Household Production of Health:  
A Microeconomic Perspective on Health Transitions

Julie DaVanzo, Paul Gertler

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PREFACE

The Note was prepared for the Workshop on the Measurement of Health Transition Concepts held in London, June 7–9, 1989. The workshop was cosponsored by the Rockefeller Foundation and the London School of Hygiene and Tropical Medicine.

Support for the preparation of this Note was provided by research funds from The RAND Corporation. The Note should be of interest to researchers and policymakers wishing to learn about economic models for studying health behavior and health outcomes.
SUMMARY

Over the past 20 years, advances in medical technology have not led to desired health improvements in the Third World. Governments may import and distribute medical technologies widely, but the effectiveness of these technologies will depend on how people respond to them. If such programs are to be effective, planners and practitioners must know what governs families’ decisions to seek care and engage in health-improving behaviors. In other words, they need to understand and accommodate behavioral and sociocultural influences on health.

This Note argues that behavioral research can inform health policy on three dimensions: (1) how behavioral choices affect health status, (2) what determines these choices, and (3) how policymakers can influence these choices. It shows that economic theory—especially the theory of the household production of health—provides a useful framework for analyzing these three dimensions. In particular, the framework provides a theoretical organizing structure for policy analysis and has important implications for data collection, for the empirical specification of models of behavioral choices, and for the statistical analysis.
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CONTENTS

PREFACE ................................................................. iii
SUMMARY ................................................................. v
ACKNOWLEDGMENTS .................................................. vii

Section

I. INTRODUCTION ...................................................... 1

II. FEATURES OF AN ECONOMIC MODEL OF THE HEALTH
TRANSITION PROCESS ............................................... 3
       Overview .......................................................... 3
       The Behavioral Model ......................................... 4
       The Stock of Health: Consumption and Investment Aspects .. 5
       Utility Function ............................................... 6
       Health Production Function .................................. 7
       Prices, Income, and Constraints on Behaviors ............... 9
       Values, Perceptions, and Information ....................... 10
       Utility-Maximizing Behavior and the Role of Policy ...... 11

III. IMPLICATIONS FOR DATA COLLECTION ....................... 12
       Units of Observation ......................................... 12
       Health Outcomes ............................................. 12
       Inputs to the Production of Health ......................... 12
       Influences on Health Inputs (Derived Demand for Inputs) . 12
       Illustrative List of Types of Data to Collect ............. 14
       Time Frame .................................................... 17

IV. IMPLICATIONS FOR DATA ANALYSIS ........................... 19
       Estimating Influences on Health ............................ 19
       Equations for Estimation .................................... 20

V. SUMMARY AND IMPLICATIONS FOR POLICY ..................... 23

REFERENCES ............................................................. 25
FIGURES

1. The conceptual model ........................................... 6
2. Simplified version of the conceptual model ................. 8
I. INTRODUCTION

Over the past 20 years, advances in medical technology have not led to desired health improvements in the Third World. Governments may import and distribute medical technologies widely, but the effectiveness of these technologies will depend on how people respond to them. For example, a country may disseminate oral rehydration salts to treat diarrhea, but they will not affect children's health if families do not obtain and use them correctly. If such programs are to be effective, planners and practitioners must know what governs families' decisions to seek care and engage in health-improving behaviors. In other words, they need to understand and accommodate behavioral and sociocultural influences on health.

Behavioral research can inform health policy on three dimensions:

1. How behavioral choices affect health status;
2. What determines these choices; and
3. How policymakers can influence these choices.

Understanding all three dimensions of health change is the necessary foundation for developing countries in making the transition from poor to good health. For example, the first requirement for policy is to understand how the use of a particular medical technology—for example, prenatal care—affects health outcomes. This is crucial in determining the efficacy and cost-effectiveness of possible interventions designed to improve health. The second requirement focuses on analyzing the determinants of individuals' behavioral decisions to use these interventions. Investigating the determinants of behavior is important in evaluating the effectiveness of policies designed to get people to use the interventions effectively.

Economics provides a useful framework for understanding the determinants of people's behavior. Behaviors that affect people's health typically result from choices they make among alternatives available; these choices are influenced by the perceived costs and benefits and by resource constraints. Economics is the study of how people make choices among competing alternatives, subject to price and resource constraints. Thus, standard economic models are useful for points (2) and (3) in the policy agenda.

The economics of household production (Becker, 1965; Grossman, 1972a, 1972b) expands standard economic models to the notion that many goods, services, and behaviors that influence health are not valued in and of themselves but rather because
they influence health. Households combine purchased goods and services and their own time to produce health. Thus, the demands for goods and services and behaviors that influence health often derive from the demand for health. Empirically, this involves separating the technological, biological relationship that transforms behaviors into health (the health production function) from the process by which these behaviors are chosen. This separation is important in identifying behavior's effect on health (policy requirement [1]). This theoretical specification also has important implications for choice of independent variables and statistical techniques (Schultz, 1984).

The household production model is the economic analog to the model of the proximate determinants of health proposed by Mosley and Chen (1984). Both models argue that there are sets of behaviorally chosen proximate determinants of health. These proximate determinants, such as nutrition and use of medical care, have a biological impact on health. Economists refer to this biological process as the health production function, which converts behaviorally chosen inputs into health. Individuals' decisions to use these proximate determinants (inputs) are determined by socioeconomic variables, such as income and education.

The economic model is often interpreted unduly narrowly as referring only to goods and services produced and sold in formal markets, with only the money prices and people's money incomes affecting their decisions and with decisionmakers having perfect information about all options available. However, the economic framework can deal with a much broader array of influences and can incorporate facts—such as time inputs, nonmarket (household) production, imperfect information, cultural context, psychological aspects, the biomedical nature of some relationships, traditional practices, and institutional setting—not normally thought to be "economic."

While arguing that important empirical regularities exist across countries and cultures (for example, general consistency of the signs of relationships), the household production model provides several rationales as to why various health intervention programs yield different results in different settings. Specifically, there are several reasons to expect the behavioral inputs' productivity to differ. In addition, beliefs and information structures vary across cultures and countries. Therefore, the household production model explicitly recognizes the necessity of evaluating policy in the context of its application.

Section II discusses the concepts and features of the household production model of health. Sections III and IV discuss this model's implications for data collection and data analysis. The concluding section discusses the preceding sections' implications for policy.
II. FEATURES OF AN ECONOMIC MODEL OF
THE HEALTH TRANSITION PROCESS

OVERVIEW

Over a lifetime, the evolution of an individual’s health depends largely on his or her initial genetic endowment and on the sum of everyday decisions about such things as nutrition, exercise, and use of medical services. These decisions produce increments (or decrements) to health. Some decisions affect health directly; for example, the decisions an individual makes about whether to see a doctor or whether to take medicine may directly affect his or her health. Other decisions affect health indirectly; a couple’s fertility decisions, for instance, determine the number of children they have and the ages at which they choose to have them, both of which are important risk factors for maternal (and child) health (see, for example, National Research Council, 1989). In addition, the decision to smoke is clearly made for nonhealth reasons, but has adverse effects on health.

The economic model of household production provides a useful framework for analyzing influences on behaviors affecting health. Grossman (1972a, 1972b) provided a key insight into the behavioral aspects involved in the health transition process. He argued that most health-influencing behaviors, such as obtaining medical care, are valued for their effect on health rather than in and of themselves. Therefore, the demand for medical care and other behaviors affecting health typically derive from the demand for health.

To operationalize this concept, Grossman formally separated the biological relationship between behavior and health status from the process by which those behaviors are determined. The biological relationship, commonly referred to as the health production function, is a technological process that converts the use of goods, services, and time that affect health into health status. This process is also referred to as a household production function for health, because it captures the notion that household members use their time, knowledge, and purchased goods and services to “produce” health. For example, the treatment of diarrhea involves a mother taking time and possibly money to obtain oral rehydration salts and then using her knowledge to administer the salts to the child, resulting in an improvement in the child’s health. This relationship is typically governed by biology—for example, the effectiveness of oral rehydration salts in restoring the electrolyte balance and preventing dehydration, of a vaccine in reducing the probability of contracting a particular disease, of a particular therapy in curing a disease, or of the amount of nutritional status produced by a given dietary intake.
On the other hand, the relationship that determines health care utilization is behavioral in nature. This behavioral relationship tells us about the determinants of inputs used, how much of those inputs are used, and the efficiency with which they are used.

Separating the biological health production function from the behavioral input demand function has important policy and empirical implications. From a policy perspective, evaluating medical technology’s efficacy requires examining the health production function, whereas determining the most appropriate policy to get maximum benefit from the technology requires understanding the behavioral functions. For example, determining whether vaccinations against measles work involves clinical trials of whether the vaccine reduces the incidence of measles. For policy purposes, though, we need to know what factors influence whether a mother takes her child to be vaccinated. These determinants may include such variables as the vaccination’s price, the location of the service and the hours it is available, the value of alternative uses of the time the mother spends taking her child for the vaccination, and the mother’s education. Cultural influences, such as attitudes toward intervention in “natural” processes, may also determine whether the child will be vaccinated.

Key features of this economic framework affect the way we think about health decisions and have implications for the types of data that should be collected, how they should be analyzed, and the implications drawn for policy. The remainder of this section discusses features of this conceptual framework in more detail. The following sections deal with the implications for data collection, data analysis, and policy.

THE BEHAVIORAL MODEL

The economic model of the household production of health is based on the notions that people value good health, that behavioral choices affect health status, and that these choices are shaped by personal, social, cultural, and policy influences. The elements of the model are:

1. Preference rankings of the value or utility of various combinations of health and other objectives;
2. The health production function, which translates behavior into health;
3. Socioeconomic determinants of behavior, including income, money costs, time costs, costs of obtaining information, and education;
4. The assumption of “utility maximization” — that individuals choose their behaviors so as to obtain the combination of health and other objectives they
value most, given the budget constraint of the amount of time and income available and the prices of the goods under consideration.

Figure 1 represents these elements of the model schematically. The rest of this section discusses the model represented in Fig. 1.

THE STOCK OF HEALTH: CONSUMPTION AND INVESTMENT ASPECTS

The stock of health is valued both as an investment and as a consumption commodity. As a consumption commodity, health enters the utility function directly because people receive "disutility" (dissatisfaction) from being sick.

As an investment commodity, health determines the time available for market and nonmarket activities (since time sick is not very productive) and affects the length of one's lifetime. The stock of health, or "health capital," is a component of a person's human capital (the productive stock embodied in human beings) (Becker, 1964).

The stock of health depreciates over time and depreciates at an increasing rate after some stage of the life cycle. The stock of health can be increased by investments in health (for example, eating a nutritious diet, medical care), although some behaviors (such as smoking) can lead to reductions in health.

![Fig. 1—The conceptual model](image-url)
UTILITY FUNCTION

Health versus Other Sources of Utility

The extent to which individuals engage in health-promoting behavior depends on how much they value health relative to other objectives, such as better housing or recreation. The relative value of health is determined in part by how people's health affects their ability to engage in other activities and in part by cultural and social attitudes toward health, health care, and modern medicine. A crucial notion is that people value other things as well as health. Monetary and time resources spent on improving health are at the expense of pursuing other objectives. Economists represent this value system in terms of a utility function, which ranks people's preferences over various combinations of health and other goals.

The utility function can represent many different forms of values and preferences. Health may be valued as a complement to other goods. Good health may enhance ability to enjoy other activities and commodities such as food, the enjoyment of watching children grow up, and leisure activities. People's values and preferences may also be affected directly by some behaviors that affect health. For example, some individuals enjoy smoking, despite its adverse health effects. Others incur large psychological costs of embarrassment and fear associated with the use of modern medicine.

Furthermore, the utility function incorporates the intertemporal trade-off between consumption today and investment for tomorrow. The most obvious example is the use of preventive medical care, which depends on the family's value of the member's future health. Individuals may differ in their rate of "time preference"—the value they place today on goods they will consume in the future. Furthermore, the nature of the utility function and of the production function may change over time.

Derived Demand for Inputs

Many behaviors that influence health are not valued in and of themselves. For example, few people get any utility out of the act of going to see a doctor or receiving a vaccination. They engage in these behaviors because they value the resulting effects on health. Therefore, the amount individuals value a behavior depends both on how much health it produces and on how much they value that additional health. In this sense, the demand for behaviors that influence health are derived from the demand for health.

\[\text{1For example, the amount they would be willing to pay now for one dollar they would receive a year from now.}\]
Decisionmaking Unit

Decisions that affect health tend to be made at the household level. The key
decisionmakers may be persons other than those whose health is being affected. The
most obvious example is children, whose health is affected by decisions made by their
parents; for example, decisions parents make about prenatal care, breast-feeding, first
supplemental foods, and vaccinations affect their children's health. Furthermore, the
health of one member of a household may affect that of another; for instance, a lactating
mother's nutritional status and health may affect the quantity and quality of the milk she
produces for her baby. As another example, infections may spread from one member of a
household to others in the household. Furthermore, because household resources are
limited, the household may not be able to spend all it would like on every household
member and may have to decide among activities that affect the health of different
household members (see, for example, Gertler and Alderman, 1989). For all these
reasons, the household is the appropriate decisionmaking unit for analyses of influences
on health.

The earliest economic models of household behavior (see, for example, Becker,
1964) assumed that all members of the household jointly maximized some household
level of welfare and that the household could be treated as if it acted as a single
individual. More recent research has recognized that preferences may differ across
members of a household; this research has investigated how alternative decisionmaking
styles might affect the allocation of resources within the household (see Thomas [1989]
and references therein). For example, whereas one family may act as an altruistic unit, in
others one individual may act as a dictator, perhaps discriminating against other members
(such as females or the elderly), while still other families may engage in cooperative or
noncooperative bargaining over the allocation of resources.

HEALTH PRODUCTION FUNCTION
Inputs to the Production of Health

Households produce many of the commodities they consume (Becker, 1965). For
example, their behavioral choices affect their health status. These behavioral choices are
"inputs" to the "production" of health. This relationship is known as the health
production function. The actual transformation of these inputs into "outputs" (health
outcomes or improvements in health) is typically governed by biology—for example, the
effectiveness of a vaccine in reducing the probability of contracting a particular disease,
the effectiveness of a particular therapy in curing a disease, the amount of nutritional
status produced by a given dietary intake.
Health is “produced” by a number of different “inputs”—such as food, immunizations, use of uncontaminated water, curative medical care, and so on—that may, to some extent, substitute for or complement one another in producing good health. Households combine purchased goods and services with the time and know-how of household members to produce increments to health. The household production model explicitly recognizes the importance of the time and expertise of the individual used in obtaining and correctly administering the other inputs.

The household production of health approach views health as stock. The inputs individuals choose are investments that produce increments to health. Inputs are not instantaneously transformed into health—the process takes time. Therefore, today’s investments are influenced by today’s health status and produce tomorrow’s health status.

**Efficiency of Production**

The productivity of inputs to improving health is likely to vary considerably across individuals, households, and countries. For this reason, evaluating interventions designed to promote health within the particular context in which they are being considered is crucial.

The initial units of the health input may have more influence on health than do later units. This is the economic notion of *diminishing marginal returns*. For example, the first few days in the hospital are likely to improve health more than a few more days after an individual has already spent 100 days in the hospital. Another example is that the first month of unsupplemented breast-feeding will have a greater influence on the child’s health than, say, the fifth month—and, in this case, at some point (say, after eight months) the influence may actually become negative, because breast milk alone no longer supplies all the necessary nutrients.

The notion that the marginal product of medical care may be diminishing implies that the same intervention may have different effects in different settings. In countries where the level of use of an input is high (for example, the United States), the effects of additional use are likely to be small relative to a country where the use of the input is low (most less-developed countries). Indeed, family planning programs should have the greatest potential effect on maternal and child health in countries where little contraception currently exists (Walsh, Naschak, Measham, and Gertler, forthcoming).

The marginal product of an input depends very much on the *quality* of the input. The health effects of vaccinations depend on using a clean needle and on the vaccine’s dosage being efficacious. The efficacy of medical treatment depends on the practitioner’s diagnostic skills.
In addition, the marginal product of one input may depend on quantities of other inputs in use. For example, breast-feeding has its greatest effects in promoting child survival in areas where water and sanitation are poor, because breast-feeding protects against infections borne by unhygienic water (Habicht, DaVanzo, and Butz, 1988).

Individual and household characteristics may also influence the ability to combine health inputs appropriately, and, therefore, the effectiveness with which they are used. Education in particular affects the ability to understand and use inputs effectively to influence health; for example, the ability to follow treatment plans is crucial for the treatment to improve health. The cleanliness of available water influences a mother’s ability to use oral rehydration salts properly. Another example is the mother’s fertility history—an important risk factor predicting maternal and perinatal mortality (Walsh, Naschak, Measham, and Gertler, forthcoming).

PRICES, INCOME, AND CONSTRAINTS ON BEHAVIORS

The pursuit of behaviors that influence health is limited in that they typically involve expending time and money. Economists posit that individuals choose to allocate their available time and money so as to achieve the combination of health and other goals they value most, given their available resources; that is, individuals are assumed to maximize their utility, subject to their budget constraints. A household’s budget constraint depends on the time and monetary prices of inputs that influence health, the prices of achieving other pursuits, the total amount of time available to the household, and the other resources available (for example, income, assets).

A household’s ability to afford the money and time costs of various goods and activities depends on its income and wealth, its access to credit and other resources outside the household (for example, from relatives living elsewhere), and on alternative demands on and uses of family members’ time. The total amount of resources (time and money) available constrains the decisions that can be made. Indeed, in developing countries, monetary and time prices, income, and perceptions about the quality of medical care influence whether and where individuals seek care during illness (Gertler and van der Gaag, 1990).

Emphasizing the role of nonmonetary prices in the household production model is important. Individuals expend time in obtaining inputs into the production of health; for example, getting medical care for the treatment of an illness or prevention involves travel time, waiting time, and treatment time. Accordingly, producing good health not only has money costs (such as costs of foods, fees for health services and medicines), but also time costs (for example, value of time spent preparing food or traveling to the service and
waiting for its use) and psychic costs (such as embarrassment). For publicly subsidized services, the latter two are typically the main costs. When monetary prices are small—as they are in many developing countries—the opportunity costs of time are the dominant price in the medical care market (Dor, Gertler, and van der Gaag, 1987).

Because inputs may be substitutes or complements in the production of health outcomes, a change in the price of one input may affect the demand for another. Thus, a reduction in the price of contraception (resulting, for example, from the opening of a family planning clinic), may lead not only to an increase in contraceptive use, but also to a reduction in breast-feeding, an alternative means of extending the interval between births.²

Because health is not purchased on the market but is produced by households combining their own time with goods and services, no market “price of health” exists. There is, however, a cost of producing health—the value elsewhere of the resources devoted to improving health. This is known as the shadow price of health; it is determined by the prices of the inputs to health—for example, the price of medical care, the value of time spent going to the doctor—each weighted by the appropriate quantities (for instance, the amount of time spent).

The shadow price of health depends on the efficiency with which inputs can be converted to outputs. For example, the shadow price will be inversely related to the level of education if educated people are able to convert goods and time into health more efficiently. The shadow price will rise with age if the health stock is depreciating with age because producing a certain increment to health will require more inputs (alternatively stated, a given input will produce a smaller increment to health as age increases).

VALUES, PERCEPTIONS, AND INFORMATION

We have already argued that culture-specific values and beliefs are an important determinant of preferences and affect behavior through the utility function. Which inputs are chosen will also depend on their perceived costs and benefits. If people believe a particular health-promoting intervention does not work, they will be unlikely to use it, no matter how much they value health. How well people understand the health effects of various behaviors depends on the information available to them (for example, through health education programs, the media, in books) and on their ability to assimilate this information, as well as on the “true” technological relationship. The acquisition of

²Unpublished research by Julie daVanzo and Ellen Starbird on correlates of short interbirth intervals in Peninsular Malaysia.
information can be costly; hence, decisions may not take into account all relevant factors. For example, research has repeatedly found that mothers' education is among the stronger (often the strongest) influences on infant mortality and morbidity. Education seems to be associated with access to information and with the ability to process it (and hence to improve knowledge about the effect of behavioral choices on health); it probably also helps people implement medical advice.

**UTILITY-MAXIMIZING BEHAVIOR AND THE ROLE OF POLICY**

Using the above elements, we can now describe the health production decisionmaking process. Households choose behavioral inputs for the production of health so as to maximize their utility—that is, achieve the combination of health and other pursuits they most value—given their resource (budget) constraints. The utility or value of a behavior influencing health is derived from the value of the health it produces; the value of that behavior is the multiplicative product of (1) the addition to health the behavior produces, and (2) the value of that additional health. The resource constraint is determined by the time and monetary prices of goods, services, and behaviors affecting health and other desired goals and by the available time and monetary resources available to be spent. Because of this behavioral process, the inputs to the production of health are chosen based on the prices of the inputs, the available resources, cultural values, social and sociodemographic variables (such as education) influencing the value of health, the productivity of the inputs, the current level of health, and the information structure.

Thus, these decisions will be influenced by government policy that affects the availability, accessibility, public awareness, and prices of health-promoting programs and by the private market availability and prices of goods and services affecting health. Policymakers can change such factors by (for example) creating and improving access to health-promoting programs; adjusting the price, location, and quality of health services; providing information about ways of improving health; and providing "public goods" (for example, malaria control, cleaner water).
III. IMPLICATIONS FOR DATA COLLECTION

Estimating the analytic model just described requires information on health outcomes, the behaviors influencing these outcomes, and individual, household, and community characteristics affecting these outcomes and behaviors.

UNITS OF OBSERVATION

As the preceding section discussed, health outcomes largely result from decisions made within households. This occurs because household members make decisions about the health of other household members (for example, parents make decisions about children) and because the household's limited resources force it to make choices among consumption goods—including health—and about the allocation among household members. Furthermore, the health of one household member may affect that of others in the household. For all these reasons, the household is the appropriate decisionmaking unit for the analysis, and data should be collected not only about the individual under consideration but also about other household members, especially key decisionmakers within the household (for example, when studying children's health, about parents' characteristics). Ideally, we would like to have data on all members of the household. As noted below, collecting data on community-level factors affecting health is also important.

HEALTH OUTCOMES

Each study will have its own emphasis. Some may focus on a particular disease; others, on general well-being. Other studies discuss the pros and cons of alternative measures of health and the issues that arise in collecting data on them.

INPUTS TO THE PRODUCTION OF HEALTH

As noted above, many aspects of health are affected by the behaviors individuals and households engage in. For example, health may be improved by eating a nutritious diet, obtaining proper immunizations, and using uncontaminated water, soap, and medical care. Ideally, data should be collected on as many "inputs" affecting health as possible, since these may substitute for or complement one another in producing good health.

INFLUENCES ON HEALTH INPUTS (DERIVED DEMAND FOR INPUTS)

To analyze what influences households' choices of behaviors that affect health ("inputs"), we need data on the perceived costs and benefits of each input. Data should
be collected not only on the money costs of health inputs (for example, fees for health services and medicines), but also on the time costs (for example, time spent traveling to the service and waiting for its use) and psychic costs (for example, embarrassment).

Often, many alternative sources of a given type of care exist (such as private doctors, public clinics, pharmacies, traditional healers) and people choose among these. Accordingly, data should be collected on these alternative suppliers so research can assess the influences on the choices people make among these alternatives.

Furthermore, choice of health behaviors is affected by perceptions of their costs and benefits. If a person is unaware of a particular service or product, he or she cannot use it. Hence, knowing not only actual availability and prices but also people's perceptions of these is important. Similarly, if a person considers a service or product ineffective or dangerous, he or she may choose not to use it. Hence, we would like to have information on people's perceptions regarding the availability and effectiveness of various health inputs. For example, do they know where to obtain prenatal care, immunizations, and contraceptives? Do they know about the value of prenatal care or about oral rehydration therapy (and how to use it appropriately)? How accurate is their information about the costs of these “inputs” to health? What are their perceptions about the side effects of contraceptive methods?

Factors such as an individual’s level of education may affect the amount and accuracy of his or her information about influences on health. For policy purposes, knowing which aspects of education are most important would be useful—for example, particular aspects of the curriculum (such as health education or sex education), the ability to read, confidence in “dealing with the system.”

Households’ decisions are constrained by the amount of resources (money and time) available. Hence, data should be collected on the household's income and wealth and on alternative demands on and uses of household members' time, since these affect their ability to afford the money and time costs of health inputs. If preferences differ among household members and the resources of these members are not pooled, the effects of income may depend on who controls it (Thomas, 1989). For example, Thomas finds that maternal income has greater effects on children’s health than paternal income and that mothers prefer to devote their resources to improving the heights and weights of their daughters, while fathers prefer to devote their resources to sons. Accordingly, knowing about the sources (and control) of household resources is important.
ILLUSTRATIVE LIST OF TYPES OF DATA TO COLLECT

Data on Health Outcomes, Health Behaviors, and Influences upon Them

The following is an illustrative list of the types of information one might want to collect:

• **Health outcomes**
  — Health status of all household members, including
    • Morbidity
    • Chronic conditions
    • Nutritional status
    • Days lost from work or normal activities
    • Accidents
  — Pregnancy outcomes and fertility
  — Recent deaths of household members and likely causes of those deaths

• **Health behaviors and inputs**
  — Utilization of and expenditures (money and time) on health care, including
    • Modern public services (preventive and curative)
    • Modern private services (for example, private physicians, nurse-dispensers)
    • Traditional services (for example, healers)
    • Pharmacies and other drug outlets
    • Self-treatment (for example, with herbs or changes in diet)
  — Utilization of and expenditures on family planning services/contraception, including private and public, modern and traditional
  — Use of and expenditures (including time) on water
  — Health habits (for example, washing hands, boiling water, storing food, smoking, using drugs and alcohol)
  — Diet of all household members

• **Influences on health behavior**
  — Amount and sources of income and household resources and control over their use
  — Access to credit and to other resources outside the household (for example, from relatives living elsewhere)
— Value of household members' time (wage rates for workers in the formal sector), which influences their time costs of health-related behaviors
— Household composition and socioeconomic characteristics of household members, including age, gender, marital status, ethnicity, work status
— House characteristics (for example, dirt floors, ventilation, cooking facilities, toilet type, water source, standing water around the house)
— The household's duration of residence in the area (and a residence history showing where the household lived before and when)
— Community (village-level) data on the availability, prices, and type and quality of health services offered in the public and private sectors and on other community characteristics (such as proximity to major transportation and condition of water), as well as access to credit that may affect health behavior and outcomes.

Community-Level Data

Community data are particularly important for both policy and estimation purposes: (1) Community data provide information on factors affecting health care and survival that are often directly manipulable by policies and programs; (2) these data are more likely than most other factors affecting mortality and morbidity risk to be exogenous to household decisionmaking, an important feature for estimation purposes (see Sec. IV). Accordingly, there must be a sufficient number and variety of communities to provide ample variation for analysis.

Community-level information is obtainable by asking knowledgeable persons in the community, by averaging across the responses of households interviewed in the community, by actually visiting facilities in or near the community and observing conditions and interviewing key staff, and by consulting local and central administrative records. Data should be obtained on both the private sector and the public sector.

Some examples of community/health program data that would be useful to collect include the following:

• Health goods and services: availability, prices, and type and quality of goods and services offered in the public and private sectors

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3 This section draws on DaVanzo (1985).
4 This may not be true, however, if services are allocated according to the severity of an area's health problems.
Regarding *availability*, we would like information on how far a community member must go to get services, how frequently those services are available (number of days per month, number of hours per day), and the extent to which problems with service availability have occurred (for example, treks have been canceled because of shortages of fuel, supplies, or personnel; particular drugs have been unavailable in pharmacies).

For *prices*, information should be collected both on the *money* prices charged and whether these differ among individuals (for example, according to ability to pay) and on *time* costs (both travel time and waiting time); efforts should also be made to collect information on *psychic* costs—for instance, other things being the same, people may be less likely to use a service if the language or ethnic group of service providers differs from their own (see, for example, Potter, 1985).

Dimensions of *types and quality of services offered* include:

- The types of procedures that can be performed (for example, can [major] surgery be performed at the nearest delivery point? If not, what are the mechanisms for referrals of these or other problem cases to other tiers of the health system? Is transportation readily available for emergency referrals?)
- The training of service providers (for example, have birth attendants been trained about appropriate methods for cutting and treating the umbilical cord?); their time in service
- Health and family planning education programs
- The range of pharmaceutical products available and the extent to which they have been consistently available over time
- Whether drugs and supplies are stored at the proper temperatures and used within the appropriate time period
- Availability of clean needles for injection

The types of information in the above list should be collected for the following types of services, both public and private:

- Prenatal, delivery services, and well-baby care
- Other preventive care
- Curative care
- Traditional services
- Pharmaceuticals
• Immunization programs
• Nutrition programs
• Family planning
  • Prices and availability of food, including weaning foods for infants
  • Labor markets: availability of jobs in or near the community and the wages paid
  • Prices and availability of electricity, soap, pesticides
• Transportation
  — Availability and prices of public transportation and of fuel
  — Quantity and quality of roads
• Environmental conditions
  — Prevalence of disease vectors
  — Campaigns to control or eradicate particular diseases
  — Climate
  — Water supply; sewerage
• Communications
  — Availability of radio, TV, newspapers, telephone
  — Use of the media for health messages and education
• Community organization regarding collection and holding of money for community purposes (for example, the village health worker, water source).

TIME FRAME

The data on health outcomes, health inputs, and availability of health services should each refer to the same time period. For example, if health outcomes (such as deaths) are collected for a five-year reference period, we would like to know about characteristics of the household and the community that may have affected mortality probabilities over that same five-year period. Because individuals may have migrated over the reference period, we need individual-level data on where else (and when) these individuals lived during the reference period, as well as on those communities’ characteristics.

As Sec. II noted, health status at one point in time is the result of health status at the previous point in time and of behaviors over this period to improve health (both preventive and curative care). Furthermore, knowing the sequencing of events, so that cause and effect can be disentangled, is important. For example, only those who are sick are at risk of seeking curative care. We would like to know which individuals are sick at a point in time, whether they sought treatment for that illness, and how that treatment
affected their subsequent health. Accordingly, we would like to know health status at several different points in time and to have data on health influences over this same period of time. Because the quality of recall about many aspects of health appears to deteriorate seriously if the reference period is much longer than two weeks, retrospective data will likely be of limited use in studying many aspects of the health transition.\textsuperscript{5} Longitudinal (prospective) surveys appear to be a more promising approach, though they are expensive and can be problematic in areas with high rates of permanent or temporary migration.

\textsuperscript{5}Retrospective data \textit{have} proved useful for studying mortality, even over fairly long periods of time. For an example, see DaVanzo and Habicht (1986).
IV. IMPLICATIONS FOR DATA ANALYSIS

ESTIMATING INFLUENCES ON HEALTH

We have just discussed the conceptual model of factors that influence health and the data that should be collected to measure health and its determinants. Policymakers trying to decide on the most cost-effective ways to improve health need information on which of the influences on health are empirically important and on the relative sizes of their effects. These estimates should show the extent of improvement in health in general or in particular health outcomes resulting from a change in a particular factor (for example, the introduction of a particular policy initiative), holding constant all other influences on that health outcome. However, many different factors affect health, and these tend to be correlated. To arrive at unbiased estimates of the effect of the main factor under consideration, other correlated influences should be held constant.

For example, more-educated women may feed more nutritious food to their children, may establish healthier environments in and around their houses, and may be more likely to seek medical care for their children. The last effect will be overestimated if the first two are not controlled. In this same example, the simple (or total) effect of education on child health (that is, with no other controls) would show a positive effect of education on child health, but would not tell us anything about the avenues through which a mother’s education affects her children’s health. Such simple effects can be useful for identifying individuals, households, or areas at higher risk and may be useful in targeting programs to those with the greatest need. However, further investigation is necessary to determine why these individuals have poorer health.

Furthermore, estimates of the effects of health inputs on health outcomes should account for the fact that health inputs are not exogenous, but result from choice and may be influenced by unobserved factors that also influence health status. For example, unobserved inherent unhealthiness may increase both the likelihood of poor health status and the use of inputs that improve health in an effort to compensate; in such a case, the input’s effectiveness in producing good health would be underestimated. As an illustration, only individuals who are ill will seek curative care. This medical care may improve their health, but they may still not be as healthy as individuals who were not sick. In this case, we could erroneously conclude that medical care is associated with poorer health. Ideally we want to consider changes over time for a given individual, rather than compare across individuals who may differ from one another in unobserved ways. This approach, which requires observations on the same individual at more than
one point in time, enables us to net out the effect of unobserved individual-specific
influences on health that do not vary over time (for example, inherent healthiness).

Health programs and household characteristics generally do not affect health
directly, but do so indirectly through the behaviors they affect. These “proximate
determinants” (that is, behaviors that affect health) are not exogenous, but result from
choice and may be influenced by unobserved factors that also influence health status—for
example, inherent “healthiness” or “frailty.” This has important implications for how we
estimate the effects of health behaviors on health outcomes.

EQUATIONS FOR ESTIMATION

The underlying conceptual model Sec. II discusses can be shown in greatly
simplified form (see Fig. 2).

![Conceptual Model Diagram]

Fig. 2—Simplified version of the conceptual model

This model has two main equations: the health production function,

\[ H = f(B), \]  

(1)

which relates health behaviors (B) to health outcomes (H), and the input demand
function,

\[ B = g(P), \]  

(2)

which shows how prices, availability of services, household characteristics, and previous
health status and health conditions (P) affect health behaviors (B). Estimating a third
equation is also possible: the reduced form equation,

\[ H = R(P), \]  

(3)
relates the social and economic influences on health behaviors directly to health itself. This equation shows the (total) effects of the P's on health outcomes, but says nothing about the avenues (the health behaviors) through which they affect health. Thus, Eq. (3) cannot be used to ascertain the effects of the behaviors themselves, but only the combination of the effect of a behavior’s determinant and of that behavior’s effect on health.

Thus, the reduced form provides less information than the model that separates (1) the relationship between behaviors and health from (2) the determinants of those behaviors. Identifying the separate relationships is important for the design of policies to promote successful health transitions. Understanding the true biological effect of a behavior on health is necessary in evaluating the efficacy and cost-effectiveness of interventions. Understanding the determinants of why and how people engage in behaviors in each society is crucial for designing policies to get people to use the interventions and use them correctly.

Much of the empirical research on influences on health treats both health inputs and the factors that affect them as explanatory variables:

\[ H = v(P, B). \]  

(4)

This equation does not derive from the conceptual model; rather, it is a hybrid of the production function (1) and the reduced form (3). The interpretation of the coefficients of P (for example, income) from such an equation is different from that in Eq. (3) because the behaviors that income affects, which in turn affect health, are also being controlled. For example, if income affects health primarily because higher-income individuals can afford to buy medicines and to go to the doctor, the full effect of income on health will be underestimated if medical care and use of medicines are also controlled. In this case, the estimated coefficient of income shows the effect of income on health that operates through behaviors other than those directly included (which can indicate whether important such behaviors are not being considered). Furthermore, most research of this type, as well as most research estimating health production functions (Eq. 1), does not consider the endogenous (behaviorally chosen) nature of the B’s, which can result in biased estimates of the effects of B.

To obtain unbiased estimates of effects using ordinary least squares regression analysis, all right-hand-side explanatory variables must be exogenous to household decisionmaking—that is, this must not be correlated with unobserved factors that also affect the outcome of interest. But such is not the case for many health behaviors since
they result from household choice and may be influenced by unobserved factors also influencing health status—for example, inherent healthiness or frailty. This has important implications for how we estimate Eq. (1)—that is, for how we estimate the effect of health behaviors on health outcomes.

Grossman (1972b) argued that to obtain statistically consistent estimates of the effect of health inputs (behaviors) on health status, simultaneous-equations methods should be used that enable the researcher to purge the health input variable of the portion of its variation resulting from variation in unobservable factors affecting both the input and the outcome (see also Schultz, 1984). For this purpose, we need one or more *instrumental variables* that account for the variation in the health input but that are independent of the unobservables. For example, the use of prenatal care may be determined both by the mother’s anticipation of pregnancy problems (assumed to be unobserved in this example) and by whether the maternal-child health team visited her village. In measuring the effect of prenatal care on pregnancy outcome, we want to purge the variable measuring use of prenatal care of the variation resulting from the (unobserved) anticipation of pregnancy problems, but to retain the (exogenous) variation caused by variation in the trekking schedule. Community-level data on time and money costs and other related aspects of public programs are useful for appropriately modeling influences on health care utilization and health outcomes because they tend to be independent of the unobservables (that is, they do not influence health directly, but only influence it through their effect on behaviors affecting health).
V. SUMMARY AND IMPLICATIONS FOR POLICY

Although some health interventions (for instance, spraying against malaria) may affect health directly (through a strictly biological mechanism), most require a behavioral response to have an effect. For example, a family must know about oral rehydration salts and choose to use them (correctly) if they are to have their intended effect. In general, health programs and household characteristics do not affect health directly, but do so indirectly through health behaviors (which have also been referred to in the literature as proximate determinants [Mosley and Chen, 1984] or inputs to the production of health [see, for example, Schultz, 1984]).

If health programs are to be effective, planners and practitioners must know what governs families’ decisions to seek care and engage in health-improving behaviors. In other words, they need to understand and accommodate behavioral and sociocultural influences on health. Estimates of the simple effect of a health intervention on health status can indicate whether or not the intervention was effective, but will not elucidate the reasons why it succeeded or failed. A thorough evaluation of a health intervention’s impact should take into account the behavioral responses to the intervention, the biomedical effects of that behavior on the health outcome, other behaviors that could affect that health outcome, mitigating or exacerbating mechanisms, and other possible confounding influences.

The economic model of the household production of health is based on the notions that people value good health, that behavioral choices affect health status, and that these choices are shaped by personal, social, cultural, and policy influences. Research based on this framework can inform health policy by providing information on three dimensions:

1. How behavioral choices affect health status;
2. What determines these choices; and
3. How policymakers can influence these choices.

Understanding all three dimensions of health change is a necessary foundation for developing countries in making the transition from poor to good health.

Separating the health production function (1) from the behavioral relationship showing the influences on behaviors that affect health (2) has important policy and empirical implications. Understanding a behavior’s true biological effect on health (1) is crucial in evaluating the potential efficacy and cost-effectiveness of interventions.
Understanding the determinants of why and how individuals engage in behaviors that affect health (2) is critical in designing policies to increase the likelihood that those individuals will use the interventions and use them correctly.

The availability, cost, and perceived effectiveness of medical care will influence whether individuals seek that care. Policymakers can change such factors by, for example, creating and improving access to health-promoting programs; adjusting the price, location, and quality of health services; increasing the costs of behaviors detrimental to health (for example, smoking); providing information about health-promoting behaviors; and providing "public goods" (for example, malaria control, cleaner water).

Policymakers trying to decide on the most cost-effective ways to improve health need information on which of the influences on health are empirically important and on the relative sizes of their effects. These estimates should show the extent of improvement in health that results from a change in a particular factor (for example, the introduction of a particular policy initiative), holding constant all other related influences on that health outcome.

In allocating scarce resources, policymakers must know how much various behaviors affect health and how policies and programs can influence behavioral choices. The general model presented here—stressing the roles of household behavior, prices, resources, preferences, information, biological mechanisms, and cultural influences—is applicable across the spectrum of socioeconomic development. The actual importance of particular factors will, of course, vary across settings. Since the relationships among these dimensions may vary dramatically across cultures, health-transition research should be conducted country-by-country so that policy prescriptions appropriate to one context are not misapplied to others.
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