If a $(1-\alpha) \times 100$-percent confidence interval does not include the value zero, the difference is significantly different from zero.

Totals

Let $\hat{y}$ denote the estimated total or aggregate for which a standard error is desired. The standard error for the estimate can be calculated by the expression

$$S_{\hat{y}} = [a\hat{y} + b\hat{y}^2]^{1/2},$$

where a and b are constants chosen from Table V for the particular estimate of interest. This formula was derived from a study of the relationship between the estimated total $\hat{y}$ and its standard error $S_{\hat{y}}^2$ in which a parabolic or quadratic relationship was observed.

As an illustration of the use of this formula, suppose that the standard error of the estimated total charges for all health services for women 17–44 years of age is needed. From Table 1, $\hat{y} = \$34{,}550{,}000{,}000$, the estimated total health care charges accumulated in 1980 by women 17–44 years of age. Table V contains the coefficients for charges, $a = 1.0986 \times 10^8$ and $b = 4.5524 \times 10^{-4}$. The estimated standard error is then computed as

$$\begin{aligned} S_{\hat{y}} &= [(1.0986 \times 10^8)(34.55 \times 10^9) + \\ &\quad (4.5524 \times 10^{-4})(34.55 \times 10^9)^2]^{1/2} \\ &= [(3.7957 \times 10^{18}) + (5.4342 \times 10^{17})]^{1/2} \\ &= 2{,}083{,}100{,}000. \end{aligned}$$

This estimated standard error for the total $\hat{y}$ can be used to create confidence intervals for total charges for women 17–44 years of age. For example, a 68-percent confidence interval is obtained by adding and subtracting the standard error from the estimate. In this case, in 68 out of 100 samples drawn exactly in the same way as in NMCUES, the estimated total charges for women 17–44 years of age will range from \$32,467,000,000 to \$36,633,000,000. Similarly, a 95-percent confidence interval can be obtained by adding and subtracting from the estimate 1.96 times the standard error. Thus, for 95 of 100 samples drawn in the same way as in NMCUES, the estimated total charges for women 17–44 years of age would be from \$30,467,000,000 to \$38,633,000,000.

Table V

Coefficients for standard error formula for estimated aggregates or totals, by estimator

Estimator	Coefficient	
	a	b
Person years	3.0476×10^4	4.7081×10^{-4}
Charges	1.0986×10^8	4.5524×10^{-4}
Lost productivity and value of lost productivity	1.1593×10^1	9.1757×10^{-4}
Visits, prescription acquisitions, or disability days	4.6408×10^2	5.7634×10^{-1}

Means

A large number of means for different types of measures are presented in this report. Despite the variety of measures presented, a single formula is recommended for calculating an estimated standard error for a mean. The formula given here is based on the assumption that the standard error of the mean is determined by two quantities, the population variance and the effect of the sample design on the variances. The population variance for weighted survey data with weights w_i is estimated as

$$\hat{s}^2 = \frac{\sum w_i (y_i - \bar{y})^2}{(n-1)\sum w_i},$$

where n is the size of the sample, y_i denotes the value of the characteristic Y for the ith sample person, and $\bar{y}$ is the weighted sample mean. The effect of the sample design on the variance of a sample mean is called the design effect, or "deff" (Kish, 1965), and is often expressed as

$$\text{deff} = [1 + [(n/a) - 1]\, roh],$$

where a is the number of clusters in the sample design and roh is a measure of within-cluster similarity among observations from the same cluster.

The estimated standard error for a mean $\bar{y}$ can be calculated as

$$S_{\bar{y}} = \left[\text{deff} \cdot \frac{\hat{s}^2}{\hat{n}}\right]^{1/2}$$

$$= \left[\left[1 + \left[\frac{\hat{n}}{1{,}795{,}637} - 1\right] roh\right] \cdot \frac{\hat{s}^2}{\hat{n}}\right]^{1/2},$$

where $\hat{n}$ is the estimated population total for the subgroup under consideration and 1,795,637 represents the number of clusters ($a = 138$) times the average basic person weight. Consequently, $\hat{n}/1{,}795{,}637$ is an estimator for n/a in the expression for deff. The values of roh and $\hat{s}^2$ for a variety of means appearing in this report can be obtained from Table VI. The table provides, for example, values of roh and $\hat{s}^2$ for mean charges and mean utilization measures of various types.

As an illustration, consider the standard error of the per capita charges for all health care in 1980 for males 17–44 years of age. From Table B, for males 17–44 years of age $\bar{y} = \$473$, and from Table VI, under the entry "Mean charge per person, All charges, Total," the values $roh = 0.029644$ and $\hat{s}^2 = 7.2407 \times 10^{10}$ are obtained. There were an estimated $\hat{n} = 45{,}576{,}000$ males 17–44 years of age. Substituting these values into the expression for $S_{\bar{y}}$,

Table VI

Values for *roh* and $\hat{s}^2$ for standard error formula for estimated means, by estimator

Estimator	*roh*	$\hat{s}^2$
Mean charges per person		
All charges:		
Ambulatory visits	0.029644	2.4952×10^{9}
Hospital stays	0.029644	6.1652×10^{10}
Physician visits	0.029644	6.1914×10^{8}
Total	0.029644	7.2407×10^{10}
Emergency room visits	0.029644	9.9816×10^{7}
Prescribed medications	0.029644	9.6458×10^{7}
Hospital outpatient visits	0.031367	7.6646×10^{8}
Independent provider visits	0.031367	2.6559×10^{7}
Hospital outpatient visits (nonphysician provider)	0.031367	4.2419×10^{8}
Physician visits (nonphysician provider)	0.031367	5.3375×10^{7}
Dental and other medical expenses	0.031367	8.8305×10^{7}
Charges paid out of pocket:		
Ambulatory visits	0.029644	2.4323×10^{8}
Hospital stays	0.029644	2.4068×10^{9}
Physician visits	0.029644	1.0745×10^{8}
Total	0.029644	3.5873×10^{9}
Emergency room visits	0.029644	1.0038×10^{7}
Prescribed medications	0.029644	4.5416×10^{7}
Hospital outpatient visits	0.031367	8.6571×10^{6}
Independent provider visits	0.031367	2.4996×10^{8}
Hospital outpatient visits (nonphysician provider)	0.031367	2.5341×10^{7}
Physician visits (nonphysician provider)	0.031367	6.7847×10^{8}
Dental and other medical expenses	0.031367	3.8943×10^{8}
Mean charges per user		
All charges:		
Ambulatory visits	0.043633	3.0423×10^{9}
Hospital stays	0.043633	3.0044×10^{11}
Physician visits	0.043633	1.1955×10^{9}
Total	0.043633	8.7587×10^{10}
Emergency room visits	0.043633	3.3067×10^{8}
Prescribed medications	0.043633	1.2535×10^{8}
Charges paid out of pocket:		
Ambulatory visits	0.043633	2.9046×10^{8}
Hospital stays	0.043633	1.6296×10^{10}
Physician visits	0.043633	1.5871×10^{8}
Total	0.043633	5.3877×10^{9}
Emergency room visits	0.043633	7.5825×10^{7}
Prescribed medications	0.043633	6.2806×10^{7}
Mean charges per visit		
All charges:		
Ambulatory visits	0.018777	3.7690×10^{7}
Hospital stays	0.018777	8.4926×10^{11}
Physician visits	0.018777	2.4686×10^{7}
Emergency room visits	0.018777	9.7896×10^{8}
Prescribed medications	0.018777	6.7348×10^{5}
Charges paid out of pocket:		
Ambulatory visits	0.018777	8.8152×10^{6}
Hospital stays	0.018777	9.4998×10^{10}
Physician visits	0.018777	9.2576×10^{6}
Emergency room visits	0.018777	1.1109×10^{8}
Prescribed medications	0.018777	7.8309×10^{5}
Mean visits per user		
Ambulatory visits	0.048246	1.4117×10^{6}
Hospital stays	0.048246	4.3009×10^{3}
Physician visits	0.048246	4.4788×10^{5}
Emergency room visits	0.048246	7.9937×10^{3}
Prescribed medications	0.048246	1.3402×10^{6}
Mean visits per person		
Ambulatory visits	0.048246	1.6398×10^{6}
Hospital stays	0.048246	1.0029×10^{4}
Physician visits	0.048246	5.5650×10^{5}
Emergency room visits	0.048246	1.6024×10^{4}
Prescribed medications	0.048246	1.6651×10^{6}
Mean percent paid out of pocket		
Ambulatory visits	0.051674	2.3071×10^{3}
Hospital stays	0.011724	1.7959×10^{2}
Prescribed medications	0.056569	2.7935×10^{3}
Dental and other medical expenses	0.053301	2.6150×10^{3}
Mean length of hospital stay	0.013098	8.5018×10^{5}
Mean bed-disability days	0.023772	7.6885×10^{6}
Mean work-loss days	0.026868	5.2013×10^{6}
Mean restricted-activity days	0.058349	3.4354×10^{7}
Mean functional limitation score	0.050066	4.9489×10^{4}
Mean number of surgical procedures	0.0	1.4628×10^{8}

$$S_{\bar{y}} = \left[\left[1 + \left(\frac{45{,}576{,}000}{1{,}795{,}637} - 1\right)(0.029644)\right] \cdot \frac{7.2407 \times 10^{10}}{45{,}576{,}000}\right]^{1/2}$$

$$= \left[\left[1 + (25.382 - 1)(0.029644)\right](1588.7)\right]^{1/2}$$

$$= [(1.7228)(1588.7)]^{1/2}$$

$$= 52.316.$$

The standard error of per capita total charges for males 17–44 years of age is $52.32.

Approximate confidence intervals may be constructed for the population mean by adding to and subtracting from the estimated mean a constant times the estimated standard error. For example, to form a 95-percent confidence interval for the estimated per capita

charges for males 17–44 years of age, 1.96 times the estimated standard error ($103) is added to and subtracted from the estimated mean $\bar{y}$ = $473. In this case, the 95-percent interval ranges from $370 to $576.

When the estimated sample size is about the same size as or smaller than the constant 1,795,637 in the standard error formula, the design effect effectively becomes equal to 1. Thus, when $\hat{n} \leq 1{,}795{,}000$, the design effect portion of the standard error formula is not necessary, and the estimated standard error can be calculated simply as

$$S_{\bar{y}} = \left[\hat{s}^2/\hat{n}\right]^{1/2},$$

where $\hat{s}^2$ is again chosen from Table VI.

For example, there are an estimated $\hat{n} = 1{,}468{,}000$ unemployed males of all ages. To estimate the standard error of the per capita charges for all health care for these persons in 1980 ($\bar{y}$ = $802 from Table J), the value $\hat{s}^2 = 7.2407 \times 10^{10}$ is obtained from Table VI as before and

$$S_{\bar{y}} = \left[\frac{7.2407 \times 10^{10}}{1{,}468{,}000}\right]^{1/2}$$

$$= 222.09.$$

To form an approximate 95-percent confidence interval for the per capita charges, 1.96 times the standard error ($435) is added to and subtracted from the estimated mean, $\bar{y}$ = $802. The 95-percent interval thus ranges from $367 to $1,237.

Proportions and Percents

The standard error of a proportion is computed using a formula similar to that recommended for the standard error of a mean. Let $\hat{p}$ denote the estimated proportion for which a standard error is needed. The standard error for $\hat{p}$ is calculated as

$$S_{\hat{p}} = \left[\left[1 + \left[\frac{\hat{n}}{1{,}795{,}637} - 1\right] roh\right] \frac{13{,}012\,\hat{p}(1-\hat{p})}{\hat{n}}\right]^{1/2},$$

where $\hat{n}$ is the estimated sample size on which the proportion is based, *roh* is a value selected from Table VII, and the constant 13,012 is the average time-adjusted weight for all persons in the sample. For proportions, the population variance can be estimated simply as

$$\hat{s}^2 = \hat{p}(1-\hat{p}),$$

and hence can be estimated directly from the sample proportions themselves (i.e., no value of $\hat{s}^2$ is needed in Table VII). The design effect, the ratio of the actual sampling variance for the estimated proportion to the variance that would be achieved for a simple random sample of the same size, is calculated for proportions in the same way as it was calculated for means.

Table VII

Values of *roh* for standard error formula for estimated proportions, by estimator

Estimator	*roh*
Person years	0.069992
Charges	0.041917
Charges paid out of pocket	0.019816
Visits	0.084014

As an illustration of the use of the formula for $S_{\hat{p}}$, consider obtaining the standard error for the proportion of total productive person years lost as a result of morbidity ($\hat{p}$ = 0.667) attributable to the unable-to-work population (Table L). To calculate the standard error for percents, the same formula can be used as for proportions after the percent has been divided by 100. There are an estimated $\hat{n}$ = 7,885,000 persons in the category (Table 8), and *roh* = 0.069992 is obtained from Table VII. Substituting these values into the formula for $S_{\hat{p}}$,

$$S_{\hat{p}} = \left[\left[1 + \left(\frac{7{,}885{,}000}{1{,}795{,}637} - 1\right)(0.069992)\right] \cdot \frac{13{,}012\ (0.667)(1-0.667)}{7{,}885{,}000}\right]^{1/2}$$

$$= \left[\left[1 + (3.3912)(0.069992)\right]\frac{2{,}890.1}{7{,}885{,}000}\right]^{1/2}$$

$$= \left[(1.2374)(3.6653 \times 10^{-4})\right]^{1/2}$$

$$= 0.021297.$$

Because $S_{\hat{p}}$ = 0.021297 is the estimated standard error for the proportion $\hat{p}$ = 0.667, simply multiply $S_{\hat{p}}$ by 100 for a standard error of 2.1297 for the percent 66.7.

An approximate 95-percent confidence interval for the percent can now be calculated by adding to and subtracting from the estimated percent 1.96 times the estimated standard error. In this case, the 95-percent interval ranges from 62.5 to 70.9 percent of total productive person years lost from morbidity that is attributable to the unable-to-work population.

When the estimated sample size is less than or equal to 1,795,637, the design effect is close to 1 and the formula can be simplified to

$$S_{\hat{p}} = \left[\frac{13{,}012\,\hat{p}(1-\hat{p})}{\hat{n}}\right]^{1/2},$$

as described for the standard error of a mean in the previous section. For example, 72.7 percent of the value of productivity lost as a result of morbidity in the black population is attributable to those who are unable to work (Table N). For the $\hat{n} = 1{,}153{,}000$ estimated persons in this subcategory (Table 8), the standard error of the proportion associated with this percent is estimated as

$$\left[\frac{13{,}012 \cdot (0.727)(1-0.727)}{1{,}153{,}000}\right]^{1/2} = 0.047327.$$

A 95-percent confidence interval for the estimated percent is calculated by multiplying this estimated standard error by $100 \cdot (1.96) = 196$ and adding the result to and subtracting the result from the percent. Thus, the 95-percent interval ranges from 63.4 to 82.0 percent.

Mutually Exclusive Subgroup Differences

Many comparisons between the same estimate for two different subgroups in the population are made in this report. Let $\hat{d} = \hat{\theta}_1 - \hat{\theta}_2$ denote the difference between two subgroup estimates, where $\hat{\theta}_1$ and $\hat{\theta}_2$ are the estimates for the two subgroups. For example, suppose that the per capita charges for females 17–44 years of age are to be compared with the per capita charges for males 17–44 years of age (Table 2). Then, $\hat{\theta}_1 = \bar{y}_1 = \$711$ for females 17–44 years of age, $\hat{\theta}_2 = \bar{y}_2 = \$473$ for males 17–44 years of age, and $\hat{d} = \bar{y}_1 - \bar{y}_2 = \$238$. The standard error of this difference is computed as

$$S_{\hat{d}} = \left[S^2_{\hat{\theta}_1} + S^2_{\hat{\theta}_2}\right]^{1/2},$$

where $S^2_{\hat{\theta}_1}$ and $S^2_{\hat{\theta}_2}$ are the estimated sampling variances for $\hat{\theta}_1$ and $\hat{\theta}_2$, respectively. (This formula ignores the nonzero covariance between $\hat{\theta}_1$ and $\hat{\theta}_2$ that arises in complex samples such as NMCUES. This covariance is typically positive and small relative to the variances themselves. Ignoring the covariance will result in standard errors for differences that are on average somewhat larger than the actual standard errors.)

From Table 3, $\hat{n}_1 = 48{,}626{,}000$ and $\hat{n}_2 = 45{,}576{,}000$; from Table VI, $roh = 0.029644$ and $\hat{s}^2 = 7.2407 \times 10^{10}$. Hence,

$$S_{\bar{y}_1} = \left[\left[1 + \left(\frac{48{,}626{,}000}{1{,}795{,}637} - 1\right)(0.029644)\right] \cdot \frac{7.2407 \times 10^{10}}{48{,}626{,}000}\right]^{1/2}$$

$$= 51.384$$

and

$$S_{\bar{y}_2} = \left[\left[1 + \left(\frac{45{,}576{,}000}{1{,}795{,}637} - 1\right)(0.029644)\right] \cdot \frac{7.2407 \times 10^{10}}{45{,}576{,}000}\right]^{1/2}$$

$$= 52.316.$$

Therefore, the standard error of the difference is computed as

$$S_{\hat{d}} = \left[(51.384)^2 + (52.316)^2\right]^{1/2} = 73.330.$$

This standard error can be used to form an approximate confidence interval for the difference in the same manner as described previously for estimates of totals, means, proportions, and percents. In this instance, the 95-percent confidence interval is from \$94.27 to \$381.73. Since this interval does not include the value zero, it can be concluded with 95-percent confidence that per capita charges differ for the two categories. In other words, the chances are only 5 in 100 that the difference over a large number of identical surveys will be equal to zero.

Subgroup to Total Group Differences

Another type of comparison made in this report is between an estimate for a subgroup and the same estimate for a group that contains the subgroup. Let $\hat{d} = \hat{\theta}_1 - \hat{\theta}_T$ denote the difference between a subgroup estimate and the estimate for a group in which the subgroup is contained, where $\hat{\theta}_1$ is the subgroup estimate and $\hat{\theta}_T$ is the estimate for the larger group. The standard error of this difference is computed as

$$S_{\hat{d}} = S_{\hat{\theta}_1}\left[1 - (\hat{n}_1/\hat{n}_T)\right]^{1/2},$$

where $S_{\hat{\theta}_1}$ denotes the standard error of the estimator $\hat{\theta}_1$, and $\hat{n}_1$ and $\hat{n}_T$ denote the estimated sample sizes for the subgroup and for the larger group, respectively. (This mula is based on an assumption that the covariance between $\hat{\theta}_1$ and $\hat{\theta}_T$ is the same as the variance of $\hat{\theta}_1$, i.e., $S^2_{\hat{\theta}_1}$. This assumption results in an estimated standard error for the difference that is on average somewhat larger than the actual standard error.)

For example, suppose that the standard error of the difference between per capita total charges for black persons and per capita total charges for all persons is needed. From Table 2, $\hat{\theta}_1 = \bar{y}_1 = \$573$, $\hat{\theta}_T = \bar{y}_T = \$690$, $\hat{n}_1 = 26{,}046{,}000$, and $\hat{n}_T = 222{,}824{,}000$. Using the formula for estimating the standard error of the mean and values from Table VI (i.e., $\hat{s}^2 = 7.2407 \times 10^{10}$ and $roh = 0.029644$),

$$S_{\bar{y}_1} = \left[\left[1 + \left(\frac{26{,}046{,}000}{1{,}795{,}637} - 1 \right) (0.029644) \right] \frac{7.2407 \times 10^{10}}{26{,}046{,}000} \right]^{1/2}$$

$$= 62.393.$$

Hence, the standard error of the difference, $\hat{d} = \$573 - \$690 = -\$117$, is computed as

$$S_{\hat{d}} = 62.393 \left[1 - (26{,}046{,}000/222{,}824{,}000) \right]^{1/2} = 58.633.$$

A 95-percent confidence interval can be constructed for the difference by adding to and subtracting from the estimated difference 1.96 times the estimated standard error of the difference. In this instance, the 95-percent confidence interval is from $-\$231.92$ to $-\$2.08$. It can be concluded with 95-percent confidence that black persons have lower per capita total charges than all persons because this confidence interval does not include zero.

Appendix V. Methodology Employed in Calculating Direct and Indirect Costs of Illness

Introduction

Estimates of direct and indirect costs of morbidity and mortality are based on the human capital approach to the calculation of the costs of illness. Using this approach, the costs of illness are assessed in terms of (1) resources used, or direct costs (i.e., charges for goods and services devoted to medical care for the ill), and (2) resources lost, or indirect costs (i.e., productive capacity lost to society as measured by loss of work time and earnings as a result of morbidity and mortality). The NMCUES sample population is drawn from the civilian noninstitutionalized population, and the national estimates derived from that sample are for the same population. Cost estimates are also limited by the methods employed in data collection and compilation of the NMCUES public use data files. Definitions of direct and indirect costs estimated from NMCUES data, discussions of the limitations of the data as they pertain to cost estimation methodologies, and details of the procedures employed in the cost estimation processes follow.

Estimates of both direct and indirect costs in this report should be considered underestimates. Both direct and indirect costs are calculated on the basis of reported and/or estimated charges and earnings of informants and members of their households. Neither direct nor indirect costs, therefore, include the value of certain resource expenditures occasioned by morbidity and mortality. For example, the value of services such as transportation, child care, and care-giving provided by family members and others, as well as the indirect costs associated with these activities, are not included in these estimates. In addition, the psychological and psychic costs of illness, which have never been adequately measured in economic terms, are also excluded from these estimates.

Direct Costs

In the human capital approach to the estimation of the costs of illness, direct costs are estimated on the basis of the market prices for goods and services devoted to the prevention, detection, treatment, and rehabilitation of illness (Scitovsky, 1982; Hodgson and Meiners, 1982; Hu and Sandifer, 1981; Hodgson and Kopstein, 1984).

NMCUES data provide estimates of direct costs incurred during 1980 for inpatient and outpatient hospital care, physician services and the services of other health professionals, dental services, prescribed medications, and selected other medical goods and services. Some types of services traditionally included in direct costs, e.g., over-the-counter drugs, are not included in the NMCUES public use data files and therefore are not included in these estimates.

Estimates in this report are based on charges reported by household informants without provider verification. The data, therefore, are likely to be underestimates of the costs of care because respondents may not know or recall actual charges. For example, they may report only out-of-pocket costs rather than total charges. Respondents covered by various public programs may be especially likely to underreport charges; bills for services rendered are not always provided to consumers in such programs.

Limitations of the data affect direct-cost estimates calculated by diagnostic category in two ways. First, when multiple conditions are associated with a service, all related conditions are listed for the service, but no primary diagnosis is indicated. Careful examination of such cases showed that it is generally accurate to assume that the first condition listed is the primary diagnosis. Therefore, charges associated with a service were assigned to the first condition listed. However, there is little assurance that the first condition is, in all cases, the primary diagnosis and that charges associated with one diagnostic category would not have been more appropriately assigned to another. This limitation affects only 12.2 percent of hospital stays, 9.8 percent of ambulatory visits, and 3.7 percent of prescription acquisitions. Second, direct-cost estimates by diagnostic category do not include charges for dental services because conditions or diagnoses were not associated with either dental visits or charges in the NMCUES data files. Direct costs for dental care *are* included in the total direct-cost estimates not stratified by diagnostic category. This means that total direct costs reported by diagnostic category are less than total direct costs reported in other parts of the report by the amount of charges for dental care.

Indirect Costs

Indirect costs are costs associated with illness and injury that result in resource losses to society. Resource loss is generally calculated as lost productive capacity, or the loss of economic output because of morbidity and mortality. Indirect costs are usually based on the amount of time by which the individual's productivity is diminished or lost multiplied by the monetary value of that lost productive time.

Productive Years Lost Because of Morbidity

To quantify indirect costs, it is first necessary to estimate productive time lost. The usual unit for such calculations is productive person years. Productive years lost, a nonmonetary measure of morbidity costs, is defined as the number of productive days lost because of illness in a year divided by the number of productive days in a year. For employed persons, work-loss days are divided by 245, which is the average number of work days in a year. For homemakers, either bed-disability days or restricted-activity days could be used as the measure of lost output. Because homemakers could be productive every day of the year, the appropriate denominator to annualize days lost is 365. In this study, estimates are made on the basis of both bed-disability days and restricted-activity days because the former underestimates and the latter overestimates lost productivity. By making both calculations, upper and lower bounds for a reasonable estimate of lost productivity can be constructed for homemakers. Measures of lost productive time for individual workers and homemakers are weighted and aggregated to produce national estimates of productive person years lost for these two subpopulations.

A special problem exists in the calculation of indirect costs for persons unable to work because of illness for the whole year. The calculation of productive years lost for the category of individuals unable to work is complicated by the fact that NMCUES data are weighted. (See Appendixes I and III for more information.) Each individual is assigned a basic person weight. Based on sampling probabilities, this means that each case in the sample represents several thousand individuals in the U.S. civilian noninstitutionalized population. These basic person weights are used to produce estimates based only on data collected from persons during periods of survey eligibility (i.e., when the individuals were alive, were members of the civilian noninstitutionalized population, and were continuing members of the survey population).

Neither health care nor productivity data could be collected from persons not eligible for the survey. If a person was institutionalized during the survey period, for example, data could not be collected for that person after the date of institutionalization. In contrast, person characteristics such as sex or race could apply for the whole survey period. Estimates of person characteristics must be time adjusted in order to correspond to health care or productivity estimates. Therefore, in addition to a basic person weight, each individual is assigned a time-adjusted person weight to adjust for the exact amount of time the individual was actually in the eligible survey population. For example, a person who died at the end of the survey period is assigned a larger time-adjusted weight than a person who died at the beginning of the survey period, because the person who died later in the year was eligible for the survey for a longer period of time than the person who died early in the year was. These time-adjusted weights are used to produce estimates of person characteristics such as total population or proportion of the population in a given subcategory.

The collection of data on productive time lost (e.g., work-loss days) could occur only when an individual was eligible for the survey, so the basic person weight is the appropriate weight to be employed for the calculation of productive time lost for workers and homemakers. However, this is not the case for the category of persons unable to work. Because these individuals receive an assigned level of lost productivity (see discussion of assignment process below) instead of reporting actual lost productivity, survey eligibility must be taken into account. Assigned lost productive time can be counted only for the time period that the person was eligible for the survey. Therefore, the time-adjusted weight rather than the basic person weight is used in the calculation of indirect costs for the unable-to-work category.

Estimation of productive losses for the category of persons unable to work is complicated. The use of weighted data necessitates the construction of composite persons to facilitate the apportionment of lost productivity to this group without introducing a bias. In order to assign lost productivity for the unable-to-work category, the assumption is made that, even if they were able to work or keep house, not all of these individuals would do so (Cooper and Rice, 1976). Even if healthy, some would be unemployed, retired, or students. It is assumed, then, that they would be distributed across the various employment categories in a manner that reflects the distribution of employment in the general 1980 population. Assignment of employment status at the individual level should be a random process. However, the data must be weighted to produce national estimates. If employment status were to be assigned at the individual level, the weighting process would distort the distribution of employment. Therefore, composite persons are constructed at the individual level. Composite persons reflect the 1980 distribution of employment but allow estimation of national losses without distortion. Each member of the population unable to work is assigned a probability of being employed based on the 1980 labor force participation rate and the 1980 employment rate according to sex and age category. In addition, each person unable to work is assigned a probability of being a homemaker

that equals the percent of homemakers in the female population by age category. Males are assigned a zero probability of being a homemaker. The sum of the probability of being employed and the probability of being a homemaker equals the proportion of the year's productivity lost because of morbidity (disability) for a composite person. Values for these composite persons are then weighted and aggregated to produce undistorted national estimates.

Morbidity Costs

Estimates of indirect morbidity costs incurred in 1980 are calculated on the basis of earnings and work-loss time reported by the household informant when available. Reported earnings do not include employee benefits, so the reported figures are adjusted by a factor of 1.172 to account for the additional value of reported earnings represented by fringe benefits. The adjustment factor is based on 17.2 percent, the mean percent of earnings represented by employee benefits in 1980 (*Survey of Current Business,* 1981). Lost earnings for employed persons whose earnings were not reported are estimated using U.S. Department of Labor 1980 data for mean annual earnings and are specific to the individual's age, sex, race, and employment.. These figures also are adjusted to include employee benefits. Lost productivity for homemakers, whose labor is traditionally not reimbursed, is estimated using the market value approach. The value of lost homemaker services is approximated by estimating the cost of labor that would have to be purchased in the marketplace to replace those services. The imputed values employed are derived from time-use studies and wage rates (Hodgson and Rice, 1984; Walker and Gauger, 1973).

Persons unable to work or keep house because of ill health for all of 1980 are also included in the calculation of indirect costs. (See the discussion in the previous section for the rationale and procedures used to assign lost productive time to this category.) To estimate the value of lost productivity, an additional step is required. The probability of being employed is multiplied by 1980 mean annual earnings, specific to age and sex, and adjusted for fringe benefits. The probability of being a homemaker is multiplied by imputed 1980 age-specific mean annual values for homemaker services. These two products are then summed and weighted. Again, the time-adjusted person weight is employed in the weighting process.

In previous estimates of the cost of illness, specifications of the population unable to work have not included disabled homemakers. Disabled homemakers are identified and included in the unable-to-work category in this report. Therefore, the population unable to work is larger and the indirect costs associated with this category are higher as shown in this report than previous estimates have suggested. Because of limitations in the NMCUES data files, the categorical definition of the unable-to-work population does not include respondents disabled for only a portion of the year. These individuals are included in the employed category. Thus, only persons prevented from working or keeping house by health problems for the entire year are included in the unable-to-work category.

Single-Year Mortality Costs

Estimates of mortality costs incurred in 1980 (i.e., single-year mortality costs) are calculated for persons 17 years of age and over who were employed, homemakers, or unable to work for health reasons and for persons under 17 years of age who died during 1980. Lost work or housekeeping time is calculated from the date of death through December 31, 1980. Either known or estimated earnings, or values for housekeeping services, are applied to produce estimates of the value of lost productivity during the year. Both known and estimated earnings, but not values for housekeeping services, are adjusted to include fringe benefits. Estimates of losses from the death of individuals in the unable-to-work category are derived by calculating lost earnings for the portion of the year following the death of the individual and by constructing composite persons, as was done to calculate morbidity costs for this category. Again, estimates of earnings, but not values for housekeeping services, are adjusted for employee benefits. Earnings data are not available in the NMCUES public use data files for persons under 17 years of age, so imputed earnings for composite persons in that age cohort for 1980 are used for the portion of the year following the respondent's death. In the Rice-Hodgson calculations employed for this group, employee benefits are taken into account, so no further adjustment is made (Hodgson and Rice, 1984).

Productive Years Lost From Mortality

Estimates of mortality costs include productive years lost, a nonmonetary measure of costs associated with premature mortality. The estimate of productive years lost represents the total amount of potential work or housekeeping time lost when a person dies prematurely. Years of life lost are determined by comparing an individual's age at death with the sex- and race-specific life expectancy for persons of that age in 1980 (National Center for Health Statistics, 1984). Total productive years lost are measured by summing the weighted number of years lost for all persons who died in 1980. The weighting process employs the basic person weight. The NMCUES public use data files indicate only age on January 1, 1980, and not the date of birth, so the exact age at death is not known. For the National Center

for Health Statistics Life Tables, it is assumed that age is measured at midyear rather than at the beginning of the year. Newborns are assigned to the "0" age category in the Life Table, and persons 85 years of age and over at death are treated as if they were 85 years of age. It is assumed that errors in this procedure will be randomly distributed and will not bias the estimates.

Total Mortality Cost

The total economic cost of mortality is estimated for all respondents who died in 1980 and represents the present value of lifetime earnings lost because of premature mortality. Imputed values for lost lifetime earnings are based on the assumption that a person who dies represents a loss in productivity to society that equals the remainder of his or her expected stream of earnings; that is, losses occur not only in the year of death but in subsequent years as well. Annual earnings are averaged for each age and sex category and therefore do not reflect any individual's actual earnings potential.

Discounting of future earnings is necessary to compute the present value of future productivity losses resulting from premature death. In order to place an appropriate value on future earnings lost because of premature death, the lost lifetime earnings are converted to their present value, i.e., discounted. Various discount rates have been employed historically to make this conversion. Calculations for this report employ 6- and 10-percent discount rates. However, an annual increase in productivity of 2 percent is incorporated in the calculation of future earnings. This is equivalent to applying 4- and 8-percent discount rates to earnings that have not been adjusted for changes in productivity (Hodgson and Rice, 1984).

There is no generally accepted best discount rate or productivity increment to apply in these calculations. For example, the 2-percent productivity-gain adjustment reflects practices that generally have been used for many years. However, more recent productivity data over the past three decades indicate annual productivity increases on the order of only 0.9 percent. An analogous situation exists with respect to variations in the discount rate itself, which have been extremely volatile in recent years. By employing various discount rates, it is possible to bracket ranges of estimates for the present value of future earnings losses to take account of these variations.

The objective of this study is to estimate the cost of illness to society, so for this report, estimated future earnings are not adjusted for estimated future consumption charges. Economists generally agree that it is not only the individual's productive contribution to society in excess of his or her own consumption that is valued by society. Rather, the premature loss of the individual is itself a loss to society; hence, individual consumption is not deducted (Mishan, 1971; Warner and Luce, 1982).

Limitations of the Data

Reports of indirect costs of morbidity or mortality calculated by diagnostic category are not included in this report because of limitations of the NMCUES public use data files. When individuals suffer from multiple conditions and more than one of the conditions is associated with work-loss days, bed-disability days, or restricted-activity days, no primary diagnosis is assigned to those days. Furthermore, all such days are assigned to each condition associated with the loss. Each disability day may be listed several times (once for each associated condition), thereby overstating productivity loss. Therefore, morbidity costs by diagnosis were not calculated.

The calculation of the indirect costs of mortality by diagnostic category is not possible using the NMCUES public use data files because cause of death was not reported.

Categorical Definitions

The direct costs of illness are reported by health service categories, diagnostic categories, and selected population characteristics. Categorical definitions are provided below for groupings that may not be self-explanatory.

I. Health service categories.
   - A. Hospital care.
     1. Inpatient services: Sum of total charges for hospital stays.
     2. Outpatient services: Sum of total charges for emergency room services and hospital outpatient department services when a nonphysician provider was seen.
   - B. Physician services.
     1. Inpatient services: Sum of total charges for inpatient physician services.
     2. Outpatient services: Sum of total charges for hospital outpatient department physician services and for physician services provided at sites other than hospitals by physicians or nonphysicians working with a physician.
   - C. Dental services: Sum of total charges for dental visits.
   - D. Other health professional services: Sum of total charges for independent health professionals, including chiropractors, podiatrists, optometrists, psychologists, social workers, nurses, physical therapists, and others.
   - E. Prescribed medications: Sum of total charges for prescribed medications only. Does not include over-the-counter drugs.
   - F. Other medical supplies: Sum of total charges for eyeglasses, orthopedic appliances, hearing aids, diabetic supplies, and ambulance services.

II. Diagnostic categories: Reported conditions are recoded to conform to subcategories of the Tabular List of the International Classification of Diseases, Ninth Revision (ICD-9) (World Health Organization, 1977). The recodes utilized by NMCUES are listed with the corresponding ICD-9 categories and two-digit codes in Table VIII.

III. Selected population characteristics.

A. Employment categories.

1. Employed: Persons 17 years of age and over

Table VIII

Diagnostic codes used in the National Medical Care Utilization and Expenditure Survey (NMCUES): United States, 1980

ICD–9[1] category	ICD–9[1] 2–digit code	NMCUES recode of reported conditions
Infectious and parasitic diseases	01	Intestinal infectious diseases
	02	Tuberculosis
	03	Other bacterial diseases
	04	Viral diseases
	05	Rickettsiosis and other arthropod-borne diseases
	06	Venereal diseases
	07	Other infectious and parastic diseases and latent effects
Neoplasms		Malignant neoplasms of the—
	08	Lip, oral cavity, and pharynx
	09	Digestive organs and peritoneum
	10	Respiratory and intrathoracic organs
	11	Bone, connective tissue, skin, and breast
	12	Genitourinary organs
	13	Other and unspecified sites
	14	Lymphatic and haemopoietic tissue
	15	Benign neoplasms
	16	Carcinoma in situ
	17	Other and unspecified neoplasms
Endocrine, nutritional, and metabolic diseases and immunity disorders	18	Endocrine and metabolic diseases
	19	Nutritional deficiencies
Diseases of the blood and blood-forming organs	20	Diseases of the blood and blood-forming organs
Mental disorders	21	Mental disorders
Diseases of the nervous system and sense organs	22	Diseases of the nervous system
	23	Disorders of the eye and adnexa
	24	Diseases of the ear and mastoid process
Diseases of the circulatory system	25	Rheumatic fever and rheumatic heart disease
	26	Hypertensive disease
	27	Ischaemic heart disease
	28	Diseases of pulmonary circulation and other forms of heart disease
	29	Cerebrovascular disease
	30	Other diseases of the circulatory system
Diseases of the respiratory system	31	Diseases of the upper respiratory tract
	32	Other diseases of the respiratory system
Diseases of the digestive system	33	Diseases of the oral cavity, salivary glands, and jaws
	34	Diseases of other parts of the digestive system
Diseases of the genitourinary system	35	Diseases of urinary system
	36	Diseases of male genital organs
	37	Diseases of female genital organs
Complications of pregnancy, childbirth, and the puerperium	38	Abortion
	39	Direct obstetric causes
	40	Indirect obstetric causes
	41	Normal pregnancy and delivery
Diseases of the skin and subcutaneous tissue	42	Diseases of the skin and subcutaneous tissue
Diseases of the musculoskeletal system and connective tissue	43	Diseases of the musculoskeletal system and connective tissue

See notes at end of table.

Table VIII—Continued

Diagnostic codes used in the National Medical Care Utilization and Expenditure Survey (NMCUES): United States, 1980

ICD–9[1] category	ICD–9[1] 2–digit code	NMCUES recode of reported conditions
Congenital anomalies	44	Congenital anomalies
Certain conditions originating in the perinatal period	45	Certain conditions originating in the perinatal period
Signs, symptoms, and ill-defined conditions	46	Signs, symptoms, and ill-defined conditions
Injury and poisoning	47	Fractures
	48	Dislocations, sprains, and strains
	49	Intracranial and internal injuries, including nerves
	50	Open wounds and injury to blood vessels
	51	Effects of foreign body entering through orifice
	52	Burns
	53	Poisoning and toxic effects
	54	Complications of medical and surgical care
	55	Other injuries, early complications of trauma
	56	Late effects of injuries, of poisonings, of toxic effects, and of external cause
	57	Partial impairment of senses, other special impairment from accident or injury
		Unknown condition
		No condition

[1]International Classification of Diseases, Ninth Revision.

SOURCE: World Health Organization: *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death.* Based on the recommendations of the Ninth Revision Conference, 1975. Geneva. World Health Organization, 1977.

who worked at all during 1980 are classified as employed. Persons who may have been disabled for part of the year but were employed at some time during the year are classified as employed. Employed persons are subclassified as follows.

Full year, full time = 48–52 weeks, 35 hours per week or more.

Full year, part time = 48–52 weeks, less than 35 hours per week.

Part year, full time = 1–47 weeks, 35 hours per week or more.

Part year, part time = 1–47 weeks, less than 35 hours per week.

2. Unemployed: Persons who were in the labor force in 1980, looking for work, but not working all year long, are classified as unemployed. Unemployed persons who claimed homemaking as their major activity in 1979 are classified as homemakers in tables reporting data for the homemaker category.
3. Not in labor force: This category includes homemakers, students, retired persons, persons retired for health reasons, disabled workers and homemakers, discouraged workers, and others not in the labor force in 1980 for the entire year. There are four mutually exclusive subcategories and two constructed subcategories that are overlapping. The four mutually exclusive subcategories are as follows.

a. Retired for health: This category includes persons not in the labor force who were retired for health reasons for all of 1979 and 1980.
b. Retired: This category includes persons not in the labor force who were retired for all of 1980.
c. Student: This category includes persons not in the labor force who were students for all of 1980.
d. Other: This category includes all others not in the labor force for all of 1980. Although not separately categorized, it includes homemakers, discouraged workers, workers disabled for all of 1980 who were not retired for health in 1979, disabled homemakers, and others.

The four subcategories of persons not in the labor force listed above are mutually exclusive. The following two subcategories are constructed from portions of the previous four subcategories and therefore overlap them. However, the homemaker and unable-to-work categories are mutually exclusive from each other and from the employed category.

e. Homemakers: This category is constructed to include persons who did not work for all of 1980 but were not retired for health reasons or unable to work and who claimed homemaking as their major activity in 1979.

f. Unable to work: This category is constructed to include persons retired for health reasons in 1979 and 1980, workers disabled for all of 1980 who were not retired for health reasons in 1979, and disabled homemakers. Disability for the last two subcategories is determined by the individual's reported inability to work or to keep house all year for health reasons. Persons who were disabled for only part of the year are not included in this category.

Indirect Cost Estimation Procedures

Morbidity costs—Calculation of the estimated value of lost productivity for employed persons is as follows.

If earnings are reported, then indirect costs are equal to the following: (work-loss days/245) × (annual earnings) × (adjustment factor for fringe benefits) × (basic person weight). The adjustment factor for fringe benefits is 1.172, which increases annual earnings by the mean percent of earnings represented by employee benefits as calculated from the 1980 National Income Accounts (*Survey of Current Business*, 1981).

If earnings are not reported, then indirect costs are equal to (work-loss days/245) × (constructed annual earnings) × (adjustment factor for fringe benefits) × (basic person weight). The calculation of constructed annual earnings is a two-step process. Mean annual earnings for 1980 based on sex, race, and employment (number of weeks worked and hours worked per week in 1980) are taken from Current Population Survey (CPS) data (Table IX). They are age adjusted by the ratio of annual mean earnings for full-year, full-time workers for a particular age and sex category to the overall annual mean earnings for full-year, full-time workers by sex, also calculated from CPS data (Table X). (See U.S. Bureau of the Census, 1982b.) The constructed mean earnings are adjusted by a factor of 1.172 to account for fringe benefits (*Survey of Current Business*, 1981).

Calculation of the estimated value of lost productivity for homemakers is as follows.

Indirect costs are equal to (bed-disability days/365) × (basic person weight) × (mean annual value of homemaker services by sex and age category). The mean annual values of homemaker services were calculated for 1980 by Hodgson and Rice (1984) (Table XI). Calculations are also made for restricted-activity days.

Calculation of the estimated value of lost productivity for the population unable to work is as follows.

The probability of being employed is calculated from the 1980 sex- and age-specific labor force participation rates (LFPR) and the 1980 sex- and age-specific employment rates (ER) (Table XII). (See U.S Bureau of the Census, 1981.) The probability of being employed is equal to LFPR × ER. The probability of being a homemaker is derived from the Rice-Hodgson calculations for 1980 (Table XI). (See Hodgson and Rice, 1984.) The probability of being a homemaker is equal to the percent of women in a given age category who were homemakers in 1980.

Mean annual earnings for the employed are constructed from CPS data and adjusted by the fringe benefit factor of 1.172 (Table IX). The mean annual values of homemaker services are taken from Rice-Hodgson calculations for 1980 (Table XI). (See Hodgson and Rice, 1984; U.S. Bureau of the Census, 1982b.)

Indirect costs for a person in the unable-to-work population, then, are equal to the following: [(probability of being employed) × (constructed mean annual earnings) × (fringe benefit adjustment factor) + (probability of being a homemaker) × (mean annual value of homemaker services)] × (time-adjusted person weight).

Single-year mortality costs—The calculation of single-year mortality costs is performed for each death, and costs are then summed to obtain aggregate costs by the various demographic characteristics. The calculation of single-year mortality costs for employed persons is a two-step process. First, days of work lost are calculated for each person who died. The number of days of work lost is equal to [(365 − date of death)/7] × 5. Single-year mortality cost is equal to (days of work lost/245) × (estimated or reported annual earnings) × (fringe benefit adjustment factor) × (basic person weight). Earnings are estimated for individuals with unreported earnings in the same manner as for morbidity costs. Reported and unreported earnings are adjusted by the fringe benefit factor of 1.172.

Single-year mortality costs for homemakers are equal to [(365 − date of death)/365] × (basic person weight) × (mean annual value of homemaker services). The Rice-Hodgson calculations for 1980 are the source for mean annual values of homemaker services (Table XI).

Calculation of single-year mortality costs for the population unable to work is again a two-step process. First, composite persons are constructed, as for morbidity costs. Costs are then calculated from the date of death, as for employed persons and homemakers.

Total economic costs of mortality—Calculations of single-year mortality costs are performed for each death and then summed to obtain aggregate costs by the various demographic characteristics.

The total economic costs of mortality are calculated in the same fashion for all persons who died; that is, total mortality costs are equal to (discounted lifetime earnings) × (basic person weight). Rice-Hodgson age- and sex-specific calculations of the present value of the lost stream of earnings at various discount rates for 1980 are the source for the discounted lifetime earnings (Table XIII). (See Hodgson and Rice, 1984.)

Table IX

Mean earnings for persons 15 years of age and over, by employment, race, and sex: United States, 1980

Race and sex	All workers	Full-time workers							Part-time workers					
			Number of weeks worked							Number of weeks worked				
		Total	50–52	48–49	40–47	27–39	14–26	Less than 14	Total	50–52	40–49	27–39	14–26	Less than 14
Black														
Male	$10,656	$12,127	$14,709	$13,759	$11,458	$8,079	$5,109	$1,595	$2,945	$6,178	$5,454	$3,201	$2,293	$776
Female	7,455	9,193	11,230	8,919	8,656	6,692	3,558	1,176	2,779	4,131	4,663	3,186	1,610	588
White														
Male	16,308	18,168	21,023	15,928	13,376	10,288	6,243	2,254	3,976	6,708	6,367	3,330	2,047	687
Female	7,595	9,846	12,156	9,442	8,645	6,405	3,859	1,496	3,110	5,048	4,066	2,972	1,660	553

SOURCE: U.S Bureau of the Census: Money income of households, families, and persons in the United States, 1980. *Current Population Reports.* Series P–60, No. 132. Washington. U.S. Government Printing Office, 1982. Table 59.

Table X

Mean earnings for full-time, full-year workers 18 years of age and over, by sex and age: United States, 1980

Age	Male	Female
Total	$20,543	$12,044
18–24 years	12,271	9,265
25–29 years	16,795	12,305
30–34 years	20,245	13,173
35–39 years	23,153	13,205
40–44 years	23,573	12,607
45–49 years	24,270	12,357
50–54 years	23,617	12,556
55–59 years	23,197	12,193
60–64 years	20,902	12,338
65 years and over	17,466	9,997

SOURCE: U.S Bureau of the Census: Money income of households, families, and persons in the United States, 1980. *Current Population Reports.* Series P–60, No. 132. Washington. U.S. Government Printing Office, 1982. Table 52.

Table XI

Percent of female population who are homemakers and annual *mean value of housekeeping services for females not in* labor force and keeping house, by age: United States, 1980

Age	Percent of female population	Annual mean value of housekeeping services
15–19 years	6.8	$ 8,274
20–24 years	19.2	10,402
25–29 years	27.6	12,595
30–34 years	30.5	12,479
35–39 years	31.0	11,952
40–44 years	30.2	11,222
45–49 years	34.0	10,557
50–54 years	37.0	10,035
55–59 years	42.8	8,732
60–64 years	52.1	7,100
65–69 years	66.4	5,430
70–74 years	67.7	3,866
75–79 years	64.8	2,631
80–84 years	59.0	1,530
85 years and over	49.4	866

SOURCE: Hodgson, T. A., Chief Economist, Office of Analysis and Epidemiology, National Center for Health Statistics, and Rice, D. P., Professor, Department of Social and Behavioral Science and the Aging Health Policy Center, University of California at San Francisco: Personal communication, 1984.

Table XII

Labor force participation rate and employment rate, by sex and age: United States, 1980

Age	Labor force participation rate		Employment rate	
	Male	Female	Male	Female
Total	77.4	51.5	93.1	92.6
16–19 years	60.5	52.9	81.8	82.8
20–24 years	85.9	68.9	87.5	89.7
25–34 years	95.2	65.5	93.3	92.8
35–44 years	95.5	65.5	95.9	94.7
45–54 years	91.2	59.9	96.4	95.5
55–64 years	72.1	41.3	96.6	96.7
65 years and over	19.0	8.1	96.9	96.9

SOURCE: U.S Bureau of the Census: *Statistical Abstract of the United States, 1981,* 102d ed. Washington. U.S. Government Printing Office, 1981. Tables 636 and 639.

Table XIII

Present value of expected future lifetime earnings and housekeeping services discounted at 6 and 10 percent, by sex and age: United States, 1980

Age	Discounted at 6 percent		Discounted at 10 percent	
	Male	Female	Male	Female
Under 1 year	$200,992	$166,303	$ 56,173	$ 51,194
1–4 years	222,067	183,597	68,085	62,002
5–9 years	264,604	218,641	95,842	87,229
10–14 years	321,232	265,301	140,028	127,380
15–19 years	382,235	308,166	195,970	171,579
20–24 years	429,152	325,736	247,482	198,450
25–29 years	446,490	314,918	279,025	201,908
30–34 years	434,295	288,221	288,553	191,522
35–39 years	397,573	256,285	278,238	176,550
40–44 years	344,695	221,311	253,340	158,732
45–49 years	281,249	182,338	217,538	136,295
50–54 years	209,546	140,696	170,539	109,535
55–59 years	132,720	98,510	113,364	79,530
60–64 years	62,538	60,224	54,830	49,785
65–69 years	23,810	33,453	20,535	27,906
70–74 years	11,750	18,772	10,271	15,965
75–79 years	5,719	10,159	5,074	8,855
80–84 years	2,847	4,115	2,578	3,722
85 years and over	892	1,169	852	1,116

SOURCE: Hodgson, T. A., Chief Economist, Office of Analysis and Epidemiology, National Center for Health Statistics, and Rice, D. P., Professor, Department of Social and Behavioral Science and the Aging Health Policy Center, University of California at San Francisco: Personal communication, 1984.

Appendix VI.
Definition of Terms

Age—This is the age of the person as of January 1, 1980. Babies born during the survey period were included in the youngest age category.

Ambulatory care visit—A direct personal exchange between an ambulatory patient and a health care provider is an ambulatory care visit. The visit may take place in the provider's office, hospital outpatient department, emergency room, clinic, health center, or the patient's home. Services may be rendered by a physician, chiropractor, podiatrist, optometrist, psychologist, social worker, nurse, or other ancillary personnel.

Average length of stay—The average length of stay is the total number of hospital days accumulated at time of discharge by patients discharged during the year divided by the number of patients discharged.

Bed-disability day—A bed-disability day is one on which a person stays in bed more than half of the daylight hours because of a specific illness or injury. All hospital days for inpatients are considered to be bed-disability days even if the patient was not actually in bed at the hospital.

Condition—Any entry on the questionnaire that describes a departure from a state of physical or mental well-being is included. A condition is any illness, injury, complaint, impairment, or problem perceived by the respondent as inhibiting usual activities or requiring medical treatment. Pregnancy, vasectomy, and tubal ligation were not considered to be conditions; however, related medical care was recorded as if they were conditions. Neoplasms were classified without regard to site. Conditions, except impairments, were classified by type according to the Ninth Revision of the International Classification of Diseases (World Health Organization, 1977) as modified by the National Health Interview Survey Medical Coding Manual; these modifications make the code more suitable for a household interview survey. Impairments are chronic or permanent defects, usually static in nature, that result from disease, injury, or congenital malformation. They represent decrease or loss of ability to perform various functions, particularly those of the musculoskeletal system and the sense organs. Impairments are classified by using a supplementary code specified in the coding manual. In the supplementary code, impairments are grouped according to type of functional impairment and etiology.

Disability—Disability is the general term used to describe any temporary or long-term reduction of a person's activity as a result of an acute or chronic condition.

Disability day—Short-term disability days are classified according to whether they are days of restricted activity, bed-disability days, hospital days, or work-loss days. All hospital days are by definition days of bed disability; all days of bed disability are by definition days of restricted activity. The converse form of these statements is, of course, not true. Days lost from work apply only to the working population. Work-loss days are also days of restricted activity. Hence, the restricted-activity day is the most inclusive term used to describe disability days.

Education of head of family—The years of school completed by the head of family, if the family head was 17 years of age and over, is classified. Only years completed in regular schools, where persons are given a formal education, were included. A "regular" school is one that advances a person toward an elementary or high school diploma or a college, university, or professional school degree. Thus, education in vocational, trade, or business schools outside the regular school system was not counted in determining the highest grade of school completed.

Employed—An individual is classified as employed if he or she worked at any time in 1980.

Family—A group of people living together and related to each other by blood, marriage, adoption, or foster care status is considered a family. An unmarried student 17–22 years of age living away from home was also considered part of the family even though his or her residence was in a different location during the school year.

Family head—At the time of the first interview, the respondent for the family was asked to designate a "family head." If no head was designated or this information was missing, a family head was imputed.

Family income in 1980—Each member of a family is classified according to the total income of the family of which he or she is a member. Because some persons changed families during the year, their family income is defined as the income of the family they were a member of the longest. If a family did not exist for the entire year, the family income is adjusted to an annual basis by dividing actual income by the proportion of the year the family existed. Unrelated persons are

classified according to their own income. For each person, 12 categories of income were collected, including income from employment for persons 14 years of age and over and income from various government programs, pensions, alimony or child support, interest, and net rental income. When information was missing, data were imputed. The total income of persons who were members of more than one family was allocated to each family in proportion to the amount of time they were in that family.

Homemaker—An individual is classified as a homemaker if he or she did not work at all in 1980 (unemployed or not in the labor force) and claimed housekeeping as his or her main activity in 1979. Disabled homemakers are not included. (See "Unable to work for health reasons.")

Hospital admission—This is the formal acceptance by a hospital of a patient who is provided room, board, and regular nursing care in a unit of the hospital. A patient admitted to the hospital and discharged on the same day is considered to have had a hospital admission. Also included is a hospital stay resulting from an emergency department visit.

Hospital days—The total number of inpatient days accumulated at time of discharge by patients discharged from short-stay hospitals during a year constitute hospital days. A stay of less than 1 day (patient admission and discharge on the same day) is counted as zero days in the summation of hospital days. For patients admitted and discharged on different days, the number of days of care is computed by counting all days from (and including) the date of admission to (but not including) the date of discharge.

Hospital outpatient department visit—This is a face-to-face encounter between an ambulatory patient and a medical person. The patient comes to a hospital-based ambulatory care facility to receive services and departs on the same day. If more than one department or clinic is visited on a single trip, each department or clinic visited is counted as a separate visit.

Household—Occupants of group quarters or of a housing unit that was included in the sample constitute a household. A household can comprise one person, a family of related people, a number of unrelated people, or a combination of related and unrelated people.

Housing unit—A group of rooms or a single room occupied or intended for occupancy as separate living quarters is a housing unit if the occupants do not live and eat with any other persons in the structure and if there was either direct access from the outside or through a common hall or there were complete kitchen facilities for the use of the occupants only.

Key person—A key person was (1) an occupant of a national household sample housing unit or group quarters at the time of the first interview; (2) a person related to and living with a State Medicaid household case member at the time of the first interview; (3) an unmarried student 17–22 years of age living away from home and related to a person in one of the first two groups; (4) a related person who had lived with a person in the first two groups between January 1, 1980, and the round 1 interview, but was deceased or had been institutionalized; (5) a baby born to a key person during 1980; or (6) a person who was living outside the United States, was in the Armed Forces, or was in an institution at the time of the round 1 interview but who had joined a related key person.

Mean charge per unit of service—The arithmetic mean calculated from charges reported by the household respondent without consideration for the amount actually paid or the source of payment is the mean charge. Zero charges were assigned to service units that the household reported, in response to three separate questions, as free from the provider.

Nonkey person—A person related to a key person who joined him or her after the round 1 interview but was part of the civilian noninstitutionalized population of the United States at the date of the first interview is considered nonkey.

Not in labor force—An individual is classified as not in the labor force if he or she was retired, retired for health reasons, a student, or not working for some other reason for all of 1980. This category includes persons unable to work for health reasons and most homemakers. Unemployed persons are not included.

Patient—A person who is formally admitted to the inpatient service of a short-stay hospital for observation, care, diagnosis, or treatment is considered a patient. In this report, the number of patients refers to the number of discharges during the year, including any multiple discharges of the same individual from one or more short-stay hospitals. The terms "patient" and "inpatient" are used synonymously.

Per capita charges—These charges were calculated by dividing the total charges by the number of people in the reference population.

Poverty status—The poverty status in 1980 was calculated by dividing the person's 1980 family income by the appropriate 1980 nonfarm poverty level threshold and converting it to percent. These thresholds, used by the U.S. Bureau of Census, are determined by the age and sex of the family head and the average number of persons in the family.

Prescribed medicine acquisitions—Each time a person had a prescription filled, regardless of whether it was an initial filling or a refill of a prescription, is included in the number of acquisitions.

Race—The race of people 17 years of age and over was reported by the family respondent; the race of those under 17 was derived from the race of other family members. If the head of the family was male and had a wife who was living in the household, her race was assigned to any children under 17 years of age. In all other cases, the race of the head of the family (male or female) was assigned to any children under 17 years of age. Race is classified as "white," "black," or "other."

The "other" race category includes American Indian, Alaskan Native, Asian, and Pacific Islander. The category "white and other" includes the categories "white" and "other."

Region—NORTHEAST: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania; NORTH CENTRAL: Michigan, Wisconsin, Ohio, Indiana, Illinois, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas; SOUTH: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas; WEST: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii.

Reporting unit—This is the basic unit for reporting data in the household component of NMCUES. A reporting unit consists of all related people residing in the same housing unit or group quarters. One person could give information for all members of the reporting unit.

Restricted-activity day—A restricted-activity day is one on which a person cuts down on his usual activities for the whole of that day because of an illness or an injury. The term "usual activities" for any day means the things that the person would ordinarily do on that day. A day spent in bed or a day home from work because of illness or injury is, of course, a restricted-activity day.

Round—A round was the administrative term used to designate all interviews that occurred within a given period of time and that used the same instruments and procedures.

Unable to work for health reasons—This category includes persons who were retired for health reasons at the beginning of the survey (and for all of 1980) as well as homemakers and others who stated they were disabled and therefore unable to work or keep house for all of 1980 for health reasons. Persons who were unable to work for health reasons for only part of the year are not included.

Unemployed—An individual is classified as unemployed if he or she did not work but looked for work for the entire year 1980.

Work-loss day—A work-loss day is a day on which a person did not work at his or her job or business because of a specific illness or injury. The number of days lost from work is determined only for persons 17 years of age and over who reported that at any time during the survey period they either worked at or had a job or business.

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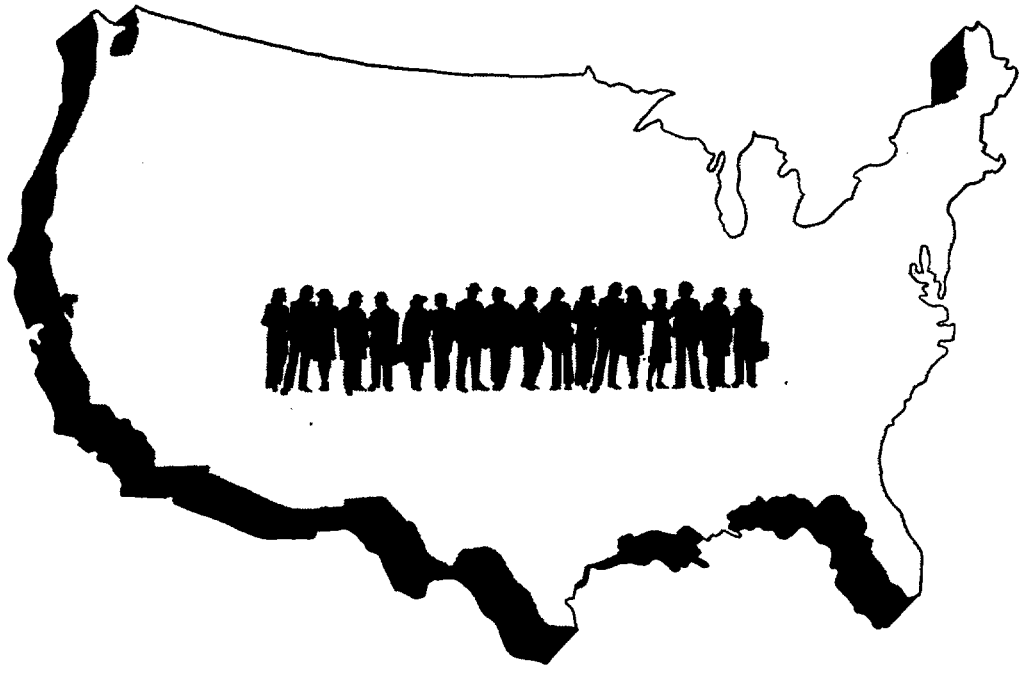

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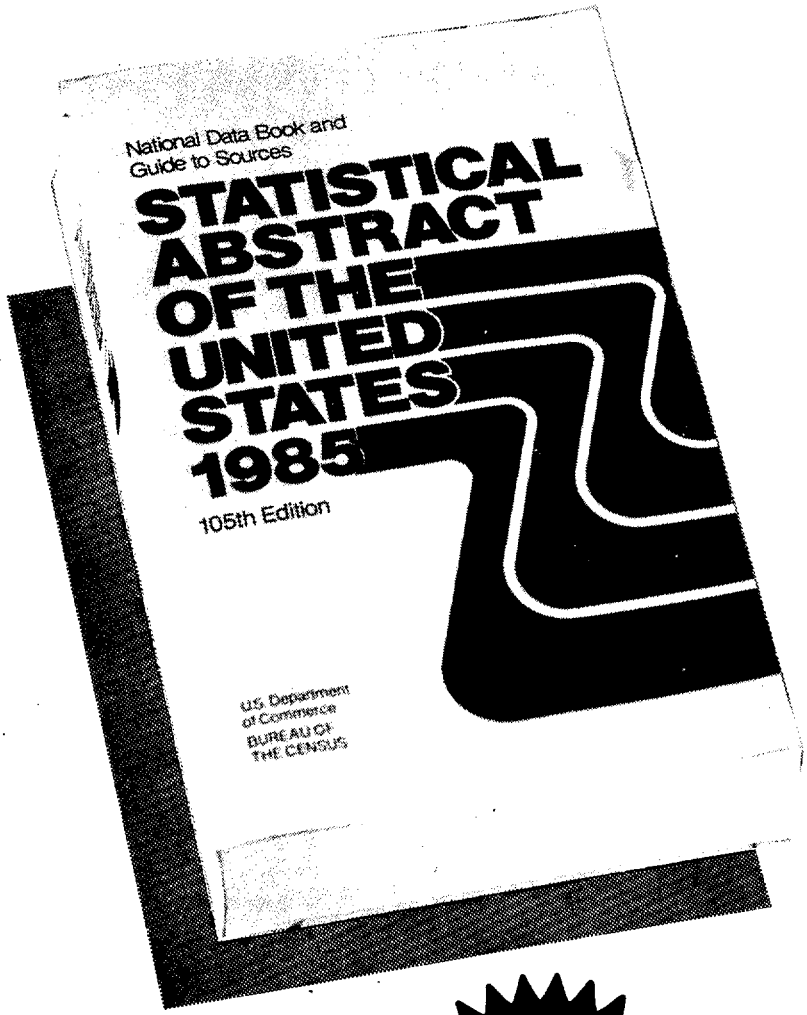

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