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Financial Initiatives, Competition and Providers' Behavior in the Health Care Market

The physician's behavior and equity under a fundholding contract

Jacob Glazer [a,b,*], Amir Shmueli [b,c]

[a] *Tel Aviv University, University Campus, P.O. Box 39010, Ramat Aviv, Tel Aviv 69978, Israel*
[b] *Gertner Institute for Epidemiology and Health Policy Research*
[c] *Hebrew University, Jerusalem, Israel*

Abstract

We study the physician's allocation of a fixed budget across patients arriving sequentially at his office. It is shown that, at any point in time, the resources allocated to the present patient will depend on the amount of resources already expended on previous patients and on the physician's attitude towards risk. Consequently, we prove that under a fundholding contract, certain basic equity criteria are violated.

Keywords: Fundholding; Contracts; Equity

JEL classification: 110, D63

1. Introduction

The purpose of this paper is to study the physician's behavior under a fundholding contract and to demonstrate that it may result in violation of certain very basic equity criteria.

Consider a physician operating under a fixed annual budget, and assume that his objective is simply to maximize the (expected) sum of treatment benefits of his prospective patients. If the physician knew for certain the initial health status of the patients who will be appearing at his door (including repeat visits of the same patients), he could allocate his budget in advance, according to his objective (see

* Corresponding author.

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Culyer and Wagstaff (1993) and Lerner and Claxton (1994) for example). In reality, however, the patients arrive sequentially at the physician's office, including repeat-visits patients. Since the physician is not aware of the initial health status of future patients, he must prescribe medical care to the present patient knowing only that patient's initial health and the budget left at his disposal. Notice that even when the capitation arrangement specifies an age-related yearly mean cost, for example, this information is of little value in any given contact, since the physician cannot know at present the patient's future needs within the year. The fundholding rates are specified for *individuals* but the physician's decision must be made by *visits*.

We show that the physician's decision on how much of his resources to allocate to an individual patient will, in general, depend not only on that patient's needs but also on the budget left at the physician's disposal and on the distribution of prospective patients. More specifically, our first result is that two patients with equal needs may get unequal treatment from the same physician, depending on the amount of resources the physician has already spent on his previous patients.

Our second result is that the physician's 'risk attitude' (formalized precisely in the next section) will affect his decision. We show that physicians can be described as either 'cautious' or 'careless'. The 'cautious' physicians will 'save' on patients who come early in the year, in order to reserve budget for possible future patients with more serious ailments. The 'careless' physician will 'waste' resources on his earlier patients, downplaying the possibility that sicker patients will arrive later on in the year.

We conclude that neither horizontal nor vertical equity are satisfied under the fundholding system: depending on the date of their appearance during the budget year, two patients with identical needs, may get unequal treatment and a sick patient may receive less intensive treatment than a healthier one.

The behavior of health care providers operating under a fixed budget has received little attention in the health economics literature. An exception is the work by Lerner and Claxton (1994). These authors provide a theoretical model, but do not address the case where patients with ex-ante uncertain health problems arrive sequentially. For some empirical evidence on provider's behavior under the fundholding system, see Crump et al. (1991).

The issue of equity and equality in health care has been widely studied by health economists, philosophers and many others. A recent comprehensive review and interesting analysis of this issue is to be found in Culyer and Wagstaff (1993).

2. The model

Two patients denoted $i = 1, 2$ arrive, one after the other, at the physician's office. Let s_i denote patient i's initial health status. Let m_i denote the amount of resources allocated by the physician to patient i's treatment. Let h_i denote patient i's health status following treatment.

We assume: $h_i = h(m_i, s_i)$; $h_m > 0$, $h_s > 0$, $h_{mm} \leq 0$, $h_{ss} \leq 0$ and $h_{ms} \leq 0$, where subscripts denote partial derivatives.

Let u_i denote the physician's utility from patient i's health status following treatment. We assume: $u_i = u_i(h_i)$; $u' > 0$ and $u'' < 0$.

Define: $U(m_i, s_i) \equiv u(h(m_i, s_i))$. U is the physician's utility from patient i's initial health, s_i, and the treatment the patient receives, m_i. From now on we will carry out our analysis using the utility function U. Clearly, $U_m > 0$, $U_{mm} < 0$, $U_s > 0$, $U_{ss} < 0$ and $U_{ms} < 0$.

Assume that the physician knows that the two patients will arrive at his office in sequence. Only when a patient arrives does the physician learn the patient's initial health status and decide on m_i. Prior to his arrival, each patient's initial health status is a random variable denoted by S_i. We assume that S_1 and S_2 are independent and identically distributed with mean μ.

Under the fundholding system the physician receives a fixed budget of size B that he can spend on the two patients. That is, the physician has to allocate m_1 and m_2 so that

$$m_1 + m_2 \leq B. \tag{1}$$

Our purpose is to study whether the fundholding system satisfies the following equity criteria:

Ex post horizontal equity (EPHE). The system satisfies EPHE if $m_1 = m_2$ whenever $s_1 = s_2$.

Ex post vertical equity (EPVE). The system satisfies EPVE if $m_i > m_j$ whenever $s_i < s_j$, for $i = 1, 2$, $j = 1, 2$, and $i \# j$.

The physician's objective is to maximize the sum of his (expected) utilities from treating the two patients. Therefore, when patient 1 arrives, the physician chooses m_1 to

$$\text{Max } U(m_1, s_1) + \mathrm{E}[U(m_2, s_2)] \quad \text{s.t.} \quad (1)$$

where the expected value is taken over s_2.

The solution to this problem depends on s_1 and will be denoted by $m_1(s_1)$ and $m_2(s_1)$, where:

$$U_m(m_1(s_1), s_1) = \mathrm{E}[U_m(m_2(s_1), s_2)] \tag{2}$$

and

$$m_2(s_1) = B - m_1(s_1). \tag{3}$$

By our assumptions about the function U and from (2) and (3), it is easy to see that $m_1'(s_1) < 0$ and $m_2'(s_1) > 0$. That is, the worse the initial health level of the first patient, the greater the amount of resources allocated to him by the physician, and the less the amount of resources allocated to patient 2. It is important to note that patient 2's treatment level depends only on patient 1's initial health status s_1.

This result indicates a problematic characteristic of the fundholding system: The patient's treatment will depend on the health problems of the previous patients visiting the physician. The system is therefore characterized by a relatively high volatility in that patients with identical health problems may receive different levels of treatment, depending on the health problems of the patients who were treated by the physician before them.

However, it is not only the previous patients who affect the level of the present patient's treatment; future patients also have their inpact. Since the inital health status of future patients is currently unknown, the physician's attitude towards risk may affect his decision to a greater or lesser degree.

Definition. The physician is *cautious* if $m_1(\mu) < B/2$, and the physician is *careless* if $m_1(\mu) > B/2$.

By our definition, a cautious physician, when seeing a patient with average initial health, early in the year, will allocate to him less than the per capita budget, in order to reserve more resources for patients with more serious problems, who *may* come later on in the year. The careless physician, on the other hand, will allocate more than the per capita budget to average patients who come early in the year.

The following proposition shows the relationship between the physician's 'risk attitude' and his utility function, U:.

Proposition 1. The physician is cautious if $U_{mss} > 0$ *and careless if* $U_{mss} < 0$.

Proof. The proof follows directly from the fact that

$$U_m(B/2, \mu) < (>) \mathrm{E}[U_m(B/2, s_2)] \quad \text{if} \quad U_{mss} > (<) 0.$$

We can now present the main result of the paper:

Proposition 2. Neither EPHE nor EPVE is satisfied under the fundholding system.

Proof. The proof follows directly from Proposition 1 above. Suppose that $U_{mss} > 0$ and $s_1 = \mu$, then $m_1 < B/2$ and $m_2 > B/2$. If $s_2 = \mu$ too, then EPHE is not satisfied and if $s_2 > \mu$, then EPVE is not satisfied.

3. Discussion

We have shown that a very simple fundholding contract under which a physician receives a fixed budget which he can spend on patients coming from a

prespecified population, may result in violation of some very basic equity criteria. The question that arises, therefore, is whether one can construct a more sophisticated fundholding contract that will minimize, if not completely eliminate, the equity problems (without, of course, introducing new efficiency problems). Our future research will explore this issue in two directions.

First, suppose that the contract severely punishes the physician if he spends more than his budget but rewards him in some way if he spends less than his budget. In such a case, it is possible that the physician will spend his entire budget if the initial health status of the majority of his patients is below average, but will spend less than his entire budget if the majority is above average. Since the physician does not necessarily spend his entire budget, both horizontal and vertical equity may be satisfied.

A second interesting question concerns the optimal length of the budget period. From our analysis it is clear that the length of the budget period may affect the amount of resources the physician allocates to each patient. For example, the first patient may receive different treatment (i.e., allocation of resources) depending on whether the physician's budget period is a full year or half a year. If the physician is 'cautious' he may allocate less resources to the first patient in the case he has a yearly budget than in the case the budget period is only half a year.

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