PHYSICIAN BEHAVIOUR:

THE KEY TO MODELING HEALTH CARE
SYSTEMS FOR GOVERNMENT PLANNING

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FOREWORD

The aim of the Health Care Systems Modeling Task is to
build a family of models for national health care systems and
to apply them, in collaboration with national research centers,
as an aid to health service planners. This approach envisages
a number of linked submodels dealing with population, disease
prevalence, resource needs, resource supply, resource alloca-
tion, and external systems. Different submodels and combina-
tions of submodels will be appropriate for applications in dif-
ferent health services.

In this paper, Dr. Frans Rutten of the Ministry of Public Health
and Hygiene in the Netherlands, argues that in both centrally
planned and market oriented economies, national and regional
level decision makers must take into account the reactions of
physicians to their policies. The further development of a
theory that describes the behaviour of physicians is put for-
ward as a direction for future research at IIASA.

Recent publications in the IIASA Health Care Task are
listed at the end of this paper.

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ABSTRACT

The purpose of this paper is to indicate a possible direction of future activities at IIASA with respect to modeling the economic mechanisms in health care provision. In Section 1, it is argued that both in centrally planned economies and in market oriented economies, the decision makers at the national and regional level are faced with uncertainty about the reactions to their policies at the level of treatment of the patients. Therefore, modeling behaviour at this decision level is most useful. The main decision maker at this level is the physician. In Section 2, a brief survey of research activities concerned with modeling physician behaviour is presented, and Sections 3 and 4 focus on possible research activities at IIASA.

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F.F.H. Rutten

1. A GENERAL DESCRIPTION OF A HEALTH CARE SYSTEM

Each health care system can be described as consisting of
four markets (see for instance Reinhardt 1975):

- the market for health care
- the market for health manpower
- the market for non-labour inputs
- the market for health manpower training.

Of course, here, the term "market" is extended to the case in
which investments other than money (time, energy) have to be
made, to acquire the goods traded in the market. These markets
take many different forms in different countries, but they share
basic similarities*. In this paper, we will restrict ourselves
to the first market, that of health care, and we will briefly
consider the different alternatives of this market for health
care.

Looking at the research activities in the last decade, one
can say that, of the four markets mentioned above, the market

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* A complete model of a health care system should preferably incor-
porate all four markets.

for health care has received by far the largest attention from
the health economists. Arrow (1963) points out the uncertainty
which characterizes the link between the consumer and the
product "health care". The consumer does not know at what moment
he actually needs care or what product is needed to restore his
good health. Also, because the incidence of illness in the life
of an individual can have a large impact on the individual's
welfare, due to inability to work or to the large costs involved,
there has been a government intervention in all health care
systems. We choose to distinguish health care systems by consi-
dering the extension and the type of government intervention,
although we realize that other criteria, i.e. the way physicians
are paid, might also be quite useful.

The rough distinction we would propose is the following:

- a centrally planned health care system (Eastern
  European countries, Great Britain),
- a public insurance based health care system (most Western
  European countries, and Canada),
- a market oriented health care system (United States,
  Australia, etc.).

As we will point out in this section, the lines between these
three categories cannot be drawn sharply and the problems
faced in the different systems are rather similar. These general
problems concern the efficient allocation of resources given
the bureaucratic and other internal mechanisms in the system, the
imbalance between the growth of professional services on the one
hand and self care and care by volunteers on the other hand, and
the impossibility of reaching the final goal of health care provi-
sion, as suggested by the WHO in its ambitious definition of the
state of health.

When medical technology progresses, there seems to be no
end to investments in health care. In case budgetary limits are
set, which seems to be happening in many countries at the moment,
difficult decisions have to be made with respect to the reallo-
cation of resources to different health care facilities and, thus,
to different groups of individuals. When considering a centrally
planned health care system, one must also be aware that not only

the government sets the priorities in health care, but also numerous bodies representing the different actors in the system often have to be consulted and, therefore, influence central decision making. Added to this, the central decisions might have a global character and might have to be detailed at a regional level. The obvious advantage of this system is the natural way of controlling health care expenditures through using a central budget. But the goals set by programs at the central or regional levels might be frustrated by decision making at the level of the treatment of the patients and the administration of health care institutions (the behaviour of physicians and hospital administrators).

In a public insurance based, health care system problems of controlling health care costs might be even more pressing. Also here, bureaucratic tendencies at the local level might obstruct the efficient allocation of resources. This efficient allocation might be further hampered by profit/income maximizing behaviour of physicians and hospitals, depending on remuneration and financing systems. But now, ways of controlling the health care costs are often lacking, while at the same time, the public insurance system guarantees the reimbursement of costs. For instance, the sector of outpatient care provision in the Netherlands and that of inpatient care provision in West Germany, can be characterized by a serious lack of means to control costs, although, both systems are largely publicly financed. This is certainly connected with the fact that both countries spend a high fraction of GNP on health care provision.

Finally, in a market oriented system, the role of the consumer will be worthwhile considering because in such a system, choices must be made as to which insurance plan to buy and what health services to acquire at given prices. Numerous studies in the United States have concentrated on these issues, but they have somehow neglected the interaction between patient and consulting physician and the special role of the physician in making the decision about the treatment. One cannot say that fully informed and sovereign consumers determine their own requirements and choose to buy surgery as they might buy a new car.

Instead it is useful to consider this special role of the phy-
sician also in market economies. In this type of economy,
means to control health care costs cannot be embedded in large
public finance schemes, as in the formerly described health
care systems. This might be felt as a disadvantage, but on
the other hand, one may learn from experience in countries
with a long public financing tradition and decide to be parti-
cular in introducing or extending a public finance scheme.

The common observations in these short descriptions of
different health care systems are that in each system the
decision makers at the central or regional level are uncertain
about the exact impact of their decisions on the allocation of
resources and that the behaviour of physicians, hospital admi-
nistrators, and consumers might interfere with their plans.
Therefore, what is most needed in all systems is a model des-
cribing this decision behaviour at the local level and providing
the possiblity to predict this behaviour given a proposed
policy measure. Such a model should, therefore, not only give
a description of actual past behaviour, but also should quan-
tify the relationships between instrument variables and the
behaviour of the main actors at the local level. As can be
inferred, for example from the description of the Leyden
health economics project by Rutten (1978), such a model could
develop into an econometric model capable of explaining medical
consumption at different levels of care in the health care sector.
This particular model developed in Leyden, proved already to be
useful for policy making. Some ideas about how to build a general
framework for modeling health care systems, based on the principle
of describing the behaviour of actors at the level of health care
provision, are set out in a contribution to the IIASA June 1979
task force on health care system (Rutten 1979). In the present
paper we will concentrate on physician behaviour as a first
step towards developing such a framework.

2. A FIRST STEP: MODELING PHYSICIAN BEHAVIOUR

As we saw in Section 1, modeling the behaviour of actors
at the provision level of health care is a necessary activity

for modeling health care systems of any nature. The main
actors at this level are physicians, patients, hospital admi-
nistrators, controllers (connected with insurance companies,
professional standard review organizations, governmental insti-
tutions, etc.) and others depending on the particular system.
During the course of an individual passing through the medical
channel, several decisions are made concerning the type of
facility to be used, the kind of treatment to be received,
the time of discharge from an institution, etc. Except for the
first decision to contact the health care system, which is
obviously made by the patient, all these decisions are made in
a situation of consultation, where several actors are involved.
In establishing who are the main actors in the decision process
of choosing which health care facilities should be used, it seems
important to distinguish between four functions:

1. making the decision about medical treatment,
2. receiving the benefits of medical treatment,
3. providing medical treatment,
4. paying for the direct costs of medical treatment.

The way the decision about medical treatment is made depends on
who pursues the other functions mentioned above. In a normal
market situation, the functions 1, 2 and 4 will clearly be pursued
by the consumer, while the physician (or hospital administrator)
supplies medical treatment (function 3). In the health care
sector, however, functions 1 and 3 might be pursued by the same
or by different physicians (in the case of referral), while often
function 4 is exercized by some third party (public or private
insurance).

The division of roles over these functions, already provides
important indications for the variables to be taken into account
when analyzing the process of deciding about medical treatment,
but the picture is not yet complete. Other actors might influence
decision making and the organization and capacity of the system
might set several restrictions to decision making. These influ-
ences on the decision process incorporate instrument variables
that can be used to steer the system and should, therefore, be

taken into account. Below, we will make a brief inventory of approaches that have been used to analyze the decision behaviour at the treatment level.

Some research in Canada has been done to shed more light on the role of the physician in this decision process. A starting point has been the concept of the agency role of the health care provider, who can be considered as a decision maker on the patient's behalf as to what services should be provided and how they should be produced. Unless this agency role is "perfect" i.e. totally selfless providers with no economic dimensions of their own, the provider will also respond to his own economic and professional interests in deciding what level and pattern of utilization to recommend to the patient. Evans and Wolfson (1978) reported on Canadian studies that centralize on the issue of the extent of medical consumption that can be considered as patient generated or as physician induced. Boutin and Bisson (1977) performed a relatively crude analysis by classifying each medical treatment activity as patient generated or physician-induced. They did this by defining the first category as all office visits including those to physicians in private office, outpatient or emergency ward, or physician office in hospital, as well as all home visits, all psychotherapy billings by general practitioners and half of the billings by specialists. All other diagnoses and therapeutic services were included in the physician-induced category. They concluded that 80.7% of the health care costs in 1971, and 92.3% in 1975 were physician-induced. Rivard and Contandripoulos (1977) analyzed the impact of fee schedule changes on physician behaviour and found that relatively more services that were remunerated on the basis of relatively high fees in relation to time, effort, and responsibility factors invested by the physician, were performed in the period 1971 to 1973. Also Wolfson did a number of studies all giving evidence to the idea that a considerable quantity of medical consumption has a physician generated character. These and other studies, although not very convincing from an analytical point of view, lead the authors of this review-study to conclude that future research should be based on the physician discretion

model rather than the traditional neo-classical approach.

This classical approach, estimating demand--and supply--
equations, has indeed been used at several instances with dif-
ferent results. In his well-known review study Feldstein (1974)
argues that many implausible results from estimating demand
equations become plausible when one takes into account the
special role of the physician (agency role). Fuchs and Kramer
(1972), for instance, estimated a demand equation for physicians'
services and found a considerably positive elasticity (0.39) of
physicians' services with respect to physicians' per capita.
As they explained, this points out the demand-creating character
of supply. Feldstein (1974) commented on this by stating that
in this case the coefficients of the estimated relation should
be interpreted as supply-elasticities rather than demand-
elasticities. Indeed, one may conclude that only medical con-
sumption measured as the first contacts of patients with the
medical system can be tackled with traditional consumer demand
theory, while some new theory based on the physician-agent
concept, should be developed for analyzing other medical consump-
tion.

One approach to develop a new theoretical concept for phy-
sician behaviour is to consider the physician as maximizing a
utility function. This approach has been followed by Reinhardt
(1975), Murray (1974) Smallwood et al.(1975) and Zweifel (1979).
The first attempts in this tradition considered a utility func-
tion that included only income and leisure objectives. This,
however, was not consistent with the actual behaviour, because
a physician obviously does not exploit all his discretionary
power (see for instance Rutten 1978, p. 50). One has to include
some form of professional sense of obligation by the physician
measured as the quality of care delivered or the average wel-
fare of the patients in the physician's practice (Murray 1974).
Patient welfare may depend on the medical therapy received and
the patient's rate of after-medical-cost-income. When, of course,
the tradeoff between income, leisure, and quality of work is left
out and the latter two variables are suppressed, one finds one-
self with a simple target income model. This model simply assu-

mes that physician-practice adjustments are made in order to
maintain a fixed income level. Work on both models is still
under development and has not passed the theoretical stage. Al-
though it might be difficult to include many different factors
in these models because of rapidly growing mathematical complex-
ity, this work should be stimulated because it increases the in-
sight into physician behaviour and might provide indications for
the specification of behavioral equations in econometric modeling.

A more practical way of modeling the decision process at the
level of treatment has been adopted by Rutten (1978) and Van der
Gaag (1978). Their econometric study of the Dutch health care
system was based on the pysician-agent concept. They consider
medical consumption, measured by the patient flows between dif-
ferent levels of care (see Figure 1), as the outcome of decisions
of physician-agents at different places in the medical channel
system.

At each level of care, the physicians, in some agency role
decide whether to treat the patients themselves or to refer to
the next level of care. These decisions are influenced by many
factors, which can be divided into the following categories:

   - demand variables: the characteristics and pre-
     ferences of the patients, who contact the physician
     agent,

   - supply variables--the capacity of facilities offer-
     ing alternative means of treatment,

   - physician's preferences variables--variables enter-
     ing the preference function of the physician such
     as income (depending on payment systems), profes-
     sional status, quality of work, etc.,

   - colleague-relation variables--influences of other actors
     providing medical goods or services (cf. advertising of
     pharmaceutical industry, referral patterns, etc.),

   - institutional variables--regulations of the public insur-
     ance system, medical organizations, price setting insti-
     tutions, etc.

Rutten and Van der Gaag have specified and estimated equa-
tions that relate the quantities of different patient flows with
variables taken from the above-mentioned categories, which were

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        ┌─────────────────┐
        │  POPULATION     │
        └─────────────────┘
                 │
                 │        patient flow 1
                 ▼
        ┌─────────────────┐
        │  GENERAL OR     │        LEVEL 1
        │  PRIMARY CARE   │
        └─────────────────┘
                 │
                 │        patient flow 2
                 ▼
        ┌─────────────────┐
        │  OUTPATIENT     │        LEVEL 2
        │  SPECIALIST CARE│
        └─────────────────┘
                 │
                 │        patient flow 3
                 ▼
        ┌─────────────────┐
        │  INPATIENT      │        LEVEL 3
        │  SPECIALIST CARE│
        └─────────────────┘
                 │
                 │        patient flow 4
                 ▼
        ┌─────────────────┐
        │  LONG TERM CARE │        LEVEL 4
        └─────────────────┘
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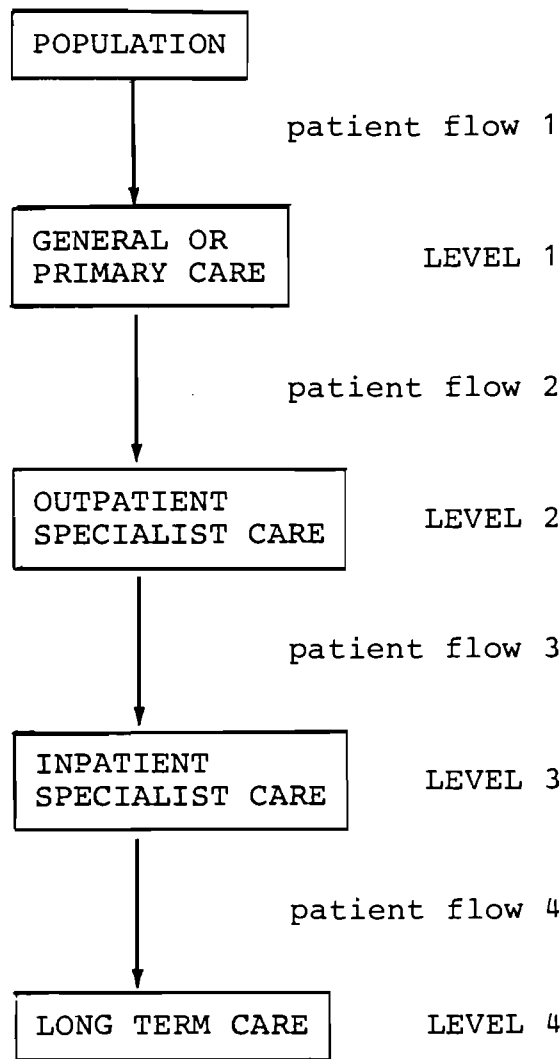
Figure 1. The medical channel system.

supposed to influence physician agent behaviour at the different levels of care in the system. Although some variables could not be incorporated in their model by lack of data, they succeed with this approach in explaining about 55% of regional variation in the patient flow from primary care to outpatient specialist care and about 75% of regional variation in the patient flow towards hospital inpatient care.

Given the quite conclusive evidence, that a traditional demand-supply analysis does not seem suitable to analyze the major part of health care consumption and that one should concentrate on the role of the physician as the key to the health care sector, this last approach could be useful to pursue at IIASA.

3. A CONTRIBUTION TO MODELING PHYSICIAN BEHAVIOUR AT IIASA

Along with playing a coordinating and stimulating role
in this area of health services research, for which some sugges-
tions are given in the next section, IIASA could also make its
own contribution to the development of physician behaviour
models, keeping in mind that manpower at IIASA is limited. A
basis for this contribution could be the concept of the agency
role of the physician and the scheme of variables explaining the
physician behaviour given above. Several activities may develop
from this.

First, it is possible to arrange the results of past research
in such a way that it fits in this general framework. Considering
these five categories of explanatory variables, one can in the
first place, point out numerous studies concerning the factors
influencing the demand for health care. A first set of variables
like age, sex, social class or occupational level, is linked
with the state of health of the individual and his perception of
that state of health. The influences of these factors on medical
consumption, reported in various studies, seem to be rather con-
sistent (Rutten 1978, p. 21). The other set of explanatory vari-
ables is related with the economic preferences of the patient
like income, and insurance rate. Most studies point out positive
income elasticities and a positive effect on consumption in case
of increasing insurance coverage.

The second category of variables, the supply variables, con-
sists of the amount of facilities and the prices of these facili-
ties. By incorporating these variables, the issues concerning
substitution of care or the presence of complementary services,
that were central in many studies, can be tackled. The third
category of preference variables consists of financial and non-
financial incentives to physicians. Results from physician's
utility maximizing models can be used here and inferences from
these studies can be made concerning the specification of the
equations in the framework. Several studies (for instance
Hummell 1970) have drawn attention to the social environment
of the physician and the influence of colleagues and peers on
his behaviour (the fourth category of variables). Finally, the

last category of institutional variables will differ largely
between countries, but few variations will be observed within a
country. This poses a problem with respect to estimating the
influence of this category of variables, to which we will re-
turn later.

A next step in IIASA's research on physician behaviour
modeling could be to invite scientists experience in this area
and ask them to develop and estimate a model based on this frame-
work, using national data. At the moment, a new model is developed
at Leyden University in the Netherlands, based on the ideas set
out above. The first estimation made on 1976 data will take
place in the second half of 1979, so in 1980 more up-to-date
knowledge on physician behaviour modeling in the Netherlands can
be made available to IIASA.

There exists a common problem in attempting to estimate
models of a health care sector on national data, for which
IIASA might be in the unique position to offer a solution. A
policy maker may find a model estimated on national data quite
useless when his actual policy measure is in the area of possible
activities that lie beyond the range of variation of the data
used to estimate the model equation. For instance, in the
Netherlands we are thinking of introducing a scheme of deduc-
tibles in the public health insurance programme. Not having
experienced deductible schemes in the past decades in the Nether-
lands, it is obviously not possible to infer the effect of in-
troducing such a scheme on health care consumption from Dutch
data. In general one could say that the effect of variables in
the fifth category of institutional variables and even of some
variables in the other categories (for example payment systems)
cannot be traced by using only national data, because these
variables are fixed at a certain value throughout a country. For
these variables, however, we may find international variation
and estimation could then be based on a pooled data set from
many countries. If IIASA has at its disposal information on
modeling activities in research centers throughout the world
and a few data sets containing variation in the different va-
riables (i.e. the data set of the National Center for Health

Services Research in Washington concerning the health interview survey reported on by G. Wilensky at the June task force, and the data set of the Leyden Health Economics project), an attempt could be made to quantify the impact of organizational structures or other interesting aspects of health care provision on health care consumption. This goal may seem rather ambitious and probably it is, but moving towards this goal might be a very rewarding activity in terms of receiving information on modeling and gaining experience with it.

As already indicated in Section 2, one still lacks a commonly accepted theory of physician behaviour, which can be tested on real data. Research in this area could be of benefit if a coordinated attempt was made to develop the theory of physician behaviour to a stage where practical use could be made of it in specifying equations in larger econometric models. IIASA might consider inviting an expert in this area to develop this theory.

4. COORDINATING AND STIMULATING HEALTH CARE RESEARCH

Because manpower at IIASA is limited, the Health Care Task could probably benefit by orienting itself more towards research carried out in other research centers in the world. One of the options for stimulating and coordinating research by IIASA is to organize a series of conferences or workshops on very specific subjects, either relating to urgent policy problems or concerning certain difficulties or lacunae in research. Physician behaviour modeling, for example, would be a very suitable subject to start concentrating on from both a policy and a research point of view.

The subject of such a workshop should be carefully defined and should preferably include both theoretical and empirical issues. A workshop on physician behaviour modeling could, for instance, deal with contributions in the utility maximizing or target income approach and further elaboration of the concept of the agency role of the physician, while at the same time reviewing current empirical work. Discussion at workshops should focus on items like:

- the usefulness of theoretical models for empirical research,

- the testing of models on real data,
- the usefulness for decision making in both planned and market economies.

Next to organizing workshops, other ways of establishing IIASA's role as a clearing house for information on health care modeling should be advanced to increase the interest of NMO countries in IIASA's health care modeling task group.

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