

CAN WE MEASURE THE SOCIAL IMPORTANCE OF HEALTH CARE?

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Abstract

This paper examines the extent to which it is possible to measure the social importance, or macro benefits, of health care. In contrast to the many micro studies of the benefits of specific health care interventions, methodology relating to such macro benefits is at a very rudimentary stage. A theoretical model is presented that seeks to capture the social consequences of a health care system. In light of this model, three existing empirical approaches to answering the question are examined: the inventory approach, the avoidable mortality approach, and the production function approach. All three have severe limitations in terms of the underlying theoretical model, data availability, and analytic tools employed. A more fruitful approach may be to investigate the value of undertaking a direct survey of citizens' attitudes toward their health care system.

Keywords: Health Care Sector; Health Systems; Outcome Assessment; Health Care Evaluation Mechanisms; Benefits Assessment

A universal and persistent concern expressed about health care in most developed countries is the large and growing volume of expenditure that it consumes, whether expressed as an absolute sum or as a proportion of national income. In some senses this concern is puzzling. Secular changes in expenditure on different sectors of the economy occur as a matter of course in response to changes in technology, changes in taste, and changes in incomes. Yet the vast increases in expenditure on, for example, overseas holidays brought about by such changes has attracted none of the same sort of concern. The question therefore arises: why is health care different?

There are probably two principal reasons for such concern. First, the functioning of a market economy requires that citizens be reasonably well informed about the goods that they wish to consume. However, it is clearly the case that for many

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aspects of health care patients rely on the advice of health care providers to make their health care decisions. There is therefore a danger of supplier-induced demand for health care. Furthermore, in any insurance-based health care system, health care decision makers—whether they are doctors, other professionals, or patients—need take little account of the immediate opportunity costs of their decisions. There is therefore a distinct danger that health care will be over-supplied relative to other traded goods and services.

Given these legitimate concerns, there is a *prima facie* case to suggest that there may be pressures for an economy to spend “too much” on health care. A fundamental question to ask is therefore: how much does health care contribute to national well-being? This paper seeks to identify the issues that need to be clarified if an answer to this question is sought. The discussion is framed within the institutional framework of the United Kingdom, in which most health care is provided by a public sector organization (the National Health Service) and funded out of general taxation. The immense pressure to reduce tax levels therefore gives a special urgency to the search for an answer to the question in the United Kingdom. In particular, the U.K. Treasury is likely to ask, quite reasonably, what it obtains in return for the vast tax expenditure on U.K. health care. Nevertheless, the issues raised here are likely to be generally applicable to most insurance-based systems of health care.

If this paper’s question is to be meaningfully addressed, there is a clear need for measures of the benefits generated by health care expenditure. There are no immediate candidates for such measures. Indeed, there are few sectors of the economy for which explicit measures of benefit have been developed. A possible exception is the case of transportation, for which evaluation techniques have required the estimation of benefits (usually in terms of travel time) and costs (such as environmental degradation). However, for most of the traded sector, it is presumed that consumers are able to judge personal benefits, which take the form of changes to utility, or satisfaction. Because goods can be freely traded, it is considered that there is little need systematically to quantify such benefits.

The principal ostensible objective of health care is to confer benefits in terms of health. The obvious starting point is therefore to examine whether there exist any measures that might capture the impact of health care on health. Clearly, given the “macro” nature of our question, we should in the first instance search for macro measures of health status, which we shall define as “population health outcome measures.” The most obvious examples of such measures are the various mortality indices routinely produced in all nations.

However, no measure of population health outcome can be used blindly as a basis for inferring the impact of health care on health outcomes, for the following reasons:

- No population health outcome measure is a perfect indicator of population health status;
- Health outcome is influenced by many factors other than health care;
- Health care contributes to welfare other than through improvements in health status;
- Many of the links between health care and changes in health status are poorly understood;
- Many of the influences of health care on health status operate over a long time period.

These considerations are considered in more detail and a short summary of previous theoretical research is presented later. We conclude that, before proposing a means of measuring the benefits of health care, it is first necessary to have an adequate

conceptual framework within which to undertake any analysis. We therefore develop such a framework, which seeks to accommodate the complicating issues noted above.

There have been some previous attempts to provide operational answers to the paper's question, most notably, the inventory approach, the avoidable mortality approach, and the production function approach. These are summarized and appraised in light of the conceptual framework. The paper then concludes with an assessment of the extent to which it may be possible to identify the benefits to society associated with health care. The conclusions are that current research is inadequate for the purposes on three counts: a) the theoretical framework; b) the data available; and c) the statistical methodology. In light of our findings, we conclude that analytic techniques will not be able to make more than a peripheral contribution to addressing the problem in the foreseeable future, and that a more promising approach may be to seek citizens' views about the contribution that health care makes to their well-being.

THE PROBLEM

In simple terms, the aim of this paper is to assess the feasibility of establishing and measuring the link between health care and health at an aggregate level. Identifying the efficacy and effectiveness of health care has become a priority in developed nations as they seek to contain health care expenditure. However, the emphasis to date has been at the microlevel—the evaluation of discrete health care treatments and evaluations. The task of the paper is to explore ways of replicating this work at a macro-level.

At the macrolevel, three issues are of supreme importance, for they determine the ability to *attribute* any changes in national well-being to health care, and it will be attribution that is a key factor in addressing our question. First, a suitable definition of health must be chosen. There are many candidates which are discussed below. Second, the determinants of that health must be identified. Otherwise, many errors may be encountered when attempting to model and statistically test the contribution of health care to health. In this respect it is worthwhile to recall Fuchs' (16) warning 30 years ago that “any attempt to analyze the relationship between health services and health runs headlong into two very difficult problems. The first concerns the definition of health and measurement of levels of health, or at least changes in levels. The second involves an attempt to estimate what portion of changes in health can be attributed to health services, as distinct from the genetic and environmental factors that also affect health.” Third, there is a widespread belief that health care and the health care system contribute to more general well-being, over and above any contribution to health, however defined.

These three considerations give rise to three fundamental questions:

1. What do we mean by health?
2. How do we go about attributing health status to various potential sources, such as the physical, social, and genetic environments, as well as to health care?
3. How do we measure the contribution of health care to well-being over and above any contribution to health status?

Each of these questions has been the subject of extensive consideration elsewhere, so we review below only the issues directly relevant to our question.

Measuring Health Status

Numerous concepts of health status have been developed, which can be summarized as follows, in roughly increasing order of generality:

- Health as absence of illness;
- Life expectancy and mortality rates;
- Functional status and quality of life;
- Quality-adjusted life-years (QALYs);
- Well-being and self-empowerment;
- Health as a durable capital asset;
- Health and health care as utility.

The definition of health as the absence of illness is the traditional clinical definition. It defines health in terms of the role of the medical profession and its *own* definitions of indicators of success. It arose due to the challenge of fatal infectious diseases and the evident impact of epidemics on “health” in the early 20th century. Infectious disease was an obvious and legitimate target for the emerging health services in the industrialized world. However, it has also led to the propagation of a narrow view of health as the absence of disease, which is still prevalent within the medical profession.

The use of life expectancy for the individual and mortality rates for populations as definitions of health can be seen as a natural expression of the absence of illness approach in terms of measurable statistics. It rests on the assumption that disease causes illness and premature death, the sole expression of ill health. Because of the relative ease of collecting mortality data, they form the basis for the most common definitions of health used in empirical published studies. They give rise to useful summary measures. For instance, we know that average life expectancy has increased from approximately 45 to 75 years for citizens of industrialized countries over the course of the 20th century (5). Hadley (20) defends the use of mortality by arguing that, unlike broader measures, mortality is a clear and well-defined event, it is widely understood by the public and policymakers, and error rates are likely to be lower than in morbidity measures. Yet in developed nations many conditions are the subject of massive health care efforts that have little impact on mortality, suggesting that mortality measures are increasingly misleading indicators of the benefits of health care.

Indeed, absence of illness has been criticized as a measure of health. Many illnesses experienced in the developed nations are chronic, and a better definition for the individual may therefore be the ability to carry out common everyday tasks and engage in social interaction competently. Many attempts have been made to develop proxy health status indicators on this basis. The usual method is to distinguish separate aspects of physical and social functioning, and to get respondents to value different combinations of them along some sort of scale. This allows the development of some measure of health experience that is not dependent on health professionals’ interpretation or contact with the health care system. An example is the EuroQol instrument EQ-5D, which is to be included in the English National Health Survey (26).

Quality-adjusted life-years (QALYs) and similar measures such as healthy-years equivalent (HYEs) bring together in a simple index both life expectancy and functional status indicators. Average life expectancy in developed countries has

remained relatively stable in recent years, and there is an increased focus on adding life to years rather than years to life. QALYs are a means of measuring the success of this endeavor. Their strength lies in that they enable fatal and nonfatal health experiences to be directly compared, with recognition that health is not purely about length of life but also the quality of that life.

However, all the measures described above can be criticized for being indicators of the *lack* of health rather than of health itself. This has led to an undue focus on disease and illness and brings us to the need for still broader definitions of health (11). In this respect, much of the current debate is taking place in the health promotion literature, which concentrates on the positive aspects of health. Issues such as self-empowerment and the ability to make rational and informed choices are increasingly being seen as important aspects of the health of the individual. This reflects Illich's definition of a healthy individual having dignity, autonomy, and self-reliance (22).

Economists' views of health are surprisingly close to these more holistic concepts of health. Grossman (19) noted that health has two roles: as a consumption good yielding utility, or satisfaction, in its own right and, perhaps more importantly, as an investment good. Better health allows more time to be allocated to work (to increase money income and indirectly utility) and leisure (utility). In this sense, health is a durable capital asset that enables individuals to satisfy their wants more efficiently. Health care is only demanded to the extent that it contributes to this durable capital asset. Grossman's concept of health is therefore similar to that of the vaguer concept of well-being, in the sense that health is demanded for its contribution to a happy and fulfilling life.

However, there is also a more general economic tradition that argues that the purpose of human action is to maximize utility, the subjective value that individuals receive from their actions (3). Utility is not health per se. However, the purpose of improving health, as of all other actions, is in the final reckoning simply to add to utility. As Mooney (31) states, there may be little intrinsic value in health itself. If utility is taken as the ultimate objective of existence, then it may not matter for our purposes how we should define health. What matters is the extent to which health care adds to individual utility; whether its contribution is through a measurable impact on some concept of health is immaterial.

Attributing Health Outcome

If health is defined merely as the absence of disease or illness, or premature mortality, then the factors that need to be taken into account when trying to isolate the effect of health care on health are those that influence disease, illness, and premature mortality. These factors might include phenomena such as environment, genetic disorders, and lifestyle as well as health care itself. If health is more broadly defined, the range of influences will expand and the significance of each influence for total health varies. For example, mental health is now recognized as a considerable component of health in most industrialized countries. Social influences and work-related stress would therefore be important additional factors to be considered in any definition that encompassed mental health. Hancock (21) summarizes some of the key components that many commentators consider to contribute to health, apart from the health care system. Health is a function of the environment, the community, the economy, and the individual's place in it. This model draws on the social rather than biological definition of health and emphasizes the important interactions between each that contribute to health.

When seeking to isolate the contribution of health care to health, it is generally accepted that external factors such as these must be accommodated. Moreover, it is important to recognize that the activities of the health care system itself at some time in the past may have influenced the nature of some of these factors. And it must not be forgotten that there are also those who subscribe to the view that health care is actually harmful to health, with Illich (22) being the classic example. This arises from his definition, which sees health in a population being at its optimal level when “. . . the environment brings out autonomous personal, responsible coping ability.” Since the medical profession seeks to remove this autonomous control over health, it is therefore detrimental to it. A similar argument could possibly be raised by those who set great store by self-empowerment.

Nonhealth Outcomes

A crucial point that is often overlooked by economists is that health care—and the health care system—may also be valued for reasons other than any contribution to health. These considerations may be more important in some instances than the contribution to health itself. This section briefly reviews some of the main candidates under the following headings:

- Altruism, caring externalities, and equity;
- Existence value;
- Process utility;
- Reduction in uncertainty and risk pooling;
- The modern religion and extended family;
- The contribution to the economy.

Health care is valued for its benefit to others. Individuals not only value their own health (care) but also the health (care) of others, both for selfish reasons (less need for society to support unhealthy individuals) and altruistic reasons. Culyer (10) has referred to altruism as a “caring externality.” Jones-Lee (23) has recently extended this concept into the empirical domain by showing that in general the altruistic value of life is 10 to 40% of the valuation of one’s own life. Equity is an issue associated with altruism, in the sense that people may care more for certain groups of the population (the young, for instance) than for others—a specific altruism. A concern with equity implies that the same health care, having identical effects on the individuals who receive it, will be valued differently by society according to the groups that receive it. Thus, the organization of a health care system in terms of its distributional effects may have important implications for well-being.

Existence value is the value placed on a good that is unrelated to any current use of that good. In this sense the health care system is valued because it exists. Its existence is valued, perhaps because it offers the citizen an option to use it at some time in the future. Or health care may be valued because it is a sign of a civilized and concerned society. These concepts are difficult to capture in traditional economic terms (32). However, environmental economists have considerable experience in measuring the existence value of the environment. For example, the value of the Alaskan coastline in the wake of the Exxon Valdez spillage was computed to have a significant existence value to the American public, despite the fact that the vast majority will never see, experience, or use it.

Until now the relationship between health care and health has been discussed implicitly in terms of the relationship between an intervention and an outcome

from that intervention. However, several authors have criticized this emphasis solely on the outcomes of health care as being far too simplistic and undervaluing the real contribution of health care (28). Rather, the process of health care yields value in itself, in the form of process utility. Health care decision making is risky, so handing over the responsibility for those decisions to an agent, the doctor, may actually be of value to patients, in the sense that it obviates the need to make a difficult decision. Where the responsibility for decision making is not completely revoked, patients may also receive process utility from the transfer of expert information from physicians. For example, Asch et al. (1) have shown that information, regardless of outcome, has monetary value to patients; indeed, reassurance and fuller information may be the major benefits of many consultations with physicians.

Health systems also provide the individual with varying degrees of risk and uncertainty reduction with regards to ill health and their health care expenditure. Assuming risk averse individuals, this reduction in uncertainty can create value in itself, regardless of health outcomes. Public and social insurance systems, for example, spread the costs of illness across large groups and across lifetimes.

Fuchs (17) has also argued that health care in western countries has replaced the role of religion and the extended family in earlier days. For example, health care might be valued for its role of providing a decent exit from this world. The dramatic increase in the use of nursing care and health expenditure in the final years of life cannot be explained solely in terms of maximizing health status with given resources, but may represent a substitute for the role that the extended family undertook in previous generations. To assess the contribution of health care without taking this additional role into consideration may be to undervalue one of its fundamental functions.

A further non-health benefit of health care is its net contribution to the economy and thus well-being. Fuchs (16) argues that, to the extent that health care contributes to better health, it both contributes to the productive capacity of the economy by increasing the total supply of potential labor-hours *and* increases productivity, in the form of output per employee. More generally, health care spending could be seen as part of the toolkit of Keynesian demand management. Finally, Fuchs also argues that there may be an indirect effect of the health care sector through the change in a population's life attitudes as population health improves. As an extreme example, attitudes to work and saving, and more generally, time preference may be very different in a country with a low life expectancy compared to one with high life expectancy.

PREVIOUS THEORETICAL WORK

There have been many attempts to model the determinants of individual health, of which Grossman (19) is perhaps the most celebrated. However, few researchers have sought to model health and its determinants at a population level. There are perhaps two main reasons for this neglect. First, the dominant ideology is that of the individual within both clinical and economic methodology. And second, as we shall demonstrate, the complexity of the issues involved at a macro-level is daunting. There are two important exceptions: the work of the Canadian Institute for Advanced Research (CIAR) and that of Collins (9). Their work serves as a basis for proposing a conceptual framework relevant to our purposes.

Through its Program in Population Health, CIAR has assembled research and findings on the determinants of health from a wide variety of different disciplines.

Important associated interests are the measurement of population health and the development of data systems suitable to capture it. The edited work of Evans et al. (12) is an attempt to bring this work together in a single unified framework. Evans and Stoddart (15) report the culmination of this process. They start from the traditional view that health is the absence of disease and that health care is the means of removing disease or alleviating its impact. However, the health care system is not the sole determinant of health. Rather, it reacts to expressed need, which in itself may be determined by factors outside the system. After cure or care, the patient is released from the system and remains outside until the system is called upon again. A continual cycle of need and intervention can be envisaged for an individual throughout life.

Evans and Stoddart (14) elaborate on the model in an attempt to accommodate some of the issues discussed above. In particular, they incorporate three fundamental groups of factors outside the health care system that might contribute to health status: lifestyles (social environment), physical environment, and genetic endowment. Furthermore, they note that health status may not be adequately characterized by lack of disease, in the sense that poor health status, such as hypertension, may not be recognized by individuals. This in particular introduces the notion of a broader definition of health status, in the form of "health and function." This is introduced on the grounds that the clinical concept of disease may be different from the patient's concept of ill health. In turn, health is only important to the extent that it contributes to life satisfaction or well-being of the individual. Well-being is, in Evans and Stoddart's view, the fundamental objective of health policy. Finally, the authors introduce the notion of prosperity. If the ultimate objective of the health care system is the production of well-being, trade-offs exist between expenditure on health care and expenditure on all other activities that yield well-being.

Thus, the CIAR model incorporates many of the factors discussed earlier. However, one criticism of the approach is that, despite its objective of measuring the health of the population, it focuses on the health of the individual, albeit in response to wider community factors such as the social and physical environment. Yet, for the reasons already discussed, simply aggregating the direct health experience of individuals is unlikely to capture the health of the population or, more particularly from our perspective, the value of the health care sector to the population.

Collins (9) makes a similar criticism of the CIAR model and develops a model that places the health of the individual in the context of the health of the community or communities in which they live. Her model recognizes that the health of the individual and the health of the community cannot be addressed in isolation. Many feedback loops operate between the separate determinants and the two levels of individual and community, leading to a complex set of determinants of population health outcome. Thus, Collins is more explicit about the distinction between the individual and the community as *determinants* of health. However, she, too, fails to accommodate the possibility that population health may not be just the aggregate health of a collection of individuals.

Moreover, both the CIAR and Collins models appear to treat the health care *system* cursorily, even at the level of the individual. Collins' model does not include health care explicitly. The CIAR model includes health care but, as it stands, implies that health care contributes to well-being only via the alleviation of disease. This

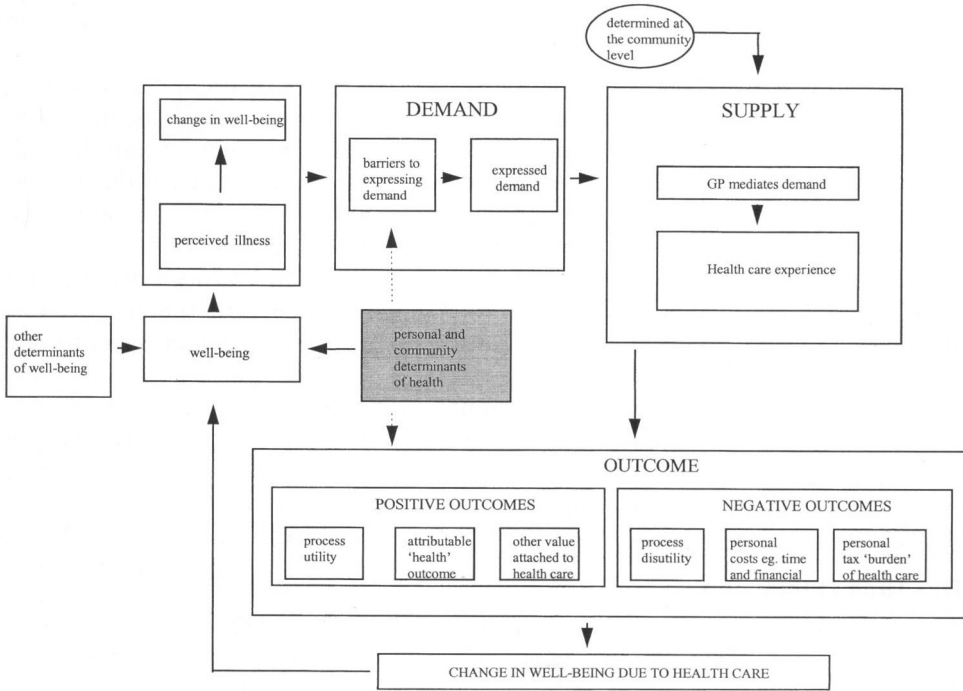


Figure 1. The individual’s experience and self-motivated valuation of health care at a point in time.

seems too restrictive and ignores the potential indirect benefits of health care to the individual other than the relief of disease, such as altruism and process utility.

TOWARD A CONCEPTUAL FRAMEWORK

In light of these limitations, we have sought to develop an extension to the work outlined above. Our conceptual model of population outcomes has as its centerpiece the role of health care and the health care system. This section builds up a model of outcome in terms of what health care delivers to individuals, for themselves and for others, and for the population as a whole. We first examine the value of health care for an individual who is only interested in health care for self-motivated reasons. The model is then extended to include more general motivations for valuing health care. A final synthesis that encompasses both narrow and broad views of the contribution of health care is then presented.

Individual: Self

Figure 1 is our representation of the key determinants of health and outcome from health care for a self-interested individual at a point in time. The factors that lie behind the demand for and supply of health care are key determinants of who expresses a demand for health care, who gets treated, and therefore the outcomes from health care for the individual and society. Demand factors such as genetic endowment, socioeconomic position in the hierarchy, and other issues discussed by Evans and Stoddart (15) above are all represented in the shaded box for simplicity. They have a direct impact on well-being, but also have an impact both on the

propensity for an individual to express a coherent demand for health care *and* on the outcomes from any health care received.

The model shows how health and other determinants of well-being lead to a stock of well-being. A perception of illness leads to a change in well-being, which in turn leads to an expressed demand for health care. In some countries this demand is mediated via a medical gatekeeper to the health care system, such as the general practitioner in the United Kingdom. The gatekeeper has a key role in making the decision over whether to treat the patient, and if so, how. In one sense, the gatekeeper is the patient's informed advocate, helping the patient to specify demand more precisely. At the same time, the gatekeeper may need to represent the interests of financiers or suppliers, and therefore must seek to balance the interests of *society* with those of the individual.

In this model, outcome is not defined narrowly. The outcome from health care takes many forms, all legitimate, as discussed above. Some of these may have a negative as well as a positive impact on well-being. The final impact is the net result of these factors. This in turn changes the "stock" of well-being in force at the start of the model.

The Time Dimension

Although complex, Figure 1 is really only representative of the short run. In the long run, current health care interventions are likely to reduce (or indeed increase) the likelihood and nature of future illness directly. Moreover, the immediate health outcome and change in well-being may act as a spur to more permanent changes, particularly behavioral, in the individual; that is, there may be important feedback loops, from short run outcome to long run behavior. In this respect, one of the main aims of health promotion activities is to change individual behavior in order to reduce the likelihood of illness in the future. Health promotion can occur outside the traditional health care sector, for example, in the form of media campaigns, or within it, in the form of anti-smoking advice following an operation. However, behavioral change will only occur through time and is difficult to represent at a point in time in the diagram above. Similarly, changes in individuals' attitudes and beliefs about health may lead to support for changes in the community determinants of health.

The treatment of time in current theoretical models of health outcome is rarely satisfactory. In principle, many of the concepts described in the preceding theoretical models should be considered *stocks*, the level of which can only be altered slowly over time. Thus, for example, "health status" should be thought of as a stock that is altered by the (annual) flow "change in health status." The flow is the result of a highly complex interaction of environmental factors and health care intervention, both in the current period and throughout a possibly long period in the past. It is worth noting parenthetically at this point that few economists have addressed the issue as to whether well-being is best modeled as a stock or a flow, and the contribution of health status and change in health status to well-being is, of course, very poorly understood.

Individual: Others

To focus solely on the individual's experience and valuation of health care for self-interested motivations may be inadequate. Earlier we presented arguments that individuals value health care not only for themselves but also for others. Moreover, individuals who are healthy may gain well-being from knowing that a satisfactory

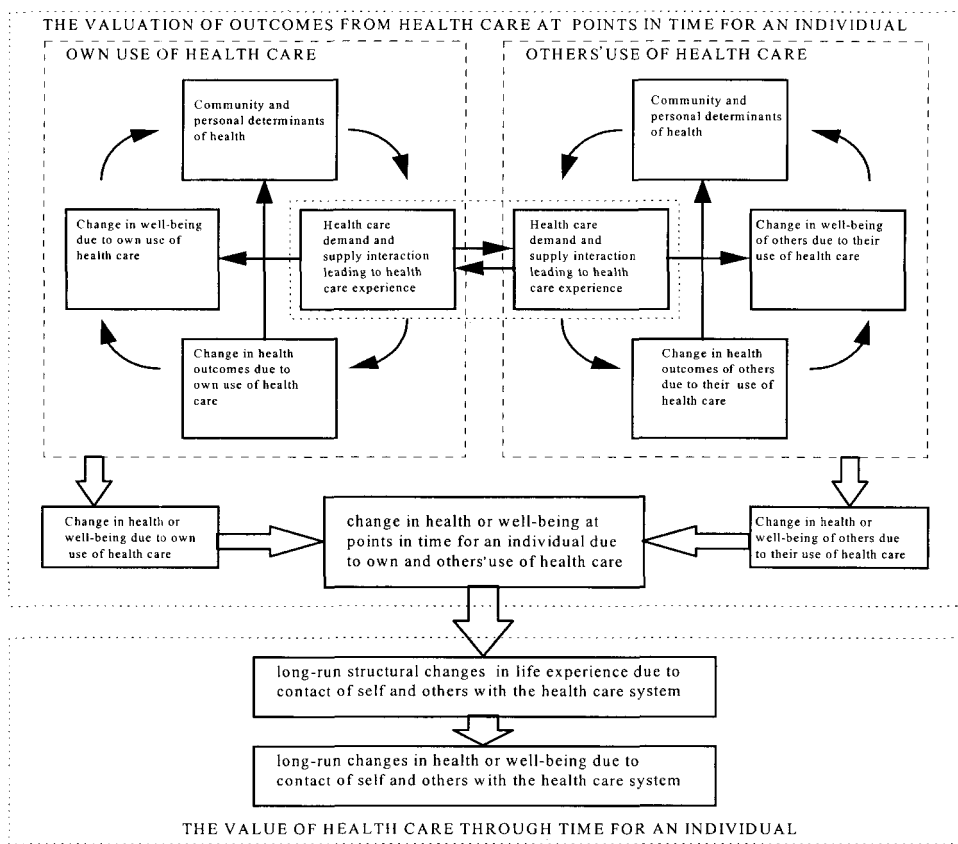


Figure 2. The contribution of the health care system to health and well-being.

health care system is in place should they suffer from ill health in the future. These altruistic and insurance considerations are not taken into account in existing models of the determinants of health and valuation of health care. There is debate and dispute about what form the valuation of the health and health care receipt of others should take and how to measure this, but there is no doubt it is valued. We must therefore incorporate into the model the value that individuals attach to knowing and seeing that others are also receiving health care.

A Synthesis

Figure 2 summarizes some of the main issues discussed above in a single diagram. At the top left is a representation of the individual's valuation of his or her own use of health care. This interacts with the use made by others (top right segment). These two broad considerations give rise to the individual's change in well-being brought about by the health care system.

Clearly this model is merely a schematic summary of the preceding arguments. However, it is important to stress that the model can encapsulate a spectrum of views about different concepts of population outcome, of progressively broader definition. The first three concepts seek to capture the contemporaneous influence of health care, encompassing increasing levels of generality, while the second group of three repeats the process but introduces long run considerations.

Concept 1: For a population, the contribution of health care to health care outcome is the sum across all individuals present of the difference between health states when entering and exiting the health system at a point in time.

Concept 2 = Concept 1 + the sum across all individuals of any additional well-being from experiencing health care.

Concept 3 = Concept 2 + the sum across all individuals of the well-being derived from others' use of health care.

Concept 4: For a population the contribution of health care to health care outcome is the sum across all individuals present of the difference between the health state profile *through time* that would have occurred without the intervention of health care and the profile that did occur because of the intervention.

Concept 5 = Concept 4 + the sum across individuals of the difference in well-being that would have been derived from not experiencing health care through time and the well-being that was derived from the existence of health care.

Concept 6 = Concept 5 + the sum across individuals of the difference in well-being of others that would have been derived from not experiencing health care through time and the well-being that was derived from the existence of health care.

Figure 2 can be interpreted in two ways. Taken as a whole it presents a broad view of the contribution of health care to health care outcome. Under this view the outcome of interest is change in well-being. However, within this nests a narrower view of health care outcome, which considers only changes in health status. The vast majority of health care outcome studies focus on the narrowest concept of outcome, concept 1. In contrast, we argue that—if the interest is in assessing the contribution of health care to national well-being—it is necessary to consider a move toward the use of the broadest concept of outcome, concept 6. These considerations clearly imply a major change in theoretical methodology.

EXISTING EMPIRICAL APPROACHES

Although we believe that the framework discussed above is a useful starting point for any analysis, the important issue is whether it can be made operational using a practical empirical approach. We have therefore examined the empirical literature to determine whether any existing empirical approaches offer the prospect of addressing the subject. In this respect we identify three broad categories of empirical work that appear to offer potential:

1. The inventory approach;
2. The avoidable mortality approach;
3. The production function approach.

The Inventory Approach

In this approach, individual health care services are considered. For each service, the relevant population is identified and the associated burden of disease is quantified. For those people receiving the service, the health gain is estimated based on the evidence of effectiveness of that service. From this, a measure of gain for the population as a whole can be calculated. Three types of approach can be identified under the inventory approach, as represented by three key studies. In the earliest, McKinlay et al. (30) examined trends in mortality for the major causes of death in relation to the date of known medical interventions. They estimated that 3.5% of the reduction in infectious disease mortality can be attributed to medical measures.

More recently, Bunker et al. (5) examined the impact of 13 preventative and 13 curative services on life expectancy. They estimated that the current gain for preventative services is 1.5 years, with a further potential gain of 7–8 months. For curative services, the current gain is 5 years, with a potential for a further 1.5–2 years. In the third approach, Bunker (4) estimates that health care can be shown to account for 3 of the 7 years' increase in life expectancy since 1950. Further, health care provides 5 years of relief from poor quality of life associated with chronic disease. He also suggests that there is a benefit of health care per se—with the placebo effect accounting for up to one-third of the total benefit of health care.

There are a number of general limitations to the inventory approach. It relies on the availability and quality of suitable information, for example, the efficacy of interventions and the proportion of reduction in incidence/symptoms that are due to the health care interventions. In many situations this information is not readily available, and so must be “best guessed.” No explicit account is taken of other factors of possible importance or their interaction with health care. The approach is inherently selective in that the specific services identified do not encompass the full scope of health care. Further, by evaluating each service individually, the interaction between services is overlooked. Due to data limitations, it is difficult to assess benefit in terms of quality of life, and so attention usually focuses on mortality. However, the aim of many medical services is not to prevent death, but rather to improve the quality of life, so evaluating the impact on mortality will not reflect the outcomes of the service. Further, none of these studies attempts to identify the associated inputs. Thus, even if the impact of health care can be evaluated, the link between inputs and outcome is not clear.

The Avoidable Mortality Approach

This approach is similar to the inventory approach in that it identifies specific areas to evaluate. However, it concentrates on medical conditions rather than health care interventions, in particular concentrating on those conditions for which health care can provide effective treatment. The distinction is made between conditions “amenable” and “non-amenable” to health care interventions. Either by considering only those conditions considered amenable, or by contrasting between amenable and nonamenable, the extent to which health care contributes to improved mortality is evaluated. The precise methods by which this is done vary across studies. All of the studies identified used mortality, although there is no reason in principle why this approach should not be applicable to outcome measures other than mortality (such as improvements in quality of life). In practice, however, data limitations make the use of mortality data inevitable for most macrostudies of health care. Avoidable mortality has been the focus of a substantial research effort. In their review of published work reporting mortality from conditions amenable to medical interventions, Mackenbach et al. (27) identified 11 studies, three looking at trends over time, and eight evaluating geographical variations. As well as the results of the studies, they compare the selection of causes of deaths, health care and other variables, and the statistical methods used. The time trend studies all report considerable declines in mortality for most or all of the conditions over the last few decades. The results suggest that improvements in health care were one of the factors in the decline in mortality, but not the only one. Mortality rates for nonamenable conditions also declined, but to a lesser extent. Whether measured across countries or through time, the associations between mortality and health care resources are

rarely statistically significant and tend to be weaker than the association between mortality and socioeconomic factors.

McGuire et al. (29) review existing work to identify the problems in the analyses of health expenditure and the production of health at an aggregate level. They found little statistical evidence of an association between health care expenditure and health, except in respect of potential life-years lost. They conclude that there are many unresolved issues that need addressing, not least of which are the statistical techniques required to make any model operational. Carr-Hill et al. (6) also assess the limitations of the avoidable mortality approach. They claim that more sophisticated statistical methods are required to account for the complexity of the model underlying analysis of mortality data, and also note that data limitations may in any case preclude meaningful modeling. They conclude that avoidable mortality has not been shown to be a useful outcomes indicator, and in the short term attention should be focused elsewhere.

Thus, although a great deal of research effort has been directed at avoidable mortality, the approach suffers from severe data limitations and model specification and estimation difficulties. Moreover, as noted above, mortality cannot in any case capture the outcomes of much of modern health care.

The Production Function Approach

The production function approach describes the production of health in terms of a function of possible explanatory variables. The production of health may be defined in a number of different ways. The variables considered to be important in the production of health vary widely across studies, as do the econometric estimation techniques used. As more sophisticated techniques become more readily available, the level of complexities of the methodologies has increased. To model fully the production of health requires the development of simultaneous equations that link health care inputs, other relevant factors (e.g., environmental, socioeconomic), and outcomes.

Examples of such studies are presented by Auster et al. (2) and Hadley (20), who examine the impact of health care on mortality in the United States, controlling for other factors. Both studies found that health care has an impact on mortality, but that income and education also have an impact that appears to be stronger. Auster et al. reported that a 10% increase in medical services leads to a drop in mortality of 1.3%, while Hadley reported that a 10% increase in health care would reduce mortality rates by an average of 1.57%. Both studies concluded that social factors were more important than health care as determinants of mortality.

Gravelle and Backhouse (18) critically appraise the methods used to investigate the determinants of mortality at the cross-sectional level and update the earlier results of work by Cochrane et al. (8). They also consider the econometric issues of multicollinearity, omitted variables, endogeneity, and functional form. Using a relatively simple model of individual health maximization subject to constraints, they explain the pitfalls of estimation procedures that lead to biased results. In an attempt to account for omitted variables (e.g., environmental), the authors suggest looking at changes over time. They find that the constant term in a difference equation (representing the missing environmental variable) is highly significant, and that the results are sensitive to different variable specifications (in particular, national wealth definitions). By introducing nonlinear effects, the results change significantly. Finally, by lagging the explanatory variables, they find that past inputs are more significant than current ones in determining mortality. They conclude

that the measured effect of medical care on mortality measures is highly dependent on the statistical methods and data used.

Numerous other studies have attempted to examine the impact of various social and health care variables on health using crude statistical techniques, such as correlation analysis or ordinary least squares regression. Such studies use a framework similar to the production function approach, but do not account for the possibility of simultaneous determination of health outcomes and health care inputs in estimation techniques. The rigor of more formal econometric estimation is lacking, and the conflicting results obtained in such studies highlight the danger of approaching this problem with inadequate analytic techniques.

AN ASSESSMENT OF EXISTING EMPIRICAL STUDIES

Existing work can be appraised under a number of criteria, such as:

1. To what extent does the method have an explicit conceptual framework, and what are its limitations?
2. How is benefit measured—mortality, morbidity, or more general well-being?
3. How is health service input measured—resources, expenditure, activity?
4. To what extent are non-health care factors (such as environmental factors and allied welfare services) accommodated in the analysis?
5. To what extent are dynamic issues accommodated in the analysis?
6. What is the availability and quality of the data used?

Many authors emphasize the need for a clear theoretical framework to underpin any empirical estimation (13;14;29), but it is difficult to determine an explicit conceptual basis to much of the work outlined above. A few authors have described relatively comprehensive frameworks through which the contribution of health care to health could be evaluated in theory. However, no one has empirically evaluated such a framework. All empirical models in practice assume away a number of the complexities or are forced to ignore them due to data limitations. Often there is a sense of an implicit, unspoken framework relating to the production of health, but the lack of explicitness makes evaluation difficult. The measures of outcome used in all three empirical approaches are very limited, generally focusing on changes in mortality and life expectancy. Historically, it may have been appropriate to focus on mortality. In most industrialized nations, however, attention is increasingly turning to the treatment of chronic disease, where the aim is to improve quality of life. Mortality from such diseases may be very low. Authors acknowledge that important aspects of quality of life are generally ignored, but cite the lack of suitable data. Issues such as the impact on non-users and the more general benefits offered by the form of the health care system should in principle also be accommodated. However, with the exception of Judge and Solomon (24), few authors have attempted to quantify such broad outcome measures.

Input measurement is given little attention in the literature. Yet it is often a crucial determinant of the measures of efficiency derived. At a broad level of aggregation (such as the entire hospital sector), it is reasonably easy to measure inputs. However, as soon as any disaggregation is attempted, difficulties of isolating expenditures on specific programs arise. For example, it is a far from trivial matter to identify NHS expenditure on, for example, cancer services. In the work by Bunker et al. (5) using an inventory approach, no attempt is made to identify inputs.

Avoidable mortality and production function studies have sought to identify inputs in the form of health care personnel or expenditure. However, the allocation of health care inputs between services is rarely examined in any detail and often relies on questionable accounting procedures.

Most studies acknowledge the importance of non-health care factors that may affect health outcome and the complexities they introduce into any empirical analysis. Related factors may confound the impact of health care services. Moreover, income, environment, or lifestyle may be likely to affect both health services and health status (and are therefore endogenous factors). Other unrelated issues, such as genetic factors, although exogenous, may still serve to obscure the picture. In practice, it is rare to find either endogenous or exogenous external factors modeled with any sensitivity.

Although the majority of studies do take some account of factors other than health care, they do not in general consider all possible factors, and few allow explicitly for interactions with health care. In the case of the inventory approach, in which individual health interventions are being considered, it is also important to consider the interaction between different interventions (competing risks). Poikolainen and Eskola (33) argue that, by distinguishing between mortality amenable and nonamenable to health service intervention, it is not necessary to adjust for any other factors. The change in mortality attributable to health services is *assumed* to be the change in amenable mortality over and above that for non-amenable mortality. The production function approach offers perhaps the best potential for dealing with the problem of confounding. Simultaneous equations can be used to try to overcome the problem of health care use itself being determined by the health of the population as well as health care influencing health (2;25;35). In this respect, many models include relatively large numbers of possible factors. Nevertheless, the production function approach still suffers from the limitations imposed by data availability and the state of econometric methodology.

The dynamic aspect of health trends gives rise to special challenges for any empirical investigation. Very little explicit attention has been paid to this issue. The usual approach is to use contemporary input and outcome measures. This may be satisfactory in situations where the impact of health care is more or less instantaneous, or where the system is in a reasonable steady state, in which population characteristics, external factors, and medical technology change only slowly. However, it is abundantly clear that for many aspects of health care none of these criteria applies, indicating a need to tackle the dynamic issue. No studies have attempted to lag both inputs and outputs. Unsurprisingly, where past inputs have been used, they have been found to be more significant than current inputs in explaining current outputs (18). Studies evaluating the impact of medical research on health use lagged inputs to assess output using simple (7) and both simple and distributed lags (34). However, problems of data availability and consistency become particularly acute if time lags are to be more generally investigated.

Indeed, data availability and limitations are frequently the driving force for many empirical models. It is difficult to find any data relating to the broader measures of both output and inputs required in this area. In contrast, although of limited relevance, mortality data are readily available. Even here, however, there are concerns about their quality. More general measures of well-being (for example, including measures of satisfaction) are not routinely collected and would need to be obtained through surveys. If the interest is in broader definitions of health or

well-being, it would be necessary to develop new survey instruments to capture citizens' valuation of the health care sector and their reasons for doing so.

CONCLUSIONS

This paper has highlighted the issues that arise when seeking to answer the question, "Can we measure the social importance of health care?" We have drawn attention to three fundamental issues that must be addressed when approaching this problem: a) what is the theoretical framework within which the analysis is to be undertaken?; b) what data are available with which to undertake the analysis?; and c) what are the technical tools available to make the analysis operational? There are serious difficulties surrounding all three issues.

As far as the theoretical framework is concerned, we have noted that health care contributes both directly and indirectly to well-being in many ways other than directly through a change in health status. Moreover, that contribution may operate over long time periods, with considerable lags and uncertainties. Furthermore, the benefits to society of the health care system as a whole may extend beyond the sum of the benefits perceived by individual citizens. Existing theoretical models are either silent on these issues or treat them very cursorily.

In the light of the theoretical discussion, we have noted that the data available for assessing the benefits of health care are inadequate. Health outcomes are measured principally in terms of mortality, which is becoming a less important focus of modern health care. Furthermore, important contextual data and the necessary time series of health outcomes data are rarely available. It seems likely that a move toward more general measures of well-being attributable to health care would require a major change in approaches toward data collection.

The complexity of the analytic problem implied by our question precludes the use of simple analytic techniques to infer a quantitative answer from the available data. Even if the requisite data were available, our discussion has cast doubt on the ability of analytic techniques to deliver convincing results. In particular, results appear to be highly dependent on model specification, and there are particular problems in addressing problems such as endogeneity of variables and time lags. There must be some doubt as to whether existing techniques are adequate for the task in question.

Thus, we must conclude that the search for an analytic framework within which to address the topic of this paper is at a very early stage, and that there must be some doubt as to whether it will ever be fruitful, given the complexity of the theoretical and practical problems involved. This is not to say that the search should not continue—rather, that there are unlikely to be dramatic and convincing results in the near future.

This conclusion raises the issue of whether there might be other approaches to the problem that do not rely on scientific evidence. In this respect, it is instructive to recall that in most markets, the social usefulness of the product is judged by consumers' willingness to pay. Health care is rarely delivered through conventional markets. Indeed, it is because of this that our question arises. However, there is no reason why the views of citizens about their system of health care should not be sought by means other than a market. In particular, it should not be impossible to design a sample survey that seeks to infer citizens' judgments about the direct health care they have received and about their more general evaluation of the health care system in place. Of course, the costs and methodological difficulties of

implementing such a survey should not be underestimated. However, if—as we believe—the question posed is an important one that should be addressed, then we see little alternative to exploring the possibility of a social survey, given the inadequacy of other approaches identified in this paper.

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