FORECASTING DEMAND FOR MEDICAL CARE FOR THE PURPOSE OF PLANNING HEALTH SERVICES

PREPARED FOR THE OFFICE OF ECONOMIC OPPORTUNITY

JOSEPH P. NEWHOUSE

R-1635-OEO
DECEMBER 1974

Rand
SANTA MONICA, CA. 90406

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PREFACE

This report was prepared for an international conference held under the auspices of the International Institute for Applied Systems Analysis, Schloss Laxenburg, Austria, in August 1974. The subject of the conference was health planning and health resource allocation.

The report addresses the problem of predicting demand for health services and, in particular, the question of how complex a model is needed to predict demand. The intellectual importance of this question is based on a standard Occam's Razor argument; the practical importance is that it costs significantly more money to obtain the information required by the more sophisticated models. It is particularly costly to obtain information on insurance coverage. Unfortunately, the results show that the omission of insurance coverage results in poor prediction of demand changes for physician services.

The report has been revised somewhat from the version appearing in the conference proceedings (available in Mark Thompson and N.T.J. Bailey (eds.), *Systems Aspects of Health Planning*, North Holland Publishing Company, Amsterdam). The revisions correct minor computational errors that do not affect the conclusions; there have also been stylistic revisions. This research is part of Rand's Health Insurance Study, which is being supported by a grant from the Office of Economic Opportunity.

SUMMARY

Two approaches to health planning--or resource allocation in medical care--can be distinguished. One attempts to allocate resources so as to maximize health status subject to a resource constraint; the other tries to ensure that resources in the proper quantity are available to meet demand. In either case, information on the future demand for medical services is likely to be useful: in the first instance, so that resources are actually used; in the second, so that necessary manpower and facilities are obtainable.

Demand can be predicted from sophisticated models deduced from economic theory. Unfortunately such models are difficult to implement. Therefore, in this study I have estimated a "simplified" version of a model for predicting the demand for hospital and physician services in order to ascertain the model's properties. The simplification involved making demand a function of only demographic variables, which can be readily obtained from 1960 and 1970 U.S. Census of Population information, and omitting measures of health status, price, and insurance coverage, which are unavailable. Thus, the "simplified" model is relatively easy to implement.

Unfortunately, this simplification comes at too great a price to be practical for health planning in the United States, at least at the present time. Changes in insurance exert too great an influence over demand to be left out of predictive equations, even if data on labor force participation, income, and education are available as explanatory variables. These variables are not satisfactory proxies. Nor is it likely that a simple measure of the percentage insured, which might be obtained through a survey, will be of much assistance, because the variation in the amount of coverage within the insured population is quite large. (That is, individuals have varying degrees of partial coverage.) Over time, as the population's insurance coverage approaches completeness, insurance may cease to be as critical in predicting demand for medical services in the United States. But at least for the next several years, it is likely to remain important.

ACKNOWLEDGMENTS

I would like to acknowledge the helpful comments of William Richardson of the University of Washington and my Rand colleague Robert Shishko on an earlier draft of this report.

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I. INTRODUCTION

The logic of health planning in the United States is schizophrenic. One approach to the subject can be called the "production function" approach (Newhouse 1971), in which the objective is to maximize the health of the population, subject to some overall resource constraint. In more global versions of this approach, health may be traded off with other goods or services to find the desired level of the resource constraint. This approach is consistent with a "needs" approach to the health sector, in which the "health planner" attempts to determine the health needs of the population at some future point in time and to provide the resources to meet those needs. (In reality, of course, there is no single health planner at either federal, state, or local levels in the United States. Decisions on the number of hospital beds, the cost per bed, the number of medical students, and the like are made by many individuals and groups, even though we shall call all of these various decisionmakers health planners.)

The production-function approach to health planning can be criticized on at least two grounds: (1) Although the resources provided may improve the health of the population if used (i.e., they may be needed), there is no guarantee that they will be used, and unused resources are wasted resources. (2) The link between additional medical services and readily measured indices of health, such as life expectancy, is tenuous, especially in developed countries. Although the average unit of medical service can be presumed to have a considerable effect on measured health status, marginal units will probably not have such an effect. Rather, additional medical services are more likely to alleviate anxiety, relieve symptoms, and provide prognostic information, none of which is easily measured (Newhouse, Phelps, and Schwartz 1974). Obviously any production function estimated from existing data is limited by the variation found in those data. Because such variation occurs at the margin, the estimated production function is likely to show little effect on traditional measures of health status.

A different approach to health planning can be called the "market signal" approach (Newhouse 1971). In essence, the objective of this approach is to predict the demand for some medical service at a given point in the future. The task of the health planner is to ensure that resources are available to meet this demand. Implicit in this assurance is the requirement that there be enough resources on hand so that prices and/or queues are at a desired level. Alternatively, the health planner's problem might be to make sure that no more than the required number of resources exist to meet the projected demand; e.g., that there are not "too many" (i.e., underused) open-heart surgery units.[1]

The market-signal approach meets the first objection to the production-function approach head on; if the resources are demanded, they will be used. It meets the second objection by assuming that if the resources are demanded, they are being optimally used to improve health status, including subjective elements. But it is precisely this assumption that is in question by those favoring the production-function approach. For a variety of reasons, including consumer ignorance and the private incentives of physicians, one can argue that demands in the medical-care market do not call into play the combination of resources that a fully informed consumer would demand.

Thus, both approaches are probably imperfect. Actual measurement of the production function is likely to contain substantial error, and market signals may well be distorted.[2] The obvious question is which

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[1]This approach is particularly relevant to those operating a hospital or hospitals, such as a local government, who need to predict demand at their facilities.

[2]Several individuals (e.g., Roemer and Shain 1959, and Feldstein 1967) have concluded that demand is not independent of supply. If by this is meant that the demand schedule shifts in response to supply variation, the market-signal approach loses much claim to normative significance. It is therefore important to examine this proposition. Unfortunately the evidence does not support the conclusion that demand depends on the supply.

It is important to distinguish between the effect of additional supply on demand and its effect on use. Additional supply may have no effect on a demand schedule (i.e., a function relating demand to money and time price), but it may affect use through the lowering of time price, as described below. Thus Feldstein's evidence that use

approach--the production function or the market signal--comes closer to generating the demand that a market of fully informed consumers would generate. Because such demand is difficult to measure,[3] a definitive answer cannot now be given; yet an answer is given, implicitly, each time a health planner makes a decision on resource allocation.

Regardless of which approach is chosen, information on demand can be useful. Such information is, by definition, at the heart of the market-signal approach. And even if the production-function approach is used, information on demand is important. If, for example, a service can be shown to be medically efficacious, and it is thought that the benefits in improved health status exceed the costs, it is important to know how to ensure that demand for the service is at an appropriate level. Thus it can be logically assumed that an individual engaged in health planning would desire information on demand. Some of the problems in obtaining that information are discussed in the following sections.

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correlates with supply in the British National Health Service can be plausibly explained by a general excess demand for hospital beds, without reference to an effect on a demand schedule. No hospital beds had been built in England in 25 years, and queues for elective surgery were very long. As a result, more of the excess demand could be accommodated in those parts of the country with a more ample supply of beds. The notion that supply can always create demand is not consistent with the general downward trend in occupancy rates in the United States (now down to 75 percent for short-term general hospitals), nor with the anecdotal evidence that there is a surplus of beds (which has led to "certificate-of-need" legislation to limit construction of new beds).

[3]While demand of perfectly informed consumers is difficult to measure, one interesting study (Bunker and Brown 1974) has provided us with some evidence. The authors compared the rates of surgeries performed among physician-patients with those performed among other professional groups, on the assumption that physicians were fully informed consumers. They found that the surgery rates were comparable in both groups, indicating no evidence of consumer ignorance among this highly educated sample.

II. FORECASTING DEMAND FOR MEDICAL SERVICES

The forecasting of demand, when actually put into practice in the United States, typically uses a rather naive model. Frequently, the demand for medical services is assumed to increase at the same rate as population growth, as in the case of projections of "needed" physicians or hospital beds, which are based on the notion that physician/population or bed/population ratios should remain constant. (The assumption of no technological change must also be made.) Implicitly, demand is solely a function of population size. Occasionally, however, demand is adjusted for certain demographic changes within the population. For example, Fein (1967) adjusts for a changed age mix. But the economic theory of demand for medical services has now been well developed by Grossman (1972) and Phelps (1973), and models of demand can be deduced from this theory that are considerably richer than the naive models just discussed (Grossman 1972; Newhouse and Phelps 1974 and forthcoming). Unfortunately, the use of such models to forecast demand for medical services in the United States is expensive. Data on variables, such as health status and insurance coverage, are necessary and usually can only be obtained through special surveys. This report explores how much is lost by employing a simple model to forecast demand, one that only requires the use of demographic characteristics, which should be readily available. If this simple model is viable, i.e., if it is nearly as good as the model deduced from economic theory, then considerable resources might be saved in the planning process.

THE MODEL DEDUCED FROM ECONOMIC THEORY

Because the economic theory underlying the demand for medical services has been developed elsewhere, there is no need to develop it here.[4] The theory specifies the following variables as affecting the demand for medical care:

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[4]It is assumed in the theory that there are two reasons for seeking medical services: (1) Medical services can reduce the number of days lost to sickness (or to restricted activity) in the future. Such

1. Health status, ideally measured directly; if not, then using age as a proxy.
2. The price of time of those in the economic unit, measured by wage income for those in the labor force; otherwise by an imputed value.
3. The money price of medical care services.
4. Education.
5. Marital status.
6. Nonwage income (consumption model only).
7. The supply of medical services. The supply of services can be reasonably assumed to be predetermined for the individual (i.e., not influenced by his demand and therefore exogenous). The supply-of-services variable is assumed to affect the proportion of time that the local medical care system exceeds capacity. If capacity is exceeded, demand is assumed not to be translated into use. Otherwise, individual use equals individual demand. Because individual use is what is observed in our data, it is important to control for the proportion of time that capacity is exceeded. Under standard assumptions on random fluctuation of demand, the proportion of time that capacity is exceeded for a given level of demand will decline nonlinearly with supply (e.g., the number of beds) (Shonick

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a reduction can result either from standard kinds of preventive services, or from curative services when the disease is not self-limiting. Grossman (1972) calls the model that focuses on this phenomenon the investment model, because the consumer "invests" in future productive time. (2) Medical services can improve utility in the present (and also in the future). Such improvement may result from relieved anxiety, from prognostic information, or from certain kinds of symptomatic relief. The consumer "feels better," even though there is no change in the total amount of sick time. Grossman (1972) calls the model that focuses on this phenomenon the consumption model.

The investment and consumption models differ in the following ways, which are minor for present purposes: (1) Nonwage income is predicted to have no effect on demand for care in the investment model, whereas it is predicted to have a positive effect in the consumption model. (2) The predicted direction of the effect of education and wage income are ambiguous in the consumption model.

1970). As an approximation to this effect, we have entered the square root of the number of beds per person and the number of physicians per person.

8. Sex and race, entered to control for variation arising for biological or behavioral reasons.

This is not a complete list of variables that affect demand; e.g., the actual amount of time spent receiving services is not included. Such omissions occur for lack of data in the data source used in this study, but there is no reason to expect that they substantially affect the results.

THE SIMPLIFIED MODEL

Data sets that contain information on all the variables listed above by individual are expensive to generate. As has been pointed out, measures of health status will generally require special surveys. In the American context, where there is no uniform insurance plan, data on insurance are extraordinarily difficult to obtain. Even survey data typically do not contain enough information on an insurance policy to define price, because detailed information on insurance coverage must usually be obtained from the employer or insurance company. This is time-consuming and expensive. One can reasonably ask the question: Would a model that omitted these difficult-to-measure variables provide a reasonably valid approximation to demand?

To determine the capabilities of such a model, I have focused on those variables listed above that can be readily measured from U.S. Census data: age, sex, race, marital status, and education. Thus, measures of price and insurance, as well as health status, are omitted. In their place is a measure of labor force participation, as it interacts with sex and marital status, because labor force participation is readily available in U.S. Census data and may be a proxy for insurance coverage. Wage and nonwage income have also been aggregated to total income, because they are usually aggregated in Census data. Although the supply of medical services is not usually part of Census data, such information is usually readily available, and it is therefore included.

These explanatory variables are used to predict the following variables:

1. Use or nonuse of the hospital and ambulatory systems (i.e., an admissions equation). The dependent variable takes the value one if there is any use, and zero if there is none.
2. Amount of use, conditional upon some use, measured by hospital days and physician visits.

The functional form employed is a step function; i.e., the continuous variables such as age, education, and so forth are broken up into discrete intervals, with a dummy variable for each interval. The method of estimation used is Ordinary Least Squares (OLS) rather than simultaneous-equation methods. Although OLS is inconsistent when estimating the model deduced from economic theory (because insurance may be a function of expected use), it gives reasonable results, whereas simultaneous-equation methods appear quite inefficient (Newhouse and Phelps, forthcoming).[5] Because the use or nonuse equations have a dichotomous dependent variable, they have been estimated by logit methods.[6] In this case, the coefficient of determination is the square of the correlation coefficient between the actual value (zero or one) and the predicted value.

The sample used to estimate these equations is the 1963 survey of the Center for Health Administration Studies (CHAS) of the University

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[5]The inconsistency occurs because of possible adverse selection in the distribution of insurance; however, estimates using simultaneous equation methods do not appear to be strongly identified. It is also convenient to employ OLS because I use the coefficient of determination as one measure of how well the equation predicts. To use simultaneous-equation methods for the model deduced from economic theory, and OLS for the simplified model, would render the coefficients of determination noncomparable.

[6]For computational convenience, a discriminant approximation was used for the physician use-no-use equation. The approximation was likely to be sufficiently poor in the case of the hospital-admissions equation that a maximum likelihood logit estimator was employed.

of Chicago. This CHAS survey is a national probability sample of the United States population; the survey (and the questionnaire used) is described in Andersen and Anderson (1967). I have used the subsample of individuals who said that they had no insurance or whose insurance has been verified with the insurance company, although I excluded those with a hospital or medical deductible in their policies.[7] The major group excluded, however, consisted of those who said that they had insurance, but whose insurance could not be verified. Thus, the sample I used (those with no insurance or verified insurance and no deductible) consisted of 3897 individuals, or 50 percent of the total sample.[8] Those individuals among the excluded 50 percent were not random selections, but tended to be employed in larger firms and have higher incomes; the results were weighted to eliminate any bias from this factor (i.e., each observation was weighted by W_{ij}/w_{ij}, where W_{ij} is the proportion of individuals in income class i and employment-size class j in the entire sample, while w_{ij} is the corresponding proportion in the included sample).

HOW GOOD IS THE SIMPLIFIED MODEL RELATIVE TO THE MODEL DEDUCED FROM ECONOMIC THEORY?

Because interest centers on the ability of the estimated equations to predict demand and not on the equations themselves, the actual equations are given in the appendix. Table 1 compares the correlation coefficients of the simplified model with those of a model deduced from economic theory. Of major interest is the amount of degration in the simplified model. The results show that there is substantial degradation in most equations.

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[7]The exclusion of those with deductibles is a restriction of the model based on economic theory (Keeler, Newhouse, and Phelps 1974).

[8]There are some very minor exclusions, in addition to those listed in the text, as described in Newhouse and Phelps (1974). About 35 percent of the sample were excluded because they did not have a verified insurance policy; about 14 percent of the sample were excluded because their policy contained a deductible. The remaining exclusions eliminated, altogether, fewer than 1 percent of the observations.

Table 1

CORRELATION COEFFICIENTS FOR VARIOUS DEPENDENT VARIABLES

Dependent Variable	Simplified Model	Model Deduced from Economic Theory
Hospital admissions (1 = admission, 0 = no admission, n = 3897)	0.01 0.01 (corrected)	0.05 0.05 (corrected)
Length of stay conditional on admission (n = 267)	0.20 0.14 (corrected)	0.25 0.17 (corrected)
Use of physician (1 = visits greater than zero, 0 = no visits, n = 3897)	0.07 0.07 (corrected)	0.11 0.11 (corrected)
Visits conditional on positive visits (n = 2062)	0.05 0.04 (corrected)	0.16 0.14 (corrected)

The implication of these results is that it may be well worth considering health status and insurance coverage when attempting to forecast demand for medical services in the United States. However, there are two related reasons why this result can only be suggestive of that conclusion. First, predictive power in a cross-section is not the same as predictive power in a time series. Health status in particular may have considerably greater interpersonal variation than intertemporal variation, and what intertemporal variation there is may not be very predictable. Thus, explanation of cross-section variation does not guarantee the ability to forecast intertemporal variation. Second, one cannot judge whether the correlation coefficients given in Table 1 are "good" or "bad." They may appear low; or, the apparently substantial additional precision of the model based on economic theory may be merely more gloss on an already shiny finish, and even the simplified model may be able to predict intertemporal variation well. To resolve these issues, it is necessary to use the equations estimated from cross-section data to predict intertemporal variation. This procedure is described in Section III.

III. INTERTEMPORAL PREDICTIVE ABILITY

Ideally, one would test the ability of both models to predict the use of medical services in the future. Unfortunately, I have been able to test only the intertemporal predictive power of the simplified model, because no data were available to me on insurance coverage and health status in a later period.[9] However, even a test of the simplified model is instructive.

The data I have had available are aggregate data on the use of medical services; i.e., data on rates of use for the entire U.S. population in various years. A test of any model using aggregate data is difficult because the models predict demand, which, as pointed out above, is not observed. Rather, use, or the interplay between supply and demand, is observed. To predict aggregate use also requires a model of supply, and I have not attempted to construct such a model. (See, however, Feldstein and Friedman, forthcoming.) Aggregate use will equal aggregate predicted demand only if the additional services that are demanded can be supplied without any rise in price (money price or time price). (In technical terms, a change in demand will equal a change in use only if supply is perfectly elastic.) Because this condition does not hold in the short run, the actual change in aggregate use will be *less* than the predicted change in aggregate demand. (Some individuals who would have demanded services at the given money and time price will not do so when the price rises.) If the actual change in use *exceeds* the predicted change in demand, there is evidence of an important misspecification of the demand equation. The importance of this test of specification will become clear from the discussion below.

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[9]Data from the 1970 CHAS survey will become available in the future and will permit the model deduced from economic theory to be tested for its ability to predict intertemporal variation.

The test of the simplified model I employ is its ability to predict the use of medical services in the United States in 1970. The details of the test are as follows: There are data from the decennial U.S. Census on the demographic characteristics of the population in 1970. There are also data on hospital use for 1965 and 1970, and on physician use for 1964 and 1970, derived from the U.S. National Health Survey. I used the 1963 CHAS survey data (a national probability sample) to obtain values of the explanatory variables in 1963 and then used these values in the estimated equations (shown in the appendix) to obtain an estimate of hospital days and physician visits. I adjusted the intercept of these equations so that they would predict 1965 hospital days and 1964 physician visits exactly,[10] and used this modified equation, together with values from the U.S. 1970 Census for explanatory variables, to predict 1970 use.

In symbols, I let

$$Y = X\beta + \alpha, \tag{1}$$

where Y is either estimated hospital days or physician visits, β is the vector of coefficients estimated in the appendix, X is the vector of values of the explanatory variables listed in the appendix (derived from the 1963 CHAS survey), and α is an adjustment to the intercept computed so that the equation predicts 1964 physician visits and 1965 hospital days perfectly.

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[10] I do not have data from 1964 and 1965 for the explanatory variables, and therefore must use 1963 data. Apart from the temporal discrepancy between 1963 and 1964-1965, the intercept should be adjusted to account for differences in definitions in, and techniques of, data collection between the 1963 CHAS survey and the U.S. National Health Survey. For example, the 1963 survey does not include a telephone consultation in its definition of physician visits, while the National Health Survey does. The 1963 data are based on a one-time interview in 1964 with 1-year recall; the National Health Survey is based on an immediate 2-week recall and uses a "rolling" sample to generate annual estimates. Adjustment of only the intercept and not of coefficients makes the results subject to some error; that error can reasonably be assumed to be sufficiently small, however, to leave the conclusions unaffected.

Values of physician visits and hospital days for 1970 are predicted by observing X from 1970 U.S. Census data and using Eq. (1).[11] The predicted value of Y is then compared with the actual value for 1970. In addition, the results from the "simplified model" are compared with the even simpler, naive model, which assumes that the rate of use per person remains constant, so that total use increases at the same rate as population. In order to see that some gain might be expected from taking into account changes in demographic variables (i.e., using the simplified rather than the naive model), Table 2 shows the changes in selected demographic variables between 1960 and 1970. Income, where considerable change occurred, is not shown because income in the Census is measured in current dollars, whereas in the simplified model it is measured in constant dollars.

HOSPITAL DAYS

The expected number of hospital days is found by predicting the probability of hospital admission for each person, multiplying the probability of admission by the expected length of stay for that person, and summing over the population. The base period for this calculation was 1965, when the total number of hospital days was 228.4 million. The results of this calculation are shown in Table 3.

As can be seen, the prediction error associated with the simplified model is considerably less than the prediction error associated with the naive model, and comes within 1 percent of the actual total.[12] All is not as well as it may seem, however. Table 4 shows predicted demand by age group.

The actual number of hospital days in the 65-and-over age group is considerably underpredicted, while the hospital days in all other age groups are considerably overpredicted. This pattern of error is

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[11] 1970 income has been deflated to 1963 values, so that income is in real terms. The Gross National Product deflator was used.

[12] It would have been desirable to present standard errors so that formal confidence intervals could be calculated, but there are no good estimates of the intertemporal variance. Therefore, I present only point estimates.

Table 2

CHANGES IN SELECTED DEMOGRAPHIC VARIABLES, 1960-1970

(In percent)

Demographic Characteristics	1970	1960	Difference (1970-1960)
Married male[a]	38	40	-2
Single male[a]	13	12	1
Single female[a]	11	8	3
Married female working[a]	15	13	2
Married female not working[a]	23	27	-4
White	88	89	-1
Non-white	12	11	1
Rural	27	30	-3
Urban	73	70	3
Age 0-5 years	8	12	-4
Age 6-17 years	26	26	0
Age 18-44 years	35	31	4
Age 45-64 years	21	21	0
Age 65+ years	9	10	-1
Education, 0-8 years[b]	27	37	-10
Education, 9-11 years[b]	24	23	1
Education, 12 years[b]	30	25	5
Education, 13-15 years[b]	11	8	3
Education, 16+ years[b]	8	7	1

Source: 1960 and 1970 U.S. Census of Population.

[a]Percentage of over 16 population.

[b]Percentage of over 14 population.

not surprising, because the institution of public health insurance for the aged in 1966 (Medicare) considerably improved their insurance coverage and thereby increased their demand for hospital services relative to other age groups. As a result, the aged's share of hospital days rose, as shown in Table 5. Because insurance coverage is omitted from the simplified model, that model could not be expected to pick up this change in the pattern of demand due to changes in insurance coverage for the aged. However, over all age groups, the change in hospital

Table 3

1970 HOSPITAL DAYS

(In millions)

Predicted by the Simplified Model	Predicted by the Naive Model	Actual
235.7	244.4	234.0

Sources: "Hospital Utilization," *United States Vital and Health Statistics*, Series 13, No. 2, Tables 2 and 3; and Series 13, No. 14, Table 3. Values of 189.8 and 203.1 million have been used for population in 1965 and 1970 in order to derive the prediction of the "naive model."

insurance coverage was not large; the average portion of the hospital bill paid out-of-pocket fell from 0.185 to 0.133 between 1965 and 1970 (computed from data in Cooper and Worthington 1973, Table 1). This relatively small change in insurance in the total population is quite consistent with the relatively small change in the total number of hospital days.

Table 4

COMPARISON OF PREDICTED AND ACTUAL HOSPITAL DAYS FOR 1970, BY AGE GROUP

(In millions)

Age	Predicted by the Simplified Model	Actual
Under 65	183.3	156.9
65 and over	52.4	77.2

Sources: "Hospital Utilization," *United States Vital and Health Statistics*, Series 13, No. 2, Tables 2 and 3; and Series 13, No. 14, Table 3.

Table 5

COMPARISON OF 1965 AND 1970 HOSPITAL DAYS, BY AGE GROUP

(In millions)

Age[a]	Total Days, 1965	Percent of Total Days, 1965	Total Days, 1970	Percent of Total Days, 1970
Under 65	168.1	73.6	156.9	67.0
65 and over	60.3	26.4	77.2	33.0

Source: "Hospital Utilization," *United States Vital and Health Statistics*, Series 13, No. 2, Tables 2 and 3; and Series 13, No. 14, Table 3.

[a]The age of 0.4 percent of the persons was unstated, and these individuals have been allocated in the same proportion as those whose age is known.

PHYSICIAN VISITS

Although the number of hospital days predicted by the simplified model was relatively close to the actual number, this is not the case for physician visits, as is shown in Table 6.

Table 6

COMPARISON OF PREDICTED AND ACTUAL
PHYSICIAN VISITS FOR 1970

(In millions)

Predicted by the Simplified Model	Predicted by the Naive Model	Actual
840.6	923.0	926.9

The base period for this calculation was 1964, when physician visits were 844.3 million. As can be seen, the prediction of the naive model is very close to the actual value (I interpret this as a coincidence), whereas the simplified model yields a very large underestimate.

What is the reason for the failure of the simplified model? It is not likely to be an unmeasured deterioration in health status. Table 7 compares various measures of health status for 1964-65 with those of

Table 7

COMPARISON OF MEASURES OF HEALTH STATUS
FOR 1964-65 and 1970

(Rates per 100 persons)

Type of Health Measure	Rates for 1964-65	Rates for 1970
Acute conditions	212.7	203.4
Restricted activity days	16.4	14.6
Bed days	6.2	6.1
Work-loss days	5.7	5.4

Sources: National Center for Health Statistics, "Current Estimates," *United States Vital Health Statistics*, Series 10, No. 25, Tables 1 and 14; Series 10, No. 72, Tables A and B.

1970. The measures indicate that there was, if anything, an improvement in health status in this period, so that omission of health status is not likely to account for the underprediction. (I assume that the causal flow is for the most part from these measures of health status to demand, and that the slight improvement in these measures of health status is not due to additional physician visits.) Rather, the reason for the underprediction is almost surely the omission of insurance coverage in the simplified model. Between 1964 and 1970, there was a very substantial improvement in the coverage of physician services, as is shown in Table 8.[13] This change in the coverage of physician services generated a considerable increase in demand. Given estimates of

[13]Physician services, as defined by these data, include inpatient services. This in unfortunate, because one cannot know exactly how coverage for ambulatory services changed. It is nevertheless likely that there was a substantial change in the coverage of outpatient services. Because inpatient services represent only about one-third of total physician services (Newhouse, Phelps, and Schwartz 1974, Appendix B), it is very unlikely that out-of-pocket payments for all physician services could have changed this much without a substantial change in the coverage of outpatient services.

Table 8

PERCENT OF EXPENDITURES ON PHYSICIAN SERVICES PAID OUT OF POCKET

1964-65	63.4
1969-70	43.5

Source: Computed from data in Cooper and Worthington (1973), Table 6.

the responsiveness of demand to insurance that have been made elsewhere, this increase could well have been in the range of 15 to 20 percent (Newhouse, Phelps, and Schwartz 1974). Omission of this large a change in demand would account for the large underprediction of the simplified model.[14]

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[14]Because use will not change as much as demand, the change in demand due to a change in insurance coverage will be larger than the actual 10 percent change in use.

IV. CONCLUSIONS

Two approaches to health planning--or resource allocation in medical care--can be distinguished: One attempts to allocate resources so as to maximize health status subject to a resource constraint; the other tries to ensure that resources in the proper quantity are available to meet demand. In either case information on the future demand for medical services is likely to be useful: in the first instance, so that resources are actually used; in the second, so that necessary manpower and facilities are available.

Sophisticated models that predict demand can be deduced from economic theory, but such models are difficult to implement. Therefore, in this study I have estimated a simplified version of a model for predicting the demand for hospital and physician services in order to ascertain the model's properties. The simplification involved making demand a function of only demographic variables, which can be readily obtained from 1960 and 1970 U.S. Census of Population information, and omitting measures of health status, price, and insurance coverage, which are unavailable. Thus, the simplified model is relatively easy to implement.

Unfortunately, this simplification comes at too great a price to be practical for health planning in the United States, at least at the present time. Changes in insurance exert too great an influence over demand to be left out of predictive equations, even if data on labor force participation, income, and education are available as explanatory variables. These variables are not satisfactory proxies. Nor is it likely that a simple measure of the percentage insured, which might be obtained through a survey, will be of much assistance, because the variation in the amount of coverage within the insured population is quite large. (That is, individuals have varying degrees of partial coverage.) Over time, as the population's insurance coverage approaches completeness, insurance may cease to be as critical in predicting demand for medical services in the United States. But at least for the next several years, it is likely to remain important.

Appendix

ESTIMATED EQUATIONS

Table A.1

EQUATIONS USING THE THEORETICALLY CORRECT MODEL[a]

Explanatory Variables	Use, No-Use		Quantity Conditional on Use	
	Hospital	Physician	Hospital	Physician
M.D. office visit coinsurance rate	-.48 η = -.3978 (-2.2126)	- .006 η = .0093 (- .59453)	----	----
Hospital coinsurance rate	-.39 η = -.2109 (-2.9134)	- .02 η = .0195 (-3.0024)	----	----
M.D. office visit net price	----	----	.03 η = .0112 (.23737)	-.04 η = -.0435 (-2.1045)
Room and board net price	----	----	-.04 η = -.0815 (-1.8676)	-.01 η = -.0434 (-2.0166)
Wages	.007 η = .1885 (4.2131)	- .0002 η = -.0135 (-3.4163)	.002 η = .01 (.18269)	.002 η = .0146 (.86830)
Value of time	.005 η = .1362 (2.3910)	.0002 η = -.0099 (1.9449)	- .0006 η = -.002 (-.03525)	-.0002 η = -.0017 (-.06544)
Yearly nonwage income	.00007 η = .0498 (1.6316)	.000002 η = -.0026 (1.1582)	----	----
Yearly nonwage income (< $3000)	----	----	.00002 (.03477)	-.0002 (-1.1943)
Yearly nonwage income (> $3000)	----	----	.0008 (1.5304)	.0001 (1.1079)
Yearly nonwage income (> $3000 (1 = yes)	----	----	-3.87 (-1.1871)	-.65 (-.86205)
Education (in years)	-.03133 η = -.1706 (-2.5867)	.0009 η = -.0110 (1.7853)	----	----
Education, 9-11 years	----	----	.89 (.75964)	.31 (1.0784)
Education, 12 years	----	----	2.21 (1.6957)	-.08 (-.25245)
Education, 13-15 years	----	----	.55 (.21289)	-.13 (-.31702)
Education, 16+ years	----	----	1.48 (.62825)	-.25 (-.51583)
Age (in years)	.00010 η = .0029 (.02450)	- .0005 η = .0288 (-2.7323)	----	----
Age, 25-34 years	----	----	1.83 (.96299)	-.04 (-.10405)
Age, 35-54 years	----	----	2.55 (1.4081)	-.37 (.97781)
Age, 55-64 years	----	----	2.41 (1.0481)	.11 (.22231)
Age, 65+ years	----	----	4.7 (2.5633)	.30 (.67854)
Family size	.038 η = .1553 (1.1470)	- .005 η = .004 (-3.7775)	-.22 η = -.1217 (-.88185)	-.17 η = -.1501 (-2.7806)
Sex	.13 (.94388)	.02 (4.0642)	.79 (.86155)	.52 (2.3757)
Race	-.44 (-2.3831)	-.03 (-3.4428)	4.39 (3.1440)	.50 (1.3780)
Disability days	----	----	.02 η = .1253 (3.4798)	.02 η = .0453 (6.0889)
Health status, good	.69 (4.9321)	.04 (6.1631)	-.88 (-.79165)	1.32 (5.7790)
Health status, fair	1.60 (7.3986)	.12 (12.511)	1.69 (1.2767)	2.96 (8.9235)
Health status, poor	3.94 (11.729)	.24 (16.689)	.38 (.23363)	5.06 (9.4664)
Married	.0223 (.13364)	- .0046 (- .64085)	-.20 (-.15305)	.49 (1.6622)
Square root of M.D.s per 100,000 pop. ratio	-.052 η = -.4900 (-1.6525)	.002 η = -.0333 (1.2686)	-.24 η = -.3223 (-1.2090)	.08 η = .1714 (1.6631)
Square root of beds per 100,000 pop. ratio	.23 η = .4109 (2.1525)	.005 η = -.0161 (.95525)	.95 η = .2533 (1.3901)	-.02 η = -.0105 (-.15304)
Constant	-3.09 (-6.2109)	.89 (41.457)	5.01 (1.9040)	2.97 (4.6480)

[a]t-statistics in parentheses.

Table A-2

EQUATIONS USING SIMPLIFIED MODEL[a]

Explanatory Variables	Use, No-Use		Quantity Conditional on Use	
	Hospital	Physician	Hospital	Physician
Age, 6-17 years	-.48 (-2.2651)	-.77 (-6.6279)	-3.18 (-1.9924)	-.28 (-.80855)
Age, 18-44 years	-.08 (-.31439)	-.64 (-4.4594)	.96 (.51804)	.85 (1.8990)
Age, 45-64 years	.33 (1.2259)	-.48 (-3.2619)	5.12 (2.7501)	1.90 (4.2854)
Age, 65+ years	.46 (1.6528)	-.39 (-2.5543)	5.65 (3.0224)	2.34 (5.1172)
Married female, working	.01 (.03063)	.38 (2.0406)	.31 (.12867)	1.17 (2.0640)
Married female, not working	.05 (.22661)	.58 (4.6488)	-.87 (-.51752)	.79 (2.0197)
Single female	.02 (.13521)	.28 (3.0269)	-1.39 (-1.0622)	.54 (1.8805)
Married male	.04 (.17734)	-.14 (-1.1532)	-2.83 (-1.7538)	.17 (.41087)
Race (= 1 if nonwhite)	-.47 (-2.8736)	-1.19 (-13.163)	4.75 (3.2910)	.33 (.95331)
Education, 9-11 years	-.0003 (-.00146)	.01 (.10233)	.69 (.53202)	.05 (.14201)
Education, 12 years	-.19 (-.95965)	.02 (.14734)	-.15 (.10355)	-.66 (-1.9349)
Education, 13-15 years	-.78 (-2.7719)	.26 (1.6836)	-2.60 (-.96886)	-.85 (-1.8518)
Education, 16 years	-.44 (-1.1131)	.52 (2.3752)	.51 (.17220)	-.11 (-.18147)
Education, 17+ years	-.55 (-1.2125)	.25 (.98988)	.20 (.04568)	-2.25 (-3.0587)
Yearly income, \$5000-\$7500	.34 (1.3885)	.24 (1.7722)	1.68 (1.0689)	.57 (1.3905)
Yearly income, \$7500-\$10,000	-.11 (-.28707)	.23 (1.1246)	-.30 (-.10934)	-.27 (-.43370)
Yearly income, \$10,000-\$15,000	-.10 (-.17483)	.89 (2.7513)	-1.08 (-.22921)	-.63 (-.72717)
Yearly income, \$15,000 or more	.61 (.92994)	.10 (.28041)	-1.10 (-.25642)	-.05 (-.05278)
Square root of M.D.s per 100,000 pop. ratio	-.04 (-1.6449)	.02 (1.4331)	.07 (.32498)	.04 (.96534)
Square root of beds per 100,000 pop. ratio	.25 (2.4219)	.004 (.06965)	.08 (.11455)	.05 (.28242)
Constant	-2.44 (-7.4991)	.49 (2.7430)	6.04 (2.3951)	2.89 (5.2470)

[a]t-statistics in parentheses.

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