Measurement and Application of Illness Costs

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THE BURDEN of the cost of illness on individuals has long been recognized. More recently, emphasis has been placed on the burden of illness, death, and disability on society, and increasing attention has been paid to the allocation of resources to the health field and to specific programs designed to prevent and mitigate illness and disability and to postpone death. This paper describes a procedure for measuring morbidity and mortality costs in a broad context, discusses the use of this estimating procedure in cost-benefit analysis, and raises some problems and issues encountered in such studies in the health area.

Direct Cost of Illness

Direct expenditures for health purposes comprise a substantial part of the total cost of illness in this country. They include expenditures for prevention, protection, treatment, rehabilitation, research, training, and capital investments in medical facilities. Or, in terms of the types of services offered, they include the amounts spent for hospital and nursing home care, physicians' and other medical and professional care, drugs, medical supplies, research, training, and nonpersonal health services.

For almost two decades the Social Security Administration has prepared figures on these direct costs by estimating public and private expenditures for health and medical care. We have data available on expenditures for health services under specified public programs and by source of payment in the private sector (*1*) and also by type of health service and source of payment (*2*). These carefully and systematically developed data are available on an annual basis for use by program planners, medical care specialists, and others who are interested in the direct expenditures for health and medical care in the United States today.

The method of obtaining these data on health expenditures is not new. What is new, perhaps, is the procedure for systematically distributing these direct expenditures by disease category for each of the types of services. Using this procedure, we found that expenditures for diseases of the digestive system during the base year of 1963 ranked highest among the disease categories, comprising 19 percent of the total expenditures that could be allocated among the various diagnostic groups (*3*). Expenditures for mental disorders ranked second with 11 percent of the total. The third highest ranking diag-

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nostic group was diseases of the circulatory system, which accounted for 10 percent of the total. Taken together, these three diagnostic groups accounted for about two-fifths of the total expenditures for health in 1963.

Direct expenditures for health purposes reached $34.3 billion in 1963. But these direct expenditures are by no means the only measure of the economic consequences of sickness, disability, and premature death. To ascertain the full impact of these factors on the economy, the indirect costs involved in the loss of output traceable to premature death and to incapacitation also must be measured.

Annual Indirect Cost of Illness

Even this method of measuring the cost of illness is not a new technique; many estimates of indirect costs have been made in the past. The Social Security Administration has published annually overall estimates of income loss from nonoccupational short term sickness by type of employment (*4*). These data, however, are not available by disease category. The National Education Committee includes within its annual report a collection of estimates of the cost of major chronic and crippling illnesses compiled from many published sources (*5*). Estimates cited are for a variety of items, including losses of wages resulting from days lost from work because of acute and chronic conditions, losses of earnings for those who died from arteriosclerotic heart disease and cancer and the tax revenue losses from these deaths, and the annual indirect costs of heart disease, mental illness, arthritis and rheumatism, and cerebral palsy.

Examination of the reported indirect losses for various illnesses shows a lack of consistency in the estimating procedures. For some diseases, earnings were applied to days of work lost; other estimates included only losses associated with institutional care; still others offered no clear basis for the derived cost. It became clear that a systematic approach was required to estimate the annual indirect losses associated with illness, disability, and death. The formulation of such an approach is the principal contribution we have made in this area.

In the basic method we used, the prevailing average earnings were applied to the productive time lost by sex and age group for each major cause of death and each major type of illness. Various sources of data were used. Of primary importance was the establishment of a systematic framework for use in estimating the annual losses in output.

We divided the 1963 U.S. population into two categories—the institutional and the noninstitutional. The institutional group includes persons confined in long term hospitals (mental, tuberculosis, and chronic disease hospitals), homes for the aged, and homes and schools for the mentally and physically handicapped.

The noninstitutional population was classified into two subgroups according to status in the labor force—the currently employed (assuming relatively high employment or 96 percent of the labor force employed) and persons not in the labor force. The subgroup not in the labor force included women keeping house—to whose services as housewives we attached an imputed value—and persons unable to work because of long term physical or mental illness. The output losses by diagnosis were measured separately for each of these population groups. The estimating procedure and the sources of the data are described in detail in the report "Estimating the Cost of Illness" (*3*).

After systematically developing the data for each of these groups by diagnosis, we arrived at an estimated total of $23.8 billion lost to the economy in 1963 due to premature death, illness, and disability from all diseases. Mortality losses accounted for 11 percent of the total; the remaining 89 percent was accounted for by morbidity losses. When the annual economic costs—the sum of the direct expenditures for medical care and the indirect costs of mortality and morbidity—were summarized, we found that the total economic cost of illness, disability, and premature death was approximately $58 billion in 1963. Of the $46.3 billion total economic cost distributed among the major diagnostic groups, 15 percent represented the costs of mental, psychoneurotic, and personality disorders—a reflection of the high losses accounted for by the mentally ill who are in institutions. Costs of diseases of the circulatory system ranked second, costs of diseases of the digestive system ranked third, and diseases of the respiratory system ranked fourth. Together, these four major diagnostic groups accounted in 1963 for more than one-half of the annual economic costs in the United States of illness, disability, and death from all causes.

Economic Cost of Mortality

From the economist's point of view, the cost estimates for the single year 1963 represent only a portion of the estimated losses in output resulting from illness, disability, and death; they therefore seriously underestimate the economic cost to society. If a person had not died in this year, most likely he would have continued to be productive for a number of years. If the person was ill and disabled in this year and if his disability continued into future years, his productivity would be affected. It is the present value of these future losses that must be included in the measure of the indirect costs of a disease.

For mortality, the estimated cost to society of all deaths is the product of the number of deaths and the expected value of the person's future earnings, with sex and age taken into account (*6*). In this method of derivation, life expectancy must be considered for different age and sex groups, as well as the changing patterns of earnings at successive ages, the varying rates of participation in the labor force, the imputed value of housewives' services, and the appropriate discount rate to convert a stream of costs or benefits into its present worth.

The quantification of the value of human life is not a new concept. Before presenting detailed estimates of this value, Dublin and Lotka traced the procedure back to the valuation of slave labor in ancient times—that labor which "made possible the enduring monuments in stone raised by the Pharoahs" (*7*). These authors followed this reference to antiquity with a historical presentation of various estimates of the value of human life, beginning with those by Sir William Petty in the 17th century and those by Adam Smith a century later.

The concept of the value of human life also has been applied commercially in life and health insurance. In 1927, Huebner (*8*) stated his thesis that life insurance protection should equal the capitalized monetary worth of the family head's earning capacity, or at least that portion of it not required for his own maintenance. This idea of using potential lifetime earnings as a measure of adequate life and health insurance protection is now applied extensively in the insurance field (*9*).

Until recently, in studies of illness costs, varying methodologies have been used in estimating the value of human life. Space does not permit a listing of all of them. Some were based on income, others on earnings; some imputed a value to housewives; some accounted for consumption; various discount rates were used.

Although estimates of lifetime earnings have been prepared by many researchers, all these estimates were devised for a specific use and are not readily adapted to other purposes. The economist engaged in the analysis of programs requiring data on lifetime earnings therefore had to develop his own set of estimates to meet his needs. Furthermore, the estimates available to economists were not current, but were based on obsolete data on income or earnings. Thus, although the concept is not new, what we did was to present a systematic framework for estimating lifetime earnings, which was applied, according to cause of death, to the number of people who died in the one year. The same procedure has been used to measure the returns from education (*10*).

The details of the basic assumptions and economic concepts that were used are beyond the scope of my paper. Suffice it to say that these factors were all taken into account. Application of the expected lifetime earnings by age and sex to the 1.8 million persons who died in 1963 indicated a loss from these deaths of nearly $50 billion to the economy at a 4 percent discount rate. In lost years, these deaths represented a total of 32.5 million.

A brief look at the distribution of these losses according to cause of death shows that circulatory diseases accounted for the largest number of deaths in 1963—43 percent of the total; neoplasms ranked second, accounting for 16 percent; diseases of the nervous system ranked third; and injuries ranked fourth. Together, these four major diagnostic groups accounted for almost four-fifths of the total number of deaths. When discounted lifetime earnings were applied, we found that circulatory diseases ranked first and neoplasms second; injuries were a close third; and diseases of the nervous system ranked fourth.

To summarize briefly, when we added the annual direct expenditures for medical care services and supplies to the losses to the economy because of illness and to the present value of the lost output for those who died in a single year, the total economic cost of poor health in 1963 amounted to more than $105 billion. If, in fiscal 1967, there were approximately the same number of deaths and disability days as in 1963 and an annual 3 percent increase in productivity took place, the fiscal 1967 economic toll would amount to at least $125 billion.

Dr. Philip R. Lee, Assistant Secretary for Health and Scientific Affairs, Department of Health, Education, and Welfare, has stated that "It is clearly recognized . . . that the economic toll of illness is an intolerable burden on the American society, and that this society can no longer afford to neglect the disease and disability which afflict so many of its members" (*11*).

Application to PPBS

Estimating the costs of illnesses is not new. What is new is the use of these estimates in the planning-programing-budgeting system (PPBS) that has swept the Government following the directive issued in October 1965 by the Bureau of the Budget to the heads of executive departments and establishments (*12*). Under PPBS, each department must formulate its objectives, weighing the benefits against the costs; must examine alternative means of achieving these objectives; and must shape its budget request on the basis of this analysis (*13*). The current use of PPBS in the Department of Health, Education, and Welfare has emphasized the need for improved tools with which to systematically measure the effectiveness of health programs.

One of these tools is cost-benefit analysis, which aims to maximize "the present value of all benefits less that of all costs, subject to specified constraints" (*14*). Ideally, all costs and all benefits of the program are evaluated. The costs of public health programs should include the Government operating and installation costs which are incurred annually over the life of the program, as well as any private outlays. The expected benefits usually take the form of the likely savings in costs of disability, death, and treatment which result each year from the institution and operation of the program. These time streams of costs and benefits are discounted to obtain the present value of costs and benefits.

The data on cost of illness described in this paper provide a framework for measuring the monetary benefits associated with health programs designed to reduce death and disability. When a health program's expected savings in hospital days, physician visits, disability days, and deaths are translated into monetary terms, the program planner and administrator has an important tool to guide him in the decision-making process. He must also consider the intangible benefits that cannot be quantified, such as savings in pain, grief, disruption in family life, and so forth. When alternative programs or alternative levels of investment are at issue, the relative dollar costs and benefits may be compared. Programs whose benefits are greater than costs may be considered for approval. The cost-benefit ratios also may be used to rank projects in order of priority, subject to adjustments resulting from noneconomic considerations.

Alternative Analytical Techniques

Health planners and economists differ to some extent with regard to the translation of benefits into dollar terms and in the calculation of the benefit-cost ratio by which the effectiveness of alternative programs may be measured. Early in 1966, the Secretary of the Department of Health, Education, and Welfare directed that a series of program analysis groups be established to analyze thoroughly the objectives, benefits, and costs of existing and alternative programs. The varying approaches to this directive illustrated the divergence of opinion on the use of dollar values in the cost-benefit analysis.

In program analysis studies of selected disease control programs (motor vehicle injuries, cancer of specific sites, arthritis, syphilis, and tuberculosis), benefit-cost ratios were developed based on identical lifetime earnings and on identical discount rates (*15–18*). Benefit-cost ratios and lifetime earnings were also applied in program analysis studies of human investment programs (adult basic education and work experience and training) and in a study of the benefits associated with vocational rehabilitation services (*19–20*).

On the other hand, in several studies, the costs of alternative programs have been measured and their benefits enumerated in terms of various mortality and morbidity measures without translation of the benefits into dollar terms. For example, in a study by the Department of Health, Education, and Welfare, the benefits of maternal and child health care programs are enumerated in terms of preventing or correcting chronic handicapping conditions, of lessening infant mortality, and of reducing unmet dental needs (*21*). In an analysis of the kidney disease program, the benefits were stated in terms of reductions in mortality, prevalence of the disease, and of illness days (*22*). In the latest program analysis of the Department of Health, Education, and Welfare, "Delivery of Health Services for the Poor" (*23*), benefits are expressed in terms of deaths averted and of various indices of reduced morbidity, such as hospital days saved, disability days averted, and so forth. The recent study, "Cost-Effectiveness Analysis Applied to the Treatment of Chronic Renal Disease" by Klarman and co-workers (*24*), has also avoided the translation of benefits into dollar terms and measured benefits only in life years gained.

Major Issues

What are the issues and problems that result in these differences in analytical procedures?

The major issue is intangible benefits, which "are difficult, if not impossible to measure," according to William Gorham, former Assistant Secretary for Program Coordination, Department of Health, Education, and Welfare (*25*). Several economists believe that ignoring the intangibles may result in distortion of the overall economic and social costs because the implicit assumption is that the economic value of intangible losses is zero (*26–28*). Others are concerned that unless the ratio of measured to nonmeasured benefits is the same in all programs—which it is not—those programs with a higher proportion of nonmeasurables will have relatively lower benefit-cost ratios and be unfairly compared (*29*).

Another problem is that translation of benefits into dollars puts a higher value on one age group than on another. The lifetime earnings of an aged person can scarcely be favorably compared with the net future lifetime earnings of a person in his twenties. Similarly, the lifetime earnings of an infant are less than those of the person in his twenties. Thus, if one program aims at reducing mortality or morbidity of one age group and another program of equal costs reduces mortality or morbidity of another age group by an equal amount, the benefit-cost ratios will not be the same. The concern is whether one age group should be "saved" before another solely because of its greater productivity. The choice between such programs seems cold and calculating if based on an economic value placed on human life, especially if, for example, the choice is between programs to save children from future illness or programs to assist older people crippled by chronic diseases.

"We are not dealing with pieces of hardware but with human beings whose needs are obvious," said Gardiner (*30*). Gorham stated that "It must be obvious that economic criteria are not the only criteria which should be applied to the allocation of resources and the distribution of program outputs. Nor do the analyses made as part of the PPB process constitute a prepackaged instant decision-maker intended to replace judgment, common sense, and compassion or turn resource allocation decisions over to computers" (*25*). Nevertheless, Gorham believes that cost-benefit analysis is an important tool for the decision-maker when program objectives are clearly identified, the alternative methods of reaching these goals are defined, and the costs over a period of time are carefully measured, along with the benefits to be derived from the alternative programs.

In health programs, the savings or benefits may be in terms of such indices as lives saved, disability days prevented, and in reductions in hospital days and physician visits. The translation of these tangible savings into one common denominator—dollar benefits—and the calculation of the numerical ratio of such benefits to dollar costs are the final stages in the analysis. When there are unmeasurable social benefits, these should be explicitly stated. But the existence of such unmeasurable benefits should not preclude detailed analysis and measurement of the expected tangible results of various alternatives. The final stage of placing dollar values on benefits extends the various medical and vital statistical indices into economic terms.

Accomplishments

The application of cost-benefit analysis to public health programs is still in its infancy. A variety of studies have been undertaken employing imaginative and varying techniques. There is some divergence of opinion on specific techniques. Nevertheless, we have come a long way since 1966, when it was stated that "William Gorham, an Assistant Secretary in the Department of Health, Education, and Welfare and an economist who recently moved up from the Defense Department to introduce into HEW the kind of analyses that have been helpful in resolving defense decision problems, finds nonquantifiable considerations already so profuse in an agency such as HEW that there is hardly any danger for some time of introducing too much calculation" (*31*).

The program analyses undertaken in the Department of Health, Education, and Welfare since 1966 have covered a wide scope of programs, including disease control, adult basic education, vocational rehabilitation, and the delivery of health services to the poor. These programs, however, represent a very small fraction of the total currently budgeted and planned in the Department. Moreover, we cannot be confident about the accuracy of the estimates obtained to date. To the extent that these analyses have quantified expected costs of, and benefits from, alternative approaches to accomplishing limited stated objectives, they have provided some additional useful insights, previously not available to the Secretary, to be weighed along with social and political value considerations in the budget-making process.

An economist and a political scientist, authorities in their fields, have both come to the conclusion that cost-benefit analyses are useful tools. In assessing child health services, Rashi Fein, the economist, succinctly concluded: "I do not say 'don't measure effectiveness.' Nor do I say 'rely totally on the benefit-cost ratio.' I suggest that the ratio tells us much. It is a powerful and useful tool. It should be sought—for even in the seeking we learn a lot, we think the problem through, we specify things more carefully. It is foolish to reject the attempts to measure and rely on vagueness" (*29a*).

Aaron Wildavsky, the political scientist, stated: "If quantifiable economic costs and benefits are not everything, neither would a decision-maker wish to ignore them entirely. The great advantage of cost-benefit analysis, when pursued with integrity, is that some implicit judgments are made explicit and subject to analysis" (*13a*).

Summary

The measurement of illness costs involves the distribution of direct expenditures by disease categories and the development of a systematic framework for use in estimating annual losses in output and the present value of lifetime earnings lost as a result of death. When the annual direct expenditures for medical care services and supplies are added to the losses to the economy caused by illness and to the present value of lost output for those who have died, the total economic costs of poor health in fiscal year 1967 are estimated to have amounted to at least $125 billion.

The measurement of illness costs has been applied and used in the several cost-benefit analyses generated by the planning-programing-budgeting system within the Department of Health, Education, and Welfare. Alternative techniques to the use of various mortality and morbidity measures include the translation of benefits into dollar terms. The major issues that result in differences in analytical procedures arise from the difficulty of measuring intangible benefits and the varying values placed on different age groups. The translation of tangible savings into dollar benefits by cost-benefit analysis enables the decision-maker to consider them along with the unmeasurable and nonquantifiable social and political benefits.

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