A RAND NOTE

SITE SELECTION CRITERIA FOR THE HEALTH INSURANCE STUDY

Philip J. Held

May 1985

N-2266-HHS

Prepared for The U.S. Department of Health and Human Services

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PREFACE

This Note describes the methodological basis on which sites were chosen for the Health Insurance Study, a large-scale social experiment conducted by The Rand Corporation from 1974 to 1982. The experiment was originally supported by the Office of Economic Opportunity; since 1973 it has been funded by a grant from the U.S. Department of Health and Human Services.

The work reported here was done in 1972, when the experiment was being designed, and was issued as an in-house working paper. It is now being published as part of the process of documenting research data gathered in the experiment. Other than being edited for clarity, the text has not been altered or updated. Christine d'Arc Taylor edited the text and wrote the summary.

SUMMARY

The Health Insurance Study (HIS) will measure the effects of varied health insurance plans on health status and the demand for health care. For accurate measurements, the sites from which experimental participants are drawn should generate estimates that (1) reflect national norms and (2) vary minimally. Selecting a participant sample from several sites instead of a dispersed national sample is a way of reducing variance (through increased precision) for a given budget, though at the cost of possible bias.

REDUCING BIAS

Site bias arises through "concomitant characteristics," local conditions that (1) affect residents' consumption of health care, (2) differ from national norms, and (3) cannot be controlled by experimenters, say, through the choice of participants within the site. Examples of concomitant characteristics are the capacity utilization of local physicians and hospitals, and regional effects on the demand for health care.

One could choose a group of sites randomly, then modify the choice to avoid known concomitant characteristics. However, it is probably more efficient to choose sites "purposively" to yield reasonable national estimates. Statistically, purposive site selection requires that the mean of the concomitant characteristics across sites approximately equal the national mean, and that the variance of the concomitant characteristics be large.

A reasonable site selection method would be to stratify possible sites along those criteria, then choose within a stratum according to operational criteria such as the cooperativeness of local government and presence of an established health maintenance organization.

Concomitant characteristics most likely to be significant to the HIS are two cited above: physician capacity utilization and regional demand effects. Probably the most feasible measure of whether physicians are used to capacity is the waiting time to obtain an appointment. In the

absence of adequate data, a national physician survey is proposed (later undertaken) to measure inter-SMSA differences in waiting time. Data on hospital utilization are available from the American Hospital Association. The effects of regional disease patterns are uncertain. To mitigate possible bias, the HIS will stratify enrollment by participants' perceived health status, assuming that regional differences between perceived and actual health status are insignificant and do not affect demand. If regional disease patterns do constitute a source of bias, we should choose sites from different geographic regions and avoid sites with significantly different disease patterns. Regional differences in medical practice (e.g., length of hospital stay) are another possible source of bias, but the data are inconclusive.

MINIMIZING VARIANCE

Lowering experimental costs per person reduces the potential variance of the estimates by permitting a larger sample for a gross total budget. Sources of intersite cost differences therefore become a factor in site selection. Intersite cost differences are mainly a function of payments to providers and participants, including payments to maintain participants' preexisting insurance and reimbursement for claims on experimental insurance plans. Those costs in turn depend on local hospital charges, local physicians' fees, and minimum coinsurance rates and deductibles in participants' preexisting policies.

Hospital charge data are available by SMSA in an annual survey conducted by the American Hospital Association. Data on physicians' fees are limited; price questions might be included in a telephone survey of physicians, or hospital per diem charges used as a surrogate. Data on insurance expenditures, though not directly available by SMSA, are easier to estimate for public insurance (Medicaid) recipients than for those with private insurance.

Other possible site selection factors, not addressed here, include the effects of experimental cost differences on the number of sites and sample sizes; other implications of purposive site selection; and possible interaction effects between concomitant characteristics.

CONTENTS

I. INTRODUCTION

This Note presents a methodological basis for the choice of sites in the Health Insurance Study (HIS). Section II defines the objectives of site selection. Section III discusses site bias resulting from "concomitant characteristics," and Sec. IV considers possible sources of such bias in the HIS. Sections V and VI respectively discuss regional differences in experimental costs and the availability of cost data. The last section outlines possible extensions of site selection criteria.

II. OBJECTIVES OF HIS SITE SELECTION

The objectives of the Health Insurance Study include [1]:

- Measuring the demand for medical care.
- Testing innovative health insurance plans for their effects and administrative feasibility.

The methodology for choosing experimental sites is part of the overall design and is determined by those objectives.

The experimental design will be sequential. We will be better able to determine the appropriate design features as the experiment progresses. Different sites will be brought into the experiment at different times. Knowledge gained in previous sites can be used to select and plan for future sites. For that reason we will continually analyze experimental data so that problems can be detected and resolved and their solutions used to improve design decisions.[1]

The HIS measures the economic behavior of individuals and families who are enrolled in various insurance plans providing a variety of marginal prices for medical care. The experimental design includes a process for selecting and allocating a sample of families with certain characteristics to a number of design control points.[2] Allocating the sample of families along the dimension of geographic location is the problem of site selection.[3]

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[1]This and other statistical design matters are discussed in Ref. 2.

[2]This process is governed by the "finite selection model," described in Ref. 2.

[3]This Note does not consider aspects of sample design concerned with the number of sites and number of participants in a site. Those matters are discussed in Refs. 3 and 4.

Two statistical criteria will govern the choice of HIS sites:

1. The sites chosen should generate unbiased national parameter estimates, which may differ from local estimates.
2. Other things equal, the sites chosen should generate minimum variance estimates.

To insure national estimates, a national sample could be chosen. However, it would be considerably more expensive per observation than a sample chosen from a smaller population, e.g., a Standard Metropolitan Statistical Area (SMSA). Therefore, a national sample implies a smaller sample size for a given budget.[4] However, as sample size is decreased, the precision of the estimate also decreases. Selection of a site sample instead of a national sample is a way of reducing variance at the cost of possible bias.

The variance of estimates based on a site sample is less than that based on a national sample not only because of the larger sample size but also because of stratification. A site sample is basically a geographically stratified sample.[5] The increased precision from geographic stratification is the result of two effects. The first is the aggregation of individuals who are similar in their principal characteristics, e.g., ethnic origin. The increase in precision due to aggregation is usually modest [5, p. 101]. The second effect of geographic stratification is that administrative procedures in the experiment are more uniform because the staff is smaller. To my knowledge such benefits have not been estimated, but presumably they could be substantial.

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[4]This is especially true considering that one of the advantages of an experiment is verification of data. Verification would be very expensive with a national sample.

[5]This is distinct from a cluster sample taken in a site.

III. SITE BIAS

The selection of experimental participants from a population smaller than the entire nation can lead to bias because of what might be called "concomitant characteristic" differences [4, p. 33].

Concomitant characteristics are the ambient (uncontrollable) conditions at a site that affect participants' consumption of medical care. By uncontrollable we mean exogenous to the experiment, although they may be endogenous to the health care delivery system as a whole. Examples are regional effects on the demand for care and capacity utilization of the local medical system. If those characteristics differ from national norms, the observed behavior at a site may generate biased estimates of national behavior.

For the HIS, the following general questions can be used to determine whether a characteristic is concomitant.

- Does the characteristic affect a person's demand for medical care?
- Is the value of the characteristic different from the national norm?
- Are experimenters unable to control for the characteristic by the choice of participants within a site?

The characteristic is concomitant if all answers are yes. For example, family income affects the demand for care, but experimenters can control for its effect by choosing families with a desired income distribution. Similarly, self-perceived health status and race can be controlled. But regional medical customs may affect all participants within a site and be outside experimenters' control. Therefore, for HIS purposes such customs are concomitant characteristics.

If the characteristics of a site lead to biased estimates of national parameters, appropriate adjustments are possible. Morris argues that this is not as efficient as having a sample reflecting national averages [4, p. 34]. That is also the main reason why Morris argues against the random selection of sites. After sites are chosen, the distribution of concomitant characteristics is known. If the distribution is not representative of national averages, the "temptation to modify the selection would be irresistible and justifiable." The existence of several concomitant characteristics yields a reasonably high probability that a random selection of sites will not have the desired distribution of characteristics. Therefore, Morris prefers the "purposive selection"[1] of sites to random selection.

Morris suggests a technique for using purposive site selection to produce unbiased national estimates. The method requires that the mean of the concomitant characteristics across sites approximately equal the national mean; the variance of the concomitant characteristics should also be large [4, p. 35].

In addition to the statistical qualities of the estimates, a number of operational and environmental criteria affecting site selection should be considered [1, p. 29]:

1. Cooperativeness of local government.
2. Stability of employment.
3. Presence of an established health maintenance organization (HMO)--required for at least one site.
4. Presence of an EMCRO (experimental medical control review organization).
5. Convenience of air travel.

A reasonable way of integrating those criteria with statistical considerations would be to stratify possible sites along criteria of statistical desirability and then choose within a stratum according to operational criteria.

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[1]Sometimes termed "judgment" [5, p. 11].

IV. CONCOMITANT CHARACTERISTICS IN THE HIS

From a long list of potential concomitant characteristics, I have selected two likely to be significant for the HIS: capacity utilization of physicians and hospitals, and the effects of regional factors on the demand for medical care.

CAPACITY UTILIZATION

The dependent variable in the model to be estimated is a measure of the consumption of medical services--in some instances continuous, in others dichotomous. The independent variables include a demographic description of the participant in terms of health capital, income, and several price variables.

The price variables include not only the marginal own-money price[1] but also a "time-price." Time-price is the economist's traditional opportunity cost, i.e., the value of the next best use of one's time, usually work or leisure. Economic theory and some empirical findings [6,7,8] suggest that the time-price of receiving medical care is a significant factor in the consumption of medical services.

In addition, there is a general belief that nonprice rationing of medical services is common. It can take the form of queues (wait for an appointment) but mainly extends the concept of opportunity cost to acknowledge that own-money price is not the patient's total cost of receiving medical care. It can be argued that the capacity utilization of the local medical system is a strong influence on the waiting period in the office and the wait for an appointment.

Capacity utilization in a service industry can be approximated by the ratio of the current production of services to the maximum sustainable output given the current resources available and the present method of organization.

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[1] Out-of-pocket cost to the consumer.

It can be argued that capacity utilization has other effects than queues on the medical care industry. Theory and empirical observation suggest that local capacity utilization affects both the inputs and outputs of the medical system. For example, the willingness of a physician to refer patients to other physicians for consultation is probably influenced by the tightness of the physician's own schedule. Similarly, revisit rates, length of visit, hospital admissions, and length of stay are likely to be influenced by the level of capacity utilization for both physicians and hospitals.

The mix of services by specialty is also likely to be influenced by capacity utilization. Popular stories suggesting a medical form of Says' law ("supply creates its own demand") are consistent with low levels of capacity utilization. Examples are appendectomies and hysterectomies under questionable diagnostic conditions.

Capacity Utilization of Physicians

I see three possible measures of the tightness of the market for physician services.

Number of Visits per Week. The American Medical Association surveys a sample of physicians annually on their average workload. Included are hours worked per week, number of office and hospital visits per week, and number of weeks worked per year. Number of weeks worked per year does not vary much. Number of visits per week is probably the most relevant of these measures to the HIS.

There are several objections to this measure. First, it is possible to substitute other factors for physicians, mainly medical aides. For example, what may be a high visit rate for one physician may be only moderate for a physician employing more aides. Furthermore, as Uwe Reinhardt has suggested, the distribution of physicians who use supplementary personnel is not random; there are distinct geographic patterns in the use of supplementary personnel [9]. Another objection is that the data are dependent on the physician's specialty and age. Finally, the AMA sample is a probability sample of 5000 physicians, which is inadequate for SMSA estimates.

Number of Physicians per Capita. Though a commonly used measure of availability, the physician-to-population ratio is generally inappropriate as a measure of capacity utilization. The statistic of concern is the demand-supply gap, and the physician-population ratio reflects only the supply side. Furthermore it is only a partial estimate of the supply side, since the differential productivity mentioned above applies here as well.

Wait for an Appointment. The waiting time to obtain an appointment is probably the best single measure of physician capacity utilization. It differs between specialties, of course, but within a specialty should be a reasonable measure of the tightness of the local physician market.

The American Medical Association included a question on the wait for an appointment in its latest survey and made some of the data available to the HIS [10]. It is clear that queues differ substantially, both across specialties and across SMSAs. Unfortunately, the AMA sample is not large enough to rank medium and smaller SMSAs. I propose a national telephone survey of physicians to measure inter-SMSA differences in the waiting time for an appointment [11].

Capacity Utilization of Hospitals

The availability of hospital space is central to the medical delivery system. As with the capacity utilization of physicians, the level of hospital usage affects the level and type of medical care consumed. For other than emergency cases, patients and their admitting physicians probably exercise considerable discretion about the timing and length of hospital stays.

The American Hospital Association publishes an annual report of utilization rate by hospital and city. That rate, defined as the ratio of actual bed days to capacity bed days, is a reliable measure of capacity utilization.

The purposive site selection process requires that the mean capacity utilization rate across sites equal the national mean (approximately 78 percent) and that the variance be large.

REGIONAL EFFECTS ON EXPERIMENTAL RESULTS

Regional effects on the demand for medical care can obviously cause site estimates to differ from national estimates. Such effects include the possibility of different geographic patterns of disease and morbidity (health capital), and possible regional influences on the forms of medical practice.

Regional Patterns of Morbidity

Disease and morbidity patterns influence the demand for medical care through the population's health status or health capital, a measure of health that consumers presumably want when they purchase an intermediate good such as medical care.

Regional health status refers to local disease patterns compared with national norms. Our tendency is to avoid sites with a significant incidence of an unusual disease such as histocytosis-x (black lung disease). But that approach neglects the total demand effects of different diseases. What is the cost of treating black lung disease? Is the probability of contracting other diseases greater or less because of black lung disease?

One way of aggregating these concepts is to refer to a person's health in terms of health capital. The mean level of health capital, adjusted for age and other characteristics, indicates that certain regions are "sicker" than others. Regional differences between current and desired levels of health capital (a function of relative price, which the HIS will change) are liable to lead to geographic biases in the demand for medical care.

The HIS will stratify enrollment by perceived health status, thus mitigating any regional disease patterns. To the extent that perceived health status reflects health capital, a sample stratified on health status within a site will reflect national norms. Regional disease patterns will then not fit the definition of a concomitant characteristic. Such patterns would only be a source of bias if there were regional differences between perceived and actual health status and if the differences affected use of the health care system.

The National Center for Health Statistics (NCHS) collects information on morbidity, both short- and long-term. The sample is geographically stratified into four regions of the country, with the South generally having the "sickest" population, followed by the West, North Central, and Northeast regions [12]. Measures of morbidity that are generally consistent by region are

- Percentage of the population with one or more chronic conditions.
- Percentage of the population with activity limitation due to chronic conditions.
- Restricted activity days per person per year.
- Bed disability days per person per year.
- Work loss days per currently employed person per year.

Demographic characteristics of the population, not regional factors, might be the source of the differences. Since the sample at a site can be stratified by demographic characteristics, these apparently regional factors would in that case not qualify as concomitant characteristics.

The effects of regional morbidity patterns are thus uncertain. If it is established that regional disease patterns are a possible source of bias, the implications for site selection are

- Choose sites that represent different geographic regions.
- Avoid sites with significantly different disease patterns.

Regional Patterns of Medical Practice

The level and composition of medical care can be influenced by regional factors. For example, in some states a substantial portion of the physicians are doctors of osteopathy; other states have none. Some studies infer distinct regional patterns in the length of hospital stay [13]. Since hospital expenditures are a large proportion of the medical budget,[2] let us consider length of hospital stay as a factor.

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[2] In 1969, hospital expenditures accounted for approximately 45 percent of total personal health care expenditures.

Table 1 shows the average length of stay for patients in short-term general hospitals in 1969.

Table 1

AVERAGE LENGTH OF HOSPITAL STAY, 1969
(Patients aged 15-44)

	Length (Days)	
Region	Males	Females*
Northeast	8.6	6.9
North Central	7.7	6.7
South	6.9	6.6
West	6.1	5.5
All	7.3	6.5

SOURCE: Ref. 14.
*Excludes stays for childbirth.

Patients in the Northeast had the longest stays, followed by patients in the North Central region, South, and West. The differences are substantial. For example, male patients in the Northeast had stays 41 percent longer than patients in the West. However, those patterns reflect regional differences not only in medical practice but also in price, insurance coverage, income, disease patterns, and capacity utilization of physicians and hospitals. Another possible factor is the distribution of teaching hospitals, where patients tend to stay longer. What is needed is a measure of regional effects after allowing for all the other conditions.

V. REGIONAL DIFFERENCES IN EXPERIMENTAL COSTS

The preceding discussion of concomitant characteristics is concerned with bias in the estimated coefficients. The second statistical criterion for site selection is minimum variance. Since sample size is a function of cost per observation, minimizing cost will maximize sample size, yielding estimates of lower variance.

The operational cost of the experiment consists of the fixed cost per site plus the variable cost of disbursements.[1] Thus, the cost per site is

$$C_{oj} + \sum_{i=1}^{M} N_{ij} C_{ij} \qquad \begin{array}{l} i = 1, \ldots M \text{ (design points)} \\ j = 1, \ldots K \text{ (sites)} \end{array} ,$$

where

C_{oj} is the fixed cost for site j,

C_{ij} is the cost for a family in plan i at site j,

N_{ij} is the number of families in plan i at site j.

Assuming K sites and C_{oj}'s of equal value, the total operational cost of the experiment is

$$KC_o + \sum_{j=1}^{K} \sum_{i=1}^{M} N_{ij} C_{ij}.$$

If we assume that N_{ij} is the same in all sites [4], possible intersite cost differences are a function of C_{ij}.

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[1]As used here, disbursements include payments to providers but exclude the cost of analysis and administration.

The variable cost of enrolling a family at design point i consists of the participation incentive (PI) and the net cost of disbursements (NC):

$$C_{ij} = G(PI_{ij}, NC_{ij}).$$

The PI for a family at design point i is a function of the preexisting health insurance, public or private. Specifically, it is a function of the policy's minimum coinsurance rate, which determines the worst-case PI payment. For example, families eligible for Medicaid could have a high PI if the HIS coverage offered them specified no coinsurance. That could be offset by the plan's specified ceiling on out-of-pocket expenditures (maximum dollar expenditure), a function of income.[2]

The net cost of disbursements depends on the price level for medical services at site j, and on the actuarial value of any repayment from preexisting insurance coverage. Price-level differences between SMSAs can be surprisingly large. For example, a 1969 Bureau of Labor Statistics (BLS) budget study showed that physician prices in Cleveland were 15 percent higher than in Dayton. Los Angeles-Long Beach physician prices were 25 percent higher than those in San Diego. Similar differences occur in hospital per diem charges. In 1972, for example, a room with two beds cost 52 percent more in Cleveland than in Dayton, and 33 percent more in San Francisco-Oakland than in San Diego.

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[2]"Participation incentive" and "maximum dollar expenditure" are further explained in Ref. 15, pp. 20-21 and 1-2, respectively.

VI. AVAILABILITY OF COST DATA

HOSPITAL CHARGES

The American Hospital Association conducts an annual survey, almost a census, of hospital charges [16]. The data are published by SMSA, state, and census division for various accommodations (one-bed room, two-bed room, etc.).

PHYSICIAN FEES

The BLS budget study is available for 39 SMSAs. It is based on a 1967 study of physician charges by city, updated by use of the consumer price index. Although less than ideal, the study is the only published source of physician prices by SMSA. Its main deficiency is the limited number of observation points.

The American Medical Association's annual survey includes data on physicians' fees. Besides the problem of access to the data, there are too few observations to rank any but the largest SMSAs, which are already covered by the BLS data.

It has been suggested that the Price Commission (Cost of Living Council) has data on physician fees. In fact, the Cost of Living Council collects very little data and relies on the consumer price index and other BLS studies for price information.

It is generally agreed, therefore, that a comprehensive index of physicians' fees is not available and that it would be worthwhile to include price questions in a telephone survey of physicians. A simplified alternative would be to recognize the higher proportion of hospital charges in the medical budget and to use hospital per diem charges as a medical cost index. Good data exist for practically all SMSAs.

PUBLIC HEALTH INSURANCE

Characteristics of state Medicaid programs are readily available. Though specific expenditures are not known by SMSA, the eligible Medicaid population (welfare population) in each SMSA is known. Some Medicaid programs include the medically indigent in addition to the categorically indigent (welfare population), but medically indigent cases are usually handled individually. That should reduce the complications of calculating the PI for Medicaid-eligible participants.

PRIVATE HEALTH INSURANCE

The Health Insurance Council annually publishes the number of persons in each state who are covered by private health insurance. No estimates are available by SMSA or city.

VII. THEORETICAL EXTENSIONS OF SELECTION CRITERIA

This discussion has assumed that the choice of HIS sites is independent of the number of sites to be chosen and the number of observations per site. We also assume that

- Purposive site selection is preferable to random site selection.
- The goal of purposive site selection is to produce unbiased national estimates with low variances.

Those site selection criteria might be extended by addressing the following questions:

1. Do the number of sites and number of observations per site change if the cost per observation is not the same in all sites?
2. Does purposive site selection imply criteria other than bias and variance of the estimates? What are reasonable error loss functions for site selection? Could biased coefficients be preferable to unbiased coefficients?
3. Should possible interaction effects between concomitant characteristics be considered?

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