The Economic Cost of Illness Revisited

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In and out of government, determining the cost of illness is a major concern. The allocation of health care resources and the evaluation of current research and program efforts depend in large measure on such information This article updates the 1963 benchmark study of the cost of illness For the 16 major diagnostic categories of illnesses, the cost is presented in terms of the direct costs for prevention, detection, and treatment, the morbidity losses due to disability, and the mortality losses resulting from premature death The method of calculating the cost of any illness is described, and data necessary for the calculation are provided

In 1972, the estimated total cost of illness was $188 billion $75 billion for direct costs, $42 billion for morbidity, and $71 billion for mortality Diseases of the circulatory system were the most costly, representing about one-fifth of all costs of illness

ESTIMATING the economic cost of illness has been a matter of great interest for a number of years These estimates are used by health planners for a variety of purposes. In cost-effectiveness analysis to determine the most efficient treatment for a particular disease, in cost-benefit analysis to justify or bolster program expenditures; or for comparisons among diseases The Department of Health, Education, and Welfare alone is currently funding about a dozen different studies on the cost of specific diseases Subsequent comparisons of the cost of these 12 diseases may not be valid, however, since such costs, when they are calculated independently, are often based on differing methodologies

About 9 years ago, to establish comparability in disease costs, Dorothy P. Rice prepared a study on estimating the cost of illness,[1] which spelled out in great detail the methodology for costing the major diagnostic categories Recent changes in treatment modes, disease incidence, and earnings distributions, as well as the development of some new theoretical approaches, indicated a need for more current data This paper updates the earlier study. It presents findings for 1972, a brief description of the methodology, and a demonstration of the application of its methods and results to calculating costs for more specific disease categories

BACKGROUND

The economic cost of illness is measured in terms of the direct outlays for prevention, detection, and treatment and the indirect costs or loss in output due to disability (morbidity) and premature death (mortality). These are the costs to society rather than to the sick individuals or their families Only the indirect costs resulting from lost earnings, however, represent losses to the gross national product (GNP) The losses due to illness of housewives who cannot perform their housekeeping duties are not part of the GNP, because nonmarket labor is not a part of GNP

One major category of costs is omitted here—that of pain and suffering No one has successfully quantified this dimension of illness, yet some diseases impose more pain and suffering than others The cost relationship among diseases is thus not completely correct[2] But though this aspect of illness cannot be taken fully into account, it is undoubtedly reflected in the allocation of resources The pain connected with cancer is probably partly responsible for the relatively large appropriation of Federal funds to this disease The Federal *Budget* shows cancer receiving about 18 percent of 1975 Federal research dollars even though the disease represents only 9 percent of the total cost of illness

Two other categories of cost were purposefully

* Office of Research and Statistics, Social Security Administration Adapted from a paper presented at the annual American Public Health Association meetings in Chicago, Ill, November 20, 1975

[1] Dorothy P Rice, *Estimating the Cost of Illness* (Health Economics Series No 6), U S Public Health Service, 1966

[2] Rashi Fein, "Definition and Scope of the Problem Economic Aspects," *Assessing the Effectiveness of Child Health Services* (A B Bergman, editor), Ross Laboratories, 1967, pages 44–50

omitted—transfer payments and taxes When income loss is used as a measure of indirect costs, adding pension or relief payments would be double counting As for tax payments, it would be double counting to add income tax losses to loss of earnings and triple counting if the tax receipts were used for public payments for medical care

DIRECT COSTS

The direct cost of illness represents expenditures for prevention, detection, treatment, rehabilitation, research, training, and capital investment in medical facilities The Social Security Administration annually publishes estimates of such spending by type of expenditure—that is, hospital care, physicians' services, etc , and source of funds The Social Security Administration estimates that in 1972 health expenditures—direct costs—exceeded $90 billion [3] Not all of these outlays can or should be allocated by disease category As shown below, about four-fifths or more than $75 billion was distributed, by diagnosis

Type of expenditure	Amount (in millions)	Percentage distribution
Total	$90 391	100 0
Allocated by diagnosis	75 231	83 2
Hospital care	34,219	37 9
Physicians' services	16,916	18 7
Dentists' services	5 581	6 2
Other professional services	1,717	1 9
Drugs and drug sundries	8,628	9 5
Eyeglasses and appliances	1,896	2 1
Nursing-home care	6,274	6 9
Not allocated	15,151	16 8
Expenses for prepayment and administration	3,697	4 1
Government public health activities	1,804	2 0
Other health services	3,306	3 7
Research	2,173	2 4
Construction	4,180	4 6

Under the general methodology used here to allocate direct expenditures by diagnosis the total expenditure for each type of service was distributed by a consistent source of data on utilization and costs (see methodology section for details).

Of the $75 billion allocated for direct costs, diseases of the digestive system represented the largest share—14.8 percent (table 1). Half these funds, however, went for dentists' services, classified in this category Diseases of the circulatory system were the next costly (14 5 percent), followed by mental disorders (9 3 percent)

The largest item of expenditure is for hospital care, representing 45 percent of all allocated outlays Most of these outlays occur in community hospitals, but a sizable portion—about one-tenth —is spent in psychiatric hospitals As a result, mental disorders, along with diseases of the circulatory system, showed the highest hospital bills —$5 3 million each

Physicians' services represent the second largest direct cost—$16 9 billion Although a different source of data was used here to distribute outlays for physicians' services, the findings confirm those recently reported by the National Center for Health Statistics (NCHS)—the largest portion of physicians' services is not for a specific illness.[4] More than one-fourth of the expenditures for doctors' care went for "special conditions without sickness" and for "symptoms and ill-defined conditions," classified here as "other." The next largest categories (both at about one-tenth of all spending for physicians' services) were respiratory diseases and those of the circulatory system

Nearly two-fifths of the expenditures for other professional services (with dentists excluded) were for diseases of the nervous system and sense organs, reflecting the large portion of this category spent for optometrists' services Chiropractors account for another big share of this category, allocated to diseases of the musculoskeletal system and connective tissues.

Spending for out-of-hospital drugs and drug sundries ($8 6 billion) is largely for persons with diseases of the respiratory and circulatory systems and those with no specific illness Dental services ($5 6 billion) were all classified with digestive diseases; eyeglasses and appliances ($1 9 billion) were classified under diseases of the nervous system and sense organs The remaining expenditures ($6.3 billion) went for nursing-home care, with two-fifths of the expenditures spent for diseases of the circulatory system.

[3] Nancy L Worthington, *National Health Expenditures, Calendar Year 1929–73* (Research and Statistics Note No 1), Social Security Administration, Office of Research and Statistics, 1975

[4] National Center for Health Statistics *Physician Visits, Volume and Interval Since Last Visit, United States, 1971* (Vital and Health Statistics Series 10, No 97), 1975

TABLE 1.—Direct costs, selected categories · Estimated amount and percentage distribution, by type of expenditure and diagnosis, 1972

Diagnosis	Total	Hospital care	Physicians' services	Dentists' services	Other professional services	Drugs and drug sundries	Eyeglasses and appliances	Nursing-home care
	Amount (in millions)							
Total	$75,231	$34,219	$16,916	$5,581	$1,717	$8,628	$1,896	$6,274
Infective and parasitic diseases	1,412	660	333	--	5	192	--	222
Neoplasms	3,872	2,957	528	--	47	186	--	154
Endocrine, nutritional, and metabolic diseases	3,436	920	1,294	--	25	869	--	328
Diseases of the blood and blood-forming organs	491	228	151	--	4	77	--	31
Mental disorders	6,985	5,261	685	--	9	434	--	596
Diseases of the nervous system and sense organs	5,947	1,033	1,294	--	655	594	1,896	475
Diseases of the circulatory system	10,919	5,271	1,676	--	86	1,305	--	2,581
Diseases of the respiratory system	5,931	2,473	1,851	--	30	1,460	--	117
Diseases of the digestive system	11,100	3,996	880	5,581	43	444	--	156
Diseases of the genitourinary system	4,471	2,899	1,089	--	34	571	--	78
Complications of pregnancy, childbirth, and the puerperium	2,607	2,331	151	--	33	86	--	--
Diseases of the skin and subcutaneous tissue	1,525	488	656	--	6	354	--	21
Diseases of the musculoskeletal system and connective tissue	3,636	1,661	770	--	368	425	--	412
Congenital anomalies	381	313	44	--	3	8	--	13
Accidents, poisonings, and violence	5,121	3,134	1,222	--	38	352	--	375
Other	7,398	794	4,292	--	326	1,271	--	716
	Percentage distribution							
Total	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0
Infective and parasitic diseases	1 9	1 9	2 0	--	3	2 2	--	3 5
Neoplasms	5 1	8 6	3 1	--	2 7	2 2	--	2 5
Endocrine, nutritional, and metabolic diseases	4 6	2 7	7 6	--	1 5	10 0	--	5 2
Diseases of the blood and blood-forming organs	7	7	9	--	2	9	--	5
Mental disorders	9 3	15 4	4 0	--	5	5 0	--	9 5
Diseases of the nervous system and sense organs	7 9	3 0	7 6	--	38 1	6 9	100 0	7 6
Diseases of the circulatory system	14 5	15 4	9 9	--	5 0	15 1	--	41 1
Diseases of the respiratory system	7 9	7 2	10 9	--	1 7	16 9	--	1 9
Diseases of the digestive system	14 8	11 7	5 2	100 0	2 5	5 1	--	2 5
Diseases of the genitourinary system	5 9	7 9	6 4	--	2 0	6 6	--	1 2
Complications of pregnancy, childbirth, and the puerperium	3 5	6 8	9	--	2 3	1 0	--	
Diseases of the skin and subcutaneous tissue	2 0	1 4	3 9	--	3	4 1	--	3
Diseases of the musculoskeletal system and connective tissue	4 8	4 9	4 6	--	21 4	4 9	--	6 7
Congenital anomalies	5	9	3	--	2	1	--	2
Accidents, poisonings, and violence	6 8	9 2	7 2	--	2 2	4 1	--	9 1
Other	9 8	2 3	25 4	--	18 9	14 7	--	8 3

MORBIDITY COSTS

Morbidity losses are incurred when illness results in absence from employment, prevents a housewife from performing her duties, or results in disability that prevents someone from working at all The lost earnings and the dollar value of the unperformed housekeeping services are the morbidity costs

Calculation of morbidity costs involves applying average earnings by age and sex to work-loss years, attaching a dollar value to housewives' services and applying it to their bed-days, and applying labor-force participation rates and earnings, by age and sex, to persons in and out of institutions who are too sick to be employed or keep house.

These procedures involve several economic concepts and issues One issue concerns measurement of the value of housewives' services Because such measurement is difficult, it is often omitted from these types of analysis Such omission, however, produces serious underestimates of the value of women and the costs of diseases associated with them

In the earlier Rice study,[5] all housewives were given the value of a domestic servant—an assumption considered an underestimate More recently, the Social Security Administration has examined other approaches to the problem, primarily the market-cost and opportunity-cost approaches[6] Briefly, the opportunity-cost approach assumes the economic value of unpaid work to be at least as much as the wage rate that the same person would command in the market place In essence, if a woman chooses housework over employment, the housework must be equal to or greater than

[5] Dorothy P Rice, *op cit*

[6] Wendyce H Brody, *Economic Value of a Housewife* (Research and Statistics Note No 9), Social Security Administration, Office of Research and Statistics, 1975

the value of the employment[7] If this approach were used here, however, it would not be consistent with the approach used for the employed population where what one does is valued rather than what one could be doing A physician in research or academia, for example, could earn much more in private practice, yet only his earnings as a researcher or teacher are counted To be consistent, the market-value approach was used here

This approach values each duty a housewife performs Based on a time-motion study of housewives, the relevant market wages for various services performed were multiplied by the hours reported for doing that service[8] That figure represents an estimate of the cost of replacing the housewife's duties with person-hours from the labor force to do the same work It takes into account the housewife's age, number of children, and age of youngest child The psychic value of a housewife to her family or society was not considered in this calculation Such measurement would involve obvious difficulties

Another issue is the treatment of persons too sick to be in the labor force or keeping house If these persons were well, not all of them would be employed or keeping house Some would not be able to secure employment, some would be in school, and some would choose a life of leisure It was assumed here that if these persons had been able to work, they would have had the same labor-force experience as the general population The assumption was that a theoretical influx of these persons into the labor force would not depress the employment rates or earnings levels The employment rates applied were for 1970—the last year of full employment, now defined at about 5 percent unemployment[9] Without the assumption of full employment, losses because of disability could not be isolated from losses because of unemployment[10] Mean annual earnings by age and sex for 1972 were applied These annual earnings, 1970 employment rates, and housekeeping values are shown below

Age	Percent employed, 1972		Mean earnings, 1972		Housewives	
	Men	Women	Men	Women	Percent of female population, 1970	Mean value, 1972
15–19	31 57	23 51	$4 599	$4 194	7 21	$5,389
20–24	63 90	48 00	7,921	5 884	31 83	6,061
25–29	85 61	40 55	10,874	7 495	52 36	6 417
30–34	90 28	39 46	12 892	7 423	54 38	6 416
35–39	90 97	43 63	13 902	7 289	49 77	5,892
40–44	90 20	47 74	14,675	7,341	44 99	5,908
45–49	89 57	50 35	14,382	7,306	40 93	5 222
50–54	87 89	48 98	13,864	7,387	42 13	5,222
55–59	83 65	46 53	13 309	7 094	41 51	3 618
60–64	73 81	37 87	12,259	7,052	44 47	2 942
65 and over	26 99	10 43	9,062	5,456	51 88	1,533

When morbidity costs are allocated by diagnosis, several methodological problems also arise Chief among these is the reliance on patients for diagnostic information Data on productivity losses for the noninstitutional population is based on information from the National Health Survey, which is a household interview survey Use of this source undoubtedly results in conservative estimates for some diseases and overstatements for others Losses for diseases such as cancer are probably understated The household respondent can report only the information given to the family by the physician The respondent may not have been told what the condition was In other cases, the respondent may have misunderstood or forgotten what the physician said For conditions not medically attended, such as diseases of the respiratory system, the diagnostic information supplied by the respondent may indicate only a symptom, and the result is a possible overstatement of morbidity and of losses

The presence of multiple diseases also creates problems in allocation by diagnosis The data from the National Health Survey include multiple listing of conditions These data were uniformly adjusted downward to yield an unduplicated total, but this procedure assumes that all associated conditions are evenly distributed, which is obvi-

[7] Reuben Gronau, "The Measurement of Output of the Nonmarket Sector The Evaluation of Housewives' Time," in *The Measurement of Economic and Social Performance*, National Bureau of Economic Research, 1973

[8] Katherine E Walker and William H Gauger, "The Dollar Value of Household Work," *Information Bulletin No 60*, New York College of Human Ecology, Ithaca, 1973

[9] According to the statements of many economists presented in *Reducing Unemployment to 2 Percent* (Hearings Before the Joint Economic Committee, 92d Cong, 2d sess, October 17–18, and 26, 1972), full employment falls between 4 5 and 5 percent unemployment The presence of more women and youth in the labor force adds 0 5 percent to the original 4-percent figure and the effect of inflation adds somewhat more

[10] Selma J Mushkin, "Health as an Investment," *Journal of Political Economy*, October 1962, Part 2, Supplement, pages 129–157

TABLE 2.—Morbidity costs. Estimated amount and percentage distribution, by labor-force status and diagnosis, 1972

Diagnosis	Total	Noninstitutional				Institutional
		Total	Currently employed	Keeping house	Unable to work	
	Amount (in millions)					
Total	$42,323	$36,118	$17,619	$3,295	$15,204	$6,205
Infective and parasitic diseases	1,200	972	669	119	184	228
Neoplasms	862	820	438	104	278	42
Endocrine, nutritional, and metabolic diseases	1,137	1,027	214	91	722	110
Diseases of the blood and blood-forming organs	220	208	78	32	98	12
Mental disorders	6,179	2,210	396	98	1,716	3,969
Diseases of the nervous system and sense organs	3,944	3,752	850	137	2,765	192
Diseases of the circulatory system	6,417	5,589	1,781	495	3,313	828
Diseases of the respiratory system	7,089	7,040	5,085	845	1,110	49
Diseases of the digestive system	2,606	2,547	1,501	245	801	59
Diseases of the genitourinary system	1,249	1,226	745	234	247	23
Complications of pregnancy, childbirth, and the puerperium	245	245	79	166	--	--
Diseases of the skin and subcutaneous tissue	460	456	355	18	83	4
Diseases of the musculoskeletal system and connective tissue	5,103	4,919	1,866	362	2,691	184
Congenital anomalies	238	232	12	12	208	6
Accidents, poisonings, and violence	3,883	3,794	3 058	242	494	89
Other	1,494	1,083	494	96	493	411
	Percentage distribution					
Total	100 0	100 0	100 0	100 0	100 0	100 0
Infective and parasitic diseases	2 8	2 7	3 8	3 6	1 2	3 7
Neoplasms	2 0	2 3	2 5	3 2	1 8	7
Endocrine, nutritional, and metabolic diseases	2 7	2 8	1 2	2 8	4 7	1 8
Diseases of the blood and blood-forming organs	5	6	4	1 0	6	2
Mental disorders	14 6	6 1	2 2	3 0	11 3	64 0
Diseases of the nervous system and sense organs	9 3	10 4	4 8	4 2	18 2	3 1
Diseases of the circulatory system	15 2	15 4	10 1	15 0	21 8	13 3
Diseases of the respiratory system	16 7	19 5	29 0	25 6	7 3	8
Diseases of the digestive system	6 2	7 1	8 5	7 4	5 3	1 0
Diseases of the genitourinary system	3 0	3 4	4 2	7 1	1 6	4
Complications of pregnancy, childbirth, and the puerperium	6	7	4	5 0	--	1
Diseases of the skin and subcutaneous tissue	1 1	1 3	2 0	1	5	3 0
Diseases of the musculoskeletal system and connective tissue	12 1	13 6	11 0	11 0	17 7	1
Congenital anomalies	6	6	1	1	1 4	--
Accidents, poisonings, and violence	9 2	10 5	17 4	7 3	3 2	2 5
Other	3 6	3 0	2 8	2 9	3 2	5 6

ously not the case. Heart disease conditions, for example, are much more likely than cancer to be secondary causes of disability.

Noninstitutional Losses

In 1972, employed men and women lost the equivalent of 1.7 million years of work because of ill-health—a loss to our economy of $17 6 billion (tables 2 and 3) [11] Colds, influenza, and other diseases of the respiratory system resulted in by far the greatest losses—about three-tenths for both the years and the dollar amount. Accidents were next with about 17 percent of the losses.

Women usually keeping house had close to 1 million person-years of disability at a value of $3 3 billion. Respiratory illness was again the major cause, claiming 26 percent of their losses. Circulatory diseases followed with 18 percent of the lost years and 15 percent of the monetary costs.

The population unable to work suffered 1 7 million years of disability, losing $15 2 billion in earnings or housework values. More than one-fifth ($3 3 billion) were the result of diseases of the circulatory system. Blindness, deafness, and other diseases of the nervous system and sense organs cost $2 8 billion; arthritis, rheumatism, and other diseases of the musculoskeletal system cost another $2.7 billion.

These three noninstitutional population groups combined—currently employed, keeping house, and unable to work—lost 4 3 million person-years of productivity, a cost to the Nation of $36.1 billion. Nearly half this loss was due to illness attacking three body systems—respiratory, circulatory, and musculoskeletal.

[11] Another calculation of work-related income loss due to illness estimates $19 4 billion for 1972. See Daniel N. Price, "Cash Benefits for Short-Term Sickness, 1973," *Social Security Bulletin*, March 1975, pages 12–14.

Institutional Losses

The Bureau of the Census reports 1 7 million persons residing in illness-related institutions in 1970. Since no later data exist, this number was assumed for 1972 Application of employment and keeping-house rates for 1970 (the last year of full employment) by age and sex yielded a total of 1 1 million person-years lost to productivity More than one-third of the institutional residents and about one-half of the person-years lost were in homes for the aged, but the largest monetary losses—$2 7 billion—were for persons in mental hospitals The younger population in mental hospitals and their higher earnings account for this difference, displayed below.

Type of institution	Number of persons	Person-years lost (in thousands)	Indirect costs (in millions)
Total	1,670,167	1,106	$6,205
Homes for			
Aged	628,633	516	1,483
Blind	6 949	2	14
Deaf	8 911	1	6
Mentally handicapped	201 992	82	939
Other physically handicapped	6,879	4	23
Nursing homes	298,881	148	608
Hospitals			
Chronic disease	67 120	38	301
Mental disease	433 890	303	2,713
Tuberculosis	16 912	12	118

Allocation of institutional losses by diagnosis was made largely on the basis of the type of institution All losses in mental hospitals and homes and schools for the mentally retarded were classified under mental disorders, those in tuberculosis hospitals were under infective and parasitic diseases; those in institutions for the blind or deaf under diseases of the nervous system and sense organs, and other physically handicapped under diseases of the bones and organs of movement The distribution of losses for persons in chronic disease hospitals and nursing homes was based on data from NCHS showing the number of residents in homes with intensive and with limited nursing care, by diagnosis The Center's diagnostic distribution of residents in homes with personal care or no nursing care was used for homes for the aged [12] Not surprisingly, two-thirds or $4 billion of the morbidity costs for the institutional population was for mental disorders The next largest category was circulatory diseases, comprising 13 percent

MORTALITY COSTS

Measurement of mortality costs—losses due to premature death—has aroused much discussion in recent years Attaching a dollar figure to death—that is, determining how much a life is worth—is an emotion-laden issue Some economists refuse to make such a determination, claiming life is priceless [13] Nevertheless, whenever public spending decisions are made, values are implicitly attached to life

Jan Acton, in a recent report, delineated five basic approaches to evaluating life-saving programs. (1) Values implicit in past decisions, (2) explicit statements of political representatives or their designees, (3) implicit values of individuals, (4) explicit statements of value by individuals ("willingness to pay"), and (5) the livelihood ("human capital") approach [14] The first three approaches have too many drawbacks to be seriously considered in a cost of illness study In discussing these three approaches, Herbert Klarman pointed out that "Life insurance holdings are clearly not applicable to bachelors and jury verdicts are inconsistent. The implications of public policy decisions or governmental spending are difficult to elicit in the absence of information on the alternatives that faced the decision makers Moreover, such valuation may lack stability and consistency" [15]

The fourth approach—"willingness to pay"—was first proposed in 1968 by Thomas Schelling [16]

[12] National Center for Health Statistics, *Charges for Care and Sources of Payment for Residents in Nursing Homes, United States, June–August 1969* (Vital and Health Statistics Series 12, No 21), 1974

[13] Richard M Titmuss, *The Gift Relationship*, Pantheon Books, 1971

[14] Jan Paul Acton, *Measuring the Social Impact of Heart and Circulatory Disease Programs Preliminary Framework and Estimates*, Rand Corporation, April 1973 See also Jan Paul Acton, *Evaluating Public Programs To Save Lives The Case of Heart Attacks*, Rand Corporation, January 1973

[15] Herbert E Klarman, "Application of Cost-Benefit Analysis to the Health Services and the Special Case of Technologic Innovation," *International Journal of Health Services*, Spring 1974

[16] Thomas C Schelling, "The Life You Save May Be Your Own," in *Problems in Public Expenditure* (S B Chase, Jr, editor), The Brookings Institution, 1965

TABLE 3.—Morbidity losses. Estimated person-years lost to productivity and percentage distribution, by labor-force status and diagnosis, 1972

Diagnosis	Total	Noninstitutional				Institutional
		Total	Currently employed	Keeping house	Unable to work	
	Number (in thousands)					
Total	5 431	4,325	1,748	834	1,743	1,106
Infective and parasitic diseases	164	119	73	28	17	46
Neoplasms	115	104	45	26	33	11
Endocrine, nutritional, and metabolic diseases	157	126	20	27	78	31
Diseases of the blood and blood forming organs	34	30	11	7	13	3
Mental disorders	720	237	40	22	175	483
Diseases of the nervous system and sense organs	482	429	77	38	314	53
Diseases of the circulatory system	913	680	157	152	371	233
Diseases of the respiratory system	840	825	534	194	98	15
Diseases of the digestive system	299	282	143	64	75	18
Diseases of the genitourinary system	164	158	85	48	26	6
Complications of pregnancy, childbirth, and the puerperium	48	48	12	27	8	--
Diseases of the skin and subcutaneous tissue	38	38	34	4		1
Diseases of the musculoskeletal system and connective tissue	728	677	171	106	400	51
Congenital anomalies	26	24	1	3	20	2
Accidents, poisonings, and violence	438	414	294	67	53	24
Other	265	136	51	24	61	129
	Percentage distribution					
Total	100 0	100 0	100 0	100 0	100 0	100 0
Infective and parasitic diseases	3 0	2 7	4 2	3 4	1 0	4 2
Neoplasms	2 1	2 4	2 6	3 1	1 9	1 0
Endocrine, nutritional, and metabolic diseases	2 9	2 9	1 2	3 2	4 5	2 8
Diseases of the blood and blood forming organs	6	7	6	8	7	3
Mental disorders	13 3	5 5	2 3	2 6	10 0	43 7
Diseases of the nervous system and sense organs	8 9	10 0	4 4	4 5	18 0	4 8
Diseases of the circulatory system	16 8	15 7	9 0	18 2	21 3	21 1
Diseases of the respiratory system	15 5	19 0	30 5	23 2	5 6	1 4
Diseases of the digestive system	5 5	6 5	8 2	7 6	4 3	1 6
Diseases of the genitourinary system	3 0	3 7	4 9	5 7	1 5	5
Complications of pregnancy, childbirth, and the puerperium	9	1 1	7	3 2	.5	1
Diseases of skin and subcutaneous tissue	7	9	1 9	5		--
Diseases of the musculoskeletal system and connective tissue	13 4	15 6	9 8	12 7	23 0	4 6
Congenital anomalies	5	6	1	3	1 1	2
Accidents, poisonings, and violence	8 1	9 6	16 8	8 0	3 0	2 2
Other	4 9	3 1	2 9	2 8	3 5	11 7

It measures the value of human life by the amount people are willing to spend to buy a specified reduction in the probability of death or disability. The Acton report is the only known published survey of willingness to pay for health programs, but several other economists advocate that approach.[17]

Such a survey permits the respondents to register different relative preferences for different health outcomes and different diseases, as well as the relative attractiveness of these outcomes in comparison with those for nonhealth goods that could be purchased for the same amount. The major drawback of the approach is the likelihood that the respondents may not grasp the question's meanings, and considerable uncertainty exists about the validity and consistency of the responses since this method has not been frequently employed. On a day when someone has stomach pains, for example, programs to combat digestive diseases may be "worth" far more than they are on a day when that person has a respiratory ailment. Furthermore, how do the respondents perceive the differences between a 1-percent reduction in the probability of death and a 0.1-percent reduction? Because of the infant state of the art and the concerns about its accuracy, that approach was not used here.

Mortality costs were calculated here on the basis of the "human capital" approach. This approach values one's life according to one's earnings or, in the case of housewives, according to the market value of one's duties. It is the most commonly used formal method and dates back to 1915.[18] There have been objections to this approach because it assumes that changes in earn-

[17] See Gary Fromm, "Civil Aviation Expenditures," in *Measuring Benefits of Government Investment* (A. Dorfman, editor), The Brookings Institution, 1965, and E. J. Mishan, *Cost Benefit Analysis, An Introduction*, Praeger Publishers, 1971.

[18] Edgar Crammond, "The Cost of the War," *Journal of the Royal Statistical Society* (Series A), May 1915.

ings streams bear a direct relationship to what society values in health program outputs: Men are valued higher than women, whites higher than other races, and those in the employed ages higher than the very young and very old Nevertheless, if one is aware of the shortcomings, this method can be used and, in fact, is the only method today that yields consistent, reliable numbers.

Under the human capital approach, calculation of mortality costs considers earnings over a lifetime rather than a single year since, if an individual had not died in 1972, he would have continued to be productive for a number of years It is the present value of these future losses that is the appropriate measure

The estimating procedure for the development of lifetime earnings was described in detail in the earlier Rice report Except for the treatment of housewives, discussed previously, the procedure used here was essentially the same. The method developed takes into account life expectancy for different age, sex, and race groups, varying labor-force participation rates, the current changing pattern of earnings at successive ages, imputed value of housewives' services, and the discount rate [19] The basic assumptions and economic concepts employed are described here in the methodology section Mortality costs were developed for two net discount rates—4 percent and 6 percent Lifetime earnings at these rates are shown in table 4 by age, sex, and race.

TABLE 4.—Present value of lifetime earnings, discounted at 4 percent and 6 percent, by age, sex, and race, 1972

Age	Men			Women		
	Total	White	Other	Total	White	Other
	4 percent					
Under 1	$95,965	$100,607	$60,045	$58,439	$59 669	$50,046
1–4	105,107	110,043	66 195	63 832	65,098	54,975
5–9	126,288	134,277	80 901	77,836	79,366	67,083
10–14	156,322	163 613	98 602	94,830	96,689	$1,751
15–19	186,500	68 628	117,940	111,603	113 827	95,957
20–24	211,537	221,116	133,069	119,737	122,248	101,956
25–29	220 884	230,892	136 384	115,647	118,206	97,347
30–34	213,745	223,647	128 288	105,979	108,559	87,262
35–39	196,143	205 423	113,951	95,149	97,721	75,795
40–44	171,149	179,120	97 784	83 008	85,476	63,473
45–49	141 077	147,325	80,472	69,315	71,645	49,953
50–54	108,581	112 956	63,301	53,929	56 015	35,842
55–59	74,750	77,377	46,078	37,990	39,695	22,568
60–64	41,930	43,293	27 103	23,674	24,821	12,865
65–69	19,718	20,302	13 694	13,054	13 656	7 066
70–74	10 667	11,000	7,370	7,146	7,433	3 980
75–79	5 822	6,079	3,399	3,624	3,763	2,095
80–84	3,343	3,495	1,918	1,567	1,625	950
85 and over	534	559	299	199	206	132
	6 percent					
Under 1	$48 720	$51,011	$31,232	$30,976	$31,557	$27,069
1–4	55,433	57,962	35 768	35,148	35,765	30,890
5–9	74,418	77,795	48,082	47,141	47,960	41,459
10–14	99,742	104 263	64,458	63 172	64,267	55 573
15–19	129 394	135,142	83,955	80,588	82,016	70,692
20–24	156 640	163,469	101,006	91,114	92 834	79,123
25–29	170,988	178,483	107,823	90,439	92 237	77 800
30–34	170,788	178 519	104,179	84 513	86,378	71,237
35–39	161,072	168,609	94,492	77,513	79,444	63,204
40–44	144,209	150 904	82 760	69,215	71,135	54,158
45–49	121,856	127,250	69,586	59,187	61,074	43 578
50–54	96,158	100,033	55,968	47,115	48,873	31,897
55–59	67,763	70 128	41,785	33 825	35,317	20 349
60–64	38,588	39,830	24,964	21,406	22,436	11,702
65–69	18,107	18,631	12,656	11,890	12,436	6,467
70–74	9,886	10 184	6,911	6 598	6,861	3 685
75–79	5,434	5,675	3,168	3,396	3 526	1,956
80–84	3,209	3,354	1,839	1,507	1,562	912
85 and over	519	543	291	194	200	128

Findings

In 1972, there were nearly 2 million deaths representing over 33 million years lost (table 5) Total years lost are estimated by multiplying the number of deaths in each age, sex, and race group by the expected number of years (the life expectancy) remaining to persons in the midyear of that group Application of lifetime earnings to the deaths yielded more than $71 billion in losses at a 4-percent discount rate. At a 6-percent discount rate, the losses amounted to $57 billion.

The greatest losses were for circulatory disorders More than half the deaths and nearly one-third of the lost years and earnings were caused by diseases in this one diagnostic category. Losses were a lower share of the total than deaths because those disorders mainly afflict the aged whose remaining years alive and employed are relatively few.

Deaths from accidents are also very costly to the Nation Ranking second in lost years and earnings, accidental deaths resulted in a $17.7 billion loss to the economy (at a 4-percent discount rate). Deaths in this category ranked third but hit those in the relatively young and productive ages

The third largest mortality losses were for cancer Ranking second in deaths, cancer deaths caused nearly 6 million lost years and $12 6 billion lost dollars

The greatest losses were for persons aged 45–64 and for men (table 6). About one-fourth of

[19] Barbara S Cooper and Wendyce H Brody, *1972 Lifetime Earnings by Age, Sex, Race, and Education Level* (Research and Statistics Note No 14), Social Security Administration, Office of Research and Statistics, 1975

TABLE 5.—Mortality losses Number of deaths, estimated total person-years lost, and discounted earnings, by diagnosis, 1972

Diagnosis	Deaths		Total years lost		Discounted earnings at—			
					4 percent		6 percent	
	Number	Percentage distribution	Number (in thousands)	Percentage distribution	Amount (in millions)	Percentage distribution	Amount (in millions)	Percentage distribution
Total	1,962,270	100 0	33 222	100 0	$71,235	100 0	$57,380	100 0
Infective and parasitic diseases	15,800	8	449	1 4	831	1 2	622	1 1
Neoplasms	352 800	18 0	5,701	17 2	12,633	17 7	10,907	19 0
Endocrine, nutritional, and metabolic diseases	47,160	2 4	496	1 5	1,357	1 9	1,144	2 0
Diseases of the blood and blood-forming organs	4,901	2	110	3	210	3	164	3
Mental disorders	8,917	5	226	7	753	1 1	618	1 1
Diseases of the nervous system and sense organs	16,644	8	476	1 4	1,060	1 5	812	1 4
Diseases of the circulatory system	1 046,217	53 3	12,152	36 6	22,724	31 9	20 004	35 0
Diseases of the respiratory system	111 596	5 7	1,934	5 8	3,434	4 8	2,744	4 8
Diseases of the digestive system	75 084	3 8	1,402	4 2	3,781	5 3	3,225	5 6
Diseases of the genitrouinary system	27,215	1 4	390	1 2	736	1 0	624	1 1
Complications of pregnancy, childbirth, and the puerperium	780	(1)	38	1	80	1	62	1
Diseases of the skin and subcutaneous tissue	2 041	1	36	1	66	1	55	1
Diseases of the musculoskeletal system and connective tissue	5,135	3	102	3	209	3	174	3
Congenital anomalies	15,050	8	942	2 8	1,284	1 8	756	1 3
Accidents, poisonings, and violence	162,520	8 3	5,471	16 5	17,674	24 8	12,645	22 0
Other	70,410	3 6	3,299	9 9	4,402	6 2	2,733	4 8

[1] Less than 0 05 percent

the deaths and two-fifths of the losses fell in this 20-year age group Although only slightly more than half the deaths struck men, the lost dollar amount was three times greater than it was for women The higher earnings for men especially in comparison with the values for housewives' services account for this substantial difference

TOTAL ECONOMIC COSTS

When all types of disease costs are combined—mortality, morbidity, and direct—the total cost of illness for 1972 reached $189 billion at a 4-percent discount rate (table 7) About $40 billion, or one-fifth, was for persons with diseases of the circulatory system Accidents cost $27 billion and were followed by diseases of the digestive system and cancer, each costing about $17 billion

These are staggering numbers. What was the toll in 1963 and were the same diseases the costliest ones? In 1963, the total cost of illness was slightly less than half the 1972 figure, or $93 5 billion The major growth has been in direct costs Although the addition of the drug category added $8 6 billion to the 1972 total, even without it direct costs have tripled in the 9-year period. The ever increasing cost of medical care has made direct costs the largest component in the cost of illness, $3.8 billion higher than the cost of premature death In 1963, mortality costs were about double direct costs, as shown below

Cost component	1963		1972	
	Amount (in billions)	Percentage distribution	Amount (in billions)	Percentage distribution
Total	$93 5	100 0	$188 8	100 0
Direct costs	[1] 22 5	24 1	[2] 75 2	39 8
Morbidity	21 0	22 5	42 8	22 5
Mortality	49 9	53 4	71 2	37 8

[1] Excludes expenditures for drugs and drug sundries amounting to $4.3 billion
[2] Includes expenditures for drugs and drug sundries amounting to $8.6 billion

The distribution by diagnosis has also changed slightly since 1963 (table 8) Diseases of the circulatory system represented about the same share in both years, but accidents have grown in importance because of a relatively higher number of deaths Neoplasms have dropped with relatively fewer cancer victims in the unable-to-work category

APPLICATION TO SPECIFIC DISEASES

The preceding discussion emphasized the importance of consistent definitions and data sources for estimating disease costs The data presented, however, are for broad diagnostic categories In most cases, more finite categories are needed, but the time required for calculating these costs is

TABLE 6.—Mortality losses Lost earnings, discounted at 4 percent, by age, sex, and diagnosis, 1972

Diagnosis	Sex			Age			
	Total	Men	Women	Under 25	25–44	45–64	65 and over
	Amount (in millions)						
Total	$71,235	$54 283	$16,953	$15,934	$16,868	$30,733	$7,696
Infective and parasitic diseases	831	574	258	349	192	244	45
Neoplasms	12,633	8,456	4,177	947	2,503	7,567	1,617
Endocrine, nutritional, and metabolic diseases	1,357	868	489	183	335	639	199
Diseases of the blood and blood-forming organs	210	128	83	77	59	59	16
Mental disorders	753	640	114	172	303	261	17
Diseases of the nervous system and sense organs	1,060	746	315	429	283	299	51
Diseases of the circulatory system	22,721	17,914	4,807	497	3,627	14 067	4,530
Diseases of the respiratory system	3 434	2,579	854	875	636	1,437	486
Diseases of the digestive system	3,781	2,851	930	243	1,177	2,107	254
Diseases of the genitourinary system	736	479	257	100	203	327	106
Complications of pregnancy, childbirth, and the puerperium	80	--	80	33	47	(1)	--
Diseases of the skin and subcutaneous tissue	67	36	31	14	20	26	6
Diseases of the musculoskeletal system and connective tissue	209	94	115	38	62	90	17
Congenital anomalies	1 284	877	406	1 099	113	66	5
Accidents, poisonings, and violence	17 674	14 915	2,758	7 657	6,848	2,927	242
Other	4,402	3,123	1,279	3,221	460	617	105
	Percentage distribution						
Total	100 0	100 0	100 0	100 0	100 0	100 0	100 0
Infective and parasitic diseases	1 2	1 0	1 5	2 2	1 1	8	6
Neoplasms	17 7	15 6	24 6	5 9	14 8	24 6	21 0
Endocrine, nutritional, and metabolic diseases	1 9	1 6	2 9	1 1	2 0	2 1	2 6
Diseases of the blood and blood-forming organs	3	2	5	5	3	2	2
Mental disorders	1 1	1 2	7	1 1	1 8	8	2
Diseases of the nervous system and sense organs	1 5	1 4	1 9	2 7	1 7	1 0	7
Diseases of the circulatory system	31 9	33 0	28 4	3 1	21 5	45 8	58 9
Diseases of the respiratory system	4 8	4 8	5 0	5 5	3 7	4 7	6 3
Diseases of the digestive system	5 3	5 3	5 5	1 5	7 0	6 9	3 3
Diseases of the genitourinary system	1 0	9	1 5	6	1 2	1 1	1 4
Complications of pregnancy, childbirth, and the puerperium	1	--	5	2	3	(1)	--
Diseases of the skin and subcutaneous tissue	1	1	2	1	1	1	1
Diseases of the musculoskeletal system and connective tissue	3	2	7	2	4	3	2
Congenital anomalies	1 8	1 6	2 4	6 9	7	2	1
Accidents, poisonings, and violence	24 8	27 5	16 3	48 1	40 6	9 5	3 1
Other	6 2	5 8	7 5	20 2	2 7	2 0	1 4

[1] Less than 0.05 percent

usually too short for the systematic framework described here In these instances, the broad category of which the disease in question is a part can provide a parameter for its cost and with the use of readily available data, an estimate can be made in a relatively short period of time

The cost of stroke—a component of diseases of the circulatory system—provides a demonstration (table 9) For direct costs, three categories—hospital care, physicians' services, and nursing-home care—represent 87 percent of circulatory disease cost and would be sufficient indicators of stroke's share of the category Days of community hospital care, number of outpatient physician visits, number of nursing-home residents, and average monthly charge, by diagnosis, are available from NCHS. Stroke's share of the circulatory disease category for each of these measurements is calculated and applied to the appropriate cost figure The sum of these three costs as a percentage of the same costs for circulatory diseases is applied to total direct costs for circulatory diseases to arrive at a figure of $2,031 million, the direct cost of stroke

Morbidity costs for stroke can be calculated separately for the institutional and noninstitutional populations For the latter group the NCHS publishes diagnostic disability data for both acute and chronic conditions [20] Persons with stroke—a chronic condition—comprised 7 6 percent of work-loss days for cardiovascular diseases, representing a $135 million loss for the currently employed Housewives' losses for this category are insignificant because of the relatively old population affected For the population unable to work, bed-days can be used as a measure. Stroke

[20] National Center for Health Statistics, *Current Estimates from the Health Interview Survey, United States, 1973* (Vital and Health Statistics Series 10, No 95), 1974, *Prevalence of Chronic Circulatory Conditions, United States, 1972* (Vital and Health Statistics Series 10, No 94), 1974, and *Limitation of Activity and Mobility Due to Chronic Conditions, United States, 1972* (Vital and Health Statistics Series 10, No 96), 1974

TABLE 7 —Total economic costs Estimated direct costs, indirect costs of morbidity and mortality, with present value of lifetime earnings discounted at 4 percent and 6 percent, by diagnosis, 1972

Diagnosis	Amount (in millions)				Percentage distribution			
	Total	Direct costs	Indirect costs		Total	Direct costs	Indirect costs	
			Morbidity	Mortality			Morbidity	Mortality
	4 percent							
Total	$188,789	$75,231	$42,323	$71,235	100 0	100 0	100 0	100 0
Infective and parasitic diseases	3,443	1,412	1,200	831	1 8	1 9	2 8	1 2
Neoplasms	17,367	3,872	862	12,633	9 2	5 1	2 0	17 7
Endocrine, nutritional, and metabolic diseases	5,930	3,436	1,137	1,357	3 1	4 6	2 7	1 9
Diseases of the blood and blood-forming organs	921	491	220	210	5	7	5	3
Mental disorders	13 917	6,985	6 179	753	7 4	9 3	14 6	1 1
Diseases of the nervous system and sense organs	10,951	5,947	3,944	1 060	5 8	7 9	9 3	1 5
Diseases of the circulatory system	40 060	10 919	6,417	22,724	21 2	14 5	15 2	31 9
Diseases of the respiratory system	16,454	5 931	7,089	3,434	8 7	7 9	16 7	4 8
Diseases of the digestive system	17 487	11,100	2,606	3,781	9 3	14 8	6 2	5 3
Diseases of the genitourinary system	6 456	4,471	1,249	736	3 4	5 9	3 0	1 0
Complications of pregnancy, childbirth, and the puerperium	2,932	2 607	245	80	1 6	3 5	6	1
Diseases of the skin and subcutaneous tissue	2 052	1,525	460	67	1 1	2 0	1 1	1
Diseases of the musculoskeletal system and connective tissue	8 948	3,636	5,103	209	4 7	4 8	12 1	3
Congenital anomalies	1 903	381	238	1,284	1 0	5	6	1 8
Accidents, poisonings, and violence	26,678	5 121	3 883	17,674	14 1	6 8	9 2	24 8
Other	13,294	7,398	1,494	4,402	7 0	9 8	3 5	6 2
	6 percent							
Total	$174,934	$75,231	$42 323	$57,380	100 0	100 0	100 0	100 0
Infective and parasitic diseases	3,234	1,412	1,200	622	1 8	1 9	2 8	1 1
Neoplasms	15 641	3,872	862	10,907	8 9	5 1	2 0	19 0
Endocrine, nutritional, and metabolic diseases	5,717	3 436	1,137	1,144	3 3	4 6	2 7	2 0
Diseases of the blood and blood forming organs	875	491	220	164	5	7	5	3
Mental disorders	13 782	6,985	6,179	618	7 9	9 3	14 6	1 1
Diseases of the nervous system and sense organs	10,703	5 947	3 944	812	6 1	7 9	9 3	1 4
Diseases of the circulatory system	37 430	10,919	6 417	20 094	21 4	14 5	15 2	35 0
Diseases of the respiratory system	15,764	5,931	7,089	2,744	9 0	7 9	16 7	4 8
Diseases of the digestive system	16,931	11,100	2,606	3,225	9 7	14 8	6 2	5 6
Diseases of the genitourinary system	6,344	4 471	1,249	624	3 6	5 9	3 0	1 1
Complications of pregnancy, childbirth, and the puerperium	2,914	2,607	245	62	1 7	3 5	6	1
Diseases of the skin and subcutaneous tissue	2 040	1 525	460	55	1 2	2 0	1 1	1
Diseases of the musculoskeletal system and connective tissue	8,913	3,636	5,103	174	5 1	4 8	12 1	3
Congenital anomalies	1,375	381	238	756	8	5	6	1 3
Accidents, poisonings, and violence	21,649	5,121	3,883	12,645	12 4	6 8	9 2	22 0
Other	11,625	7,398	1,494	2,733	6 6	9 8	3 5	4 8

TABLE 8 —Comparison of the economic cost of illness for 1963 and 1972, by diagnosis[1]

Diagnosis	Amount (in millions)		Percentage distribution	
	1963	1972	1963	1972
Total	$93,500	$188,789	100 0	100 0
Infective and parasitic diseases	2,135	3 443	2 3	1 8
Neoplasms	10,590	17,367	11 3	9 2
Endocrine, nutritional, and metabolic diseases	2,623	5,930	2 8	3 1
Diseases of the blood and blood forming organs	373	921	4	5
Mental disorders	7,277	13,917	7 8	7 4
Diseases of the nervous system and sense organs	6 795	10,951	7 3	5 8
Diseases of the circulatory system	20 948	40,060	22 4	21 2
Diseases of the respiratory system	7,413	16 454	7 9	8 7
Diseases of the digestive system	7,837	17,487	8 4	9 3
Diseases of the genitourinary system	2,560	6,456	2 7	3 4
Complications of pregnancy, childbirth, and the puerperium	1,517	2 932	1 6	1 6
Diseases of the skin and subcutaneous tissue	450	2 052	5	1 1
Diseases of the musculoskeletal system and connective tissue	2 783	8 948	3 0	4 7
Congenital anomalies	1 243	1,903	1 3	1 0
Accidents, poisonings, and violence	11,811	26,678	12 6	14 1
Other	7,146	13,294	7 6	7 0

[1] Present value of future earnings is calculated at a 4-percent discount rate

victims had 18 6 percent of the bed-days for the circulatory disease category Since stroke does affect an older population, however, 15 0 percent was used, and the resulting figure for costs in this category was about $500 million Persons in institutions with cardiovascular diseases are in three types of institutions—nursing homes, homes for the aged, and chronic disease hospitals The distribution of residents in nursing homes can be used as a measure of costs As reported by NCHS, stroke residents comprise 10 7 percent of all residents with circulatory disease Thus, institutional costs for stroke amount to $89 million (.107 x $828 million)

For mortality costs, a shortcut need not be used Mortality statistics are available for each diagnosis by age, sex, and race The present value of lifetime earnings are applied, and total mortality costs are estimated In 1972, these costs

amounted to $3,432 million (table 10). When morbidity and direct costs for stroke are added to the mortality figure, the estimated total economic cost of stroke amounts to $6 2 billion, as the following figures show:

Type of cost	*Amount (in millions)*
Total	$6,187
Direct	2,031
Morbidity	
Currently employed	135
Unable to work	500
Institutional	89
Mortality	3,432

METHODOLOGY

The cost of illness was calculated for 16 disease categories shown below with their code numbers

Diagnosis	*ICDA code*
Infective and parasitic diseases	000–136
Neoplasms	140–239
Endocrine, nutritional, and metabolic diseases	240–279
Diseases of the blood and blood-forming organs	280–289
Mental disorders	290–315
Diseases of the nervous system and sense organs	320–389
Diseases of the circulatory system	390–458
Diseases of the respiratory system	460–519
Diseases of the digestive system	520–577
Diseases of the genitourinary system	580–629
Complications of pregnancy, childbirth, and the puerperium	630–678
Diseases of the skin and subcutaneous tissue	680–709
Diseases of the musculoskeletal system and connective tissue	710–738
Congenital anomalies	740–759
Accidents, poisonings, and violence	800–999
Other[1]	760–796

[1] Certain causes of perinatal morbidity and mortality, symptoms and ill defined conditions, and special conditions without sickness and symptoms

Source National Center for Health Statistics, *Eighth Revision, International Classification of Diseases, Adapted,* 1963

Direct Costs

The total direct cost of illness—the cost of prevention, detection, and treatment—represents the amount published by the Social Security Administration for national health expenditures [21] Not all types of expenditures were allocated here according to diagnosis Included are hospital care, physicians' services, dentists' services, other professional services, drugs and drug sundries, eyeglasses and appliances, and nursing-home care. For each type of expenditure, the total expenditure was distributed, by diagnosis, on the basis of utilization and cost data, with the same data sources used for each diagnosis

[21] The data for calendar year 1972 came from Nancy L Worthington, *op cit*

TABLE 9 —Estimating procedure for calculating direct costs of stroke, 1972

Type of expenditure	Diseases of the circulatory system	Stroke	
		Amount	Percent of circulatory disease category
Hospital care			
Days of care (in thousands)[1]	44,390	7,852	17 7
Expenditures (in millions)	[2] $5,271	$933	17 7
Physicians' services			
Number of visits (in thousands)[3]	75 570	3,745	5 0
Expenditures (in millions)	[2] $1,676	$84	
Nursing homes			
Number of residents [4]	298,400	80,893	
Average monthly charge [5]	$345	$368	
Weighted charges (in millions)	103	30	29 1
Expenditures (in millions)	[2] 2,581	751	29 1
Hospital, physicians' services, and nursing-home care			
Expenditures (in millions)	$9,528	$1,768	18 6
Total direct costs (in millions)	[2] $10,919	$2,031	18 6

[1] National Center for Health Statistics "Utilization of Short-Stay Hospitals, by Diagnosis United States, 1972," *Monthly Vital Statistics Report,* July 1974

[2] Data from table 1

[3] National Center for Health Statistics, *Physician Visits, Volume and Interval Since Last Visit, United States, 1971,* Series 10, No 97, and unpublished data from the Center

[4] National Center for Health Statistics, *Chronic Conditions and Impairments of Nursing Home Residents, United States 1969,* Series 12, No 22

[5] National Center for Health Statistics, *Charges for Care and Sources of Payment for Residents in Nursing Homes, United States, June–August 1969,* Series 12, No 21

TABLE 10 —Stroke Number of deaths and present value of lifetime earnings discounted at 4 percent, by age and sex, 1972

Age	Number of deaths [1]			Discounted earnings (in thousands)		
	Total	Men	Women	Total	Men	Women
Total	213,314	95,368	117,946	$3,431,946	$2,290,411	$1,141,535
Under 1	142	88	54	11,601	8,445	3,156
1–4	120	68	52	10,466	7,147	3,319
5–9	96	58	38	10,399	7,441	2,958
10–14	138	86	52	18,375	13,444	4,931
15–19	248	160	88	39 661	29 840	9,821
20–24	284	146	138	47,408	30,884	16,524
25–29	460	222	238	76,560	49,036	27,524
30–34	696	338	358	110,186	72,246	37,940
35–39	1,134	554	580	163,849	108,663	55,186
40–44	2,186	1,050	1,136	274,003	179,706	94,297
45–49	3 716	1,834	1 882	389,186	258,735	130 451
50–54	5 854	3,074	2,780	483,701	333,778	149,923
55–59	8,496	4,830	3,666	500,313	361,042	139,271
60–64	12 860	7,334	5,526	438,338	307,515	130,823
65–69	19,288	10,384	8 904	320,985	204,752	116,233
70–74	28 128	14,320	13,808	251,423	152,751	98,672
75–79	37,794	17,096	20,698	174 543	99,533	75,010
80–84	41,718	16,890	24,828	95,368	56,463	38 905
85 and over	49,956	16,886	33,120	15,581	8,990	6,591

[1] Excludes 30 deaths with no age specified

Hospital care —Data for hospital care expenditures, as reported by the Social Security Administration, include estimates by type of hospital, shown below. For each type, a separate diagnostic

Type of hospital	Amount (in millions)	Percentage distribution
Total	$34,219	100 0
Federal hospitals	3,619	10 6
Defense Department	1,275	3 7
Veterans Administration	1,662	4 9
Public Health Service	616	1 8
St Elizabeths	52	1
Other [1]	14	1
Non-Federal hospitals	30,601	89 4
Community	26 199	76 6
Psychiatric	3,233	9 4
Tuberculosis	117	3
Long-term	753	2 2
Other [2]	299	9

[1] Represents consumer spending in Federal hospitals
[2] Represents hospitals in outlying areas of the United States
Source Unpublished data from the Social Security Administration

distribution was estimated Community hospital expenditures, representing the bulk of the hospital bill, were distributed by days of care, weighted by expenses per patient day. This weighting was not done in the original study, because no such data were available There is, however, a tremendous variation in daily costs by diagnosis—a range of $63—reflecting the vast differences in and complexities of treatment.

The diagnostic distribution of days of care is based on primary diagnosis only, although the presence of associated conditions or multiple diagnoses will affect length of stay Data on days of care by diagnosis for those under age 65 and for the population aged 65 and over came from the hospital discharge survey of the NCHS [22] Unpublished data on expenses per patient day by diagnosis were available from Aetna for their enrollees in the Federal Employees Health Benefit Plan Figures for daily expenses for the population aged 65 and over were provided by Medicare

Non-Federal psychiatric and tuberculosis hospitals were classified under the diagnoses their names imply. Non-Federal long-stay hospital costs were allocated according to the product of the number of residents in nursing homes with intensive nursing care and the average monthly charge; these data were reported by diagnosis by NCHS [23] The remaining non-Federal hospital expenditures were for outlying areas and were distributed according to those for the United States

Expenditures in Federal hospitals were distributed by diagnosis according to days of care. Since the same daily charge is used in Federal hospitals regardless of incurred cost, no weights were available on differing daily costs. Days of care in Veterans Administration hospitals are available by diagnosis in the *Administrator of Veterans Affairs Annual Report.* For Department of Defense hospitals, each service provided the number of total days of care. The Navy and Air Force provided diagnostic data as well Admissions to Navy and Marine Corps hospitals are reported by diagnosis in their quarterly reports, *Statistics of Navy Medicine.* Average length of stay by diagnosis was published in a 1973 study [24] Data for days of care by diagnosis in Air Force hospitals were provided directly by that service Data for Public Health Service hospitals came directly from the Bureau of Medical Services All spending in St Elizabeths Hospital was allocated to mental illness

Physicians' services —Expenditures for physicians' services are allocated according to the distribution of physicians' visits in 1972 by diagnosis, as reported by the National Diseases and Therapeutic Index (NDTI) (a service of IMS America Ltd , Ambler, Pennsylvania) The NDTI is a continuing study of private medical practice in the United States in which data are obtained from a representative panel of physicians who report case-history information on private patients seen over a given period of time. The assumption is made here that the cost of each physician visit is the same

Dentists' services —All of the expenditures for the services of dentists, as reported by the Social Security Administration, are classified under "diseases of the digestive system" Included in

[22] National Center for Health Statistics, "Utilization of Short-Stay Hospitals, by Diagnosis United States, 1972," *Monthly Vital Statistics Report,* July 1974

[23] National Center for Health Statistics, *Charges for Care and Sources of Payment for Residents in Nursing Homes, United States—June–August 1969* (Vital and Health Statistics Series 10, No 21), 1965

[24] Robert D Lamson, John J Waggoner, and Dale E Minner, *Navy Medical Care Study, Costs and Economic Efficiency,* Boeing Computer Services, Inc , Consulting Division, December 1973

this diagnostic group are diseases of the buccal cavity, such as dental caries; abscesses of supporting structures of teeth; other inflammatory diseases of supporting structures of teeth; disorders of occlusion, eruption, and tooth development; toothache from unspecified cause; and other diseases of teeth and supporting structures

Other professional services—Included in this category are expenditures for self-employed private-duty nurses, visiting nurses, optometrists, chiropractors, physical and speech therapists, etc Expenditures for private-duty nurses are allocated by diagnosis according to the distribution of hospital days on the assumption that most of their services are provided in the hospital The National League of Nurses provided diagnostic data for visiting nurses; optometrists' services were classified in neurological diseases and sense organs, and chiropractors' services in diseases of the musculoskeletal system The remainder—$319 million—was classified as "other" Since the Internal Revenue Service reports such expenditures in a lump figure, they could not be allocated by diagnosis

Drugs and drug sundries—This category was omitted in the 1963 study of the costs of illness, but the availability of new data allowed its inclusion here As part of its survey of physicians, the NDTI, which collects data on the type of drug prescribed for each patient seen, provided a listing of the number of times each therapeutic category was prescribed for each diagnosis. Price weights were applied, based on the National Prescription Audit of R A. Gosselin & Co, Inc., which reports data on average wholesale charges per prescription, by therapeutic category.

Nursing-home care—Expenditures for nursing-home care were allocated according to the number of nursing-home residents and the average monthly charge for each diagnosis reported in the NCHS study, referred to previously.

Morbidity Costs

The definitions and issues involved in calculation of morbidity losses are discussed in the body of this report The sources of data used for the calculations are described below.

Noninstitutional population.—Losses were calculated separately for three groups—the currently employed, women keeping house, and those unable to work The NCHS collects disability data for the currently employed and unemployed populations, according to the following classifications of usual activity Working, keeping house, retired for health reasons, retired for other reasons, and doing something else These data were supplied by age, sex, and diagnosis All work-loss days for the currently employed were multiplied by mean annual earnings; bed-days for unemployed women usually keeping house were multiplied by mean housekeeping values (see the text tabulation on page 24) Mean average earnings came from the Current Population Survey of the Bureau of the Census, and housekeeping values were those developed in the Brody study [25]

The number of persons unable to work in 1972 was reported by age and sex in the January 1973 issue of *Employment and Earnings* (Department of Labor) Employment rates and housekeeping rates for 1970 from the same source, January 1971, were applied and the appropriate dollar values attached The diagnostic distribution of these dollars, by age and sex, was based on bed-days for the "retired for health" and "something else" categories of the NCHS data The diagnostic distribution of the group under age 25, however, came from data for disability allowances under the social security program, since the NCHS "something else" category includes students as well as those unable to work.

Institutional population—The number of persons in each type of institution in 1970 is reported, by age and sex, by the Bureau of the Census [26] Employment and housekeeping rates for 1970 and the appropriate 1972 dollar values were applied The diagnostic distribution was based mainly on type of institution, as described on page 26

Mortality Costs

Mortality costs were calculated by multiplying the number of deaths (by age, sex, and race) by

[25] Wendyce Brody, *op cit*

[26] Bureau of the Census, *Persons in Institutions and Other Group Quarters* (PC(2)-4E), 1973

the present values of lifetime earnings The number of deaths was provided by the Mortality Statistics Branch of the NCHS

The estimating procedure for the development of lifetime earnings was described in detail in the earlier Rice report on the costs of illness Except for the treatment of housewives, discussed earlier, the procedure used here was essentially the same.

The method developed takes into account the life expectancy for different age, sex, and race groups, varying labor-force participation rates, the current changing pattern of earnings at successive ages, imputed value of housewives' services, and the discount rate The basic assumptions and economic concepts employed follow.

Life expectancy—The lifetime earnings data were developed on the assumption that each cohort will follow his or her pattern of life expectancy as reported for 1972 at successive ages The NCHS publishes life tables by age, sex, and race Cohort data were obtained for four groups White and nonwhite males, white and nonwhite females

Labor-force participation—The estimate of lifetime earnings takes into account varying labor-force participation rates at different ages The assumption is that an individual will be in the labor force and productive during his expected lifetime in accordance with the current pattern of labor-force participation for his sex and race group. For this calculation, the Bureau of the Census provided unpublished data from their Current Population Survey for 1970 on the number of employed persons by age, sex, and race Use of the number employed in 1970 assumes conditions of full employment (approximately 5 percent of the labor force unemployed).

Earnings—The appropriate measure of output loss for individuals is year-round, full-time earnings, and the proper measure of expected earnings is the arithmetic average or mean Mean earnings data for 1972 by age, sex, and race were provided by the Current Population Survey of the Bureau of the Census

In applying these cross-section survey data to the estimates of lifetime earnings, it is assumed that the future pattern of earnings for an average individual within a particular race and sex group will remain the same as that reported for the base year, 1972. This model recognizes that the average individual may expect his own earnings to rise as he ages and gains experience, in accordance with the cross-section survey data for 1972

The use of these average earnings based on cross-section surveys may understate the present value of expected lifetime earnings because of the failure to take into account future economic growth patterns by age If, however, an average annual rate of gain in productivity is projected, it can be applied as a partial offset to the discount rate, discussed below

The discount rate—The calculation of the present value of expected lifetime earnings raises the question of the importance of discounting and the appropriate discount rate From the economist's viewpoint, it is recognized that the arithmetic sum of lifetime earnings overstates the present value of an individual. Determining the present value of the future earnings stream is the correct way to measure the economic value over a period of time; discounting converts a stream of earnings into its present value

Economists agree that comparison of streams of earnings over varying timespans should employ the process of discounting, but there is no agreement on the discount rate to be used [27] The higher the discount rate, the lower the present value of a given money stream With a high rate of discount, earnings far into the future yield a relatively small present value.

Conversely, lowering the discount rate increases the present value of these future earnings. The discount rate can be adjusted for expected changes in productivity An increase in productivity of 1 75 percent a year, for example, can be incorporated into the discounting calculations to obtain a net effective discount rate Thus, a 6-percent discount rate adjusted for a rise in productivity of 1 75 percent a year will yield an effective dis-

[27] See Herbert E Klarman, *The Economics of Health*, Columbia University Press, 1975, and P D Henderson, "Investment Criteria for Public Enterprises," in *Public Enterprise* (R Turvey, editor), Penguin Modern Economics Readings, Penguin Books, 1968

count rate of approximately 4 percent (1 06/ 1 0175 = 1 042). An 8-percent discount rate similarly adjusted results in a rate of 6 percent (1 08/1 0175 = 1 061). These two rates, 4 percent and 6 percent, are intermediate in the range of rates currently employed and were used in this study to estimate the present value of lifetime earnings

Consumption—In the past, there was some diversity of opinion regarding the treatment of consumption—whether or not to deduct it from a person's contribution to output.[28] Recently, however, there has been wider agreement among economists that to deduct consumption in cost-of-illness calculations would be wrong since it is the losses to society that are being measured rather than those to the individual family.[29]

[28] See Burton A Weisbrod, *Economics of Public Health*, University of Pennsylvania Press, 1961, Louis I Dublin and Alfred J Lotka, *The Money Value of Man*, The Ronald Press Company, 1946, and Rashi Fein, *Economics of Mental Illness*, Basic Books, 1958

[29] E J Mishan, "Evaluation of Life and Limb," *Journal of Political Economy*, 1971

Notes and Brief Reports

Self-Employment Income At Low Earnings Levels*

The social security tax rate on self-employment earnings differs from the tax rate on wages Under certain conditions this situation could lead to the taxing of workers with low earnings at a higher average rate than those with high earnings

Since 1951, when self-employment first became covered by the social security system, the self-employment tax rate has ranged from about 68 percent to about 75 percent of the combined employee and employer rates on wages. If it is assumed for the purpose of this study that the employee ultimately bears the entire wage tax then the self-employed pay a lower rate than wage earners do And if self-employment is concentrated among individuals of moderate and higher earnings—the question this study investigates—it follows that the average tax rate is regressive in relation to taxable earnings, that is, the rate is higher for taxable earnings at the lower levels

This assumption on the burden, or incidence, of the tax means that were it not for the employer tax (a) the market wage structure would be higher by precisely the amount of the tax and (b) employers would therefore have to pay the higher going wage to obtain the employees they desire Economists disagree on the extent to which the tax burden shifts[1] (The incidence of the employee's share of the tax is part of the same theoretical question, yet observers appear to agree that at least half of the combined employee-employer tax falls on the worker Controversy in the literature on the proportion of the tax borne by the worker seems limited to a range that goes from half to all of it.)

This note presents data on the proportion of taxable earnings that is derived from self-employment at various earnings levels and examines the hypothesis of regressivity in the light of the data

TERMINOLOGY

"Earnings" in the context of taxes and the social security program are not identical with income They consist only of those portions of income that result largely from the personal effort of the earner—wages and income from self-employment. Dividends, rent, interest, and other forms of property income that involve relatively little personal effort are not called earnings and are not taxable or creditable for benefits under the program

Earnings from covered employment are taxed each year to the "maximum" amount specified

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Acknowledgement is made to Robert H Finch, Jr, and Katherine P Merrick for their work in calculating the standard errors

[1] For a presentation of the views of several economists on the incidence of the social security tax, see John A Brittain, *The Payroll Tax for Social Security*, The Brookings Institution, 1972, chapters II and III