PHYSICIAN INFORMATION IN A DYNAMIC SETTING

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CONTENTS

1 The Patient 1
1.1 Static setting under full information 1
1.2 Dynamic analysis under full information 2
2 The insurance 2
3 The physician 2
3.1 Static analyzes 2

1 THE PATIENT

The patient has a utility function

$$\begin{aligned} U &= u(h; \pi(d \mid s)) \\ h &= h(t, d) \end{aligned}$$

where h is health, t is treatment, d is a random disease variable which is unobserved, but has a known distribution $\pi(d)$, s is a signal about d and it is assumed that $\pi(s \mid d)$ is known to the physician, but not to the patient, such that the physician can infer $\pi(d \mid s)$; the probability distribution of d given s.

It is assumed that for each $s' > s$ $\pi(d \mid s')$ first order stochastically dominates $\pi(d \mid s)$

Definition 1. $\pi(d \mid s')$ first order stochastically dominates $\pi(d \mid s)$ if and only if

$$\pi(d \mid s') \leq \pi(d \mid s)$$

and for every non-decreasing function $u : \mathbb{R} \to \mathbb{R}$ it holds that

$$Eu(h; \pi(d \mid s')) \geq Eu(h; \pi(d \mid s)) \tag{1}$$

1.1 *Static setting under full information*

To derive the optimal behavior of the patient, I start by analyzing the patient optimal treatment decision d, where the patient has the same information as the physician. for simplicity, I assume now that the only relevant costs are s produced at a cost

$$c = c(s)$$

where $c' > 0$ and $c'' > 0$. Given this, a rational agent would acquire a volume of s given by

$$Eu(h - c(s); \pi(d \mid s)) = Eu(h)\pi(d)$$

That is, the expected gain in utility from a decrease in uncertainty, must equal the loss in utility from the cost of obtaining signals s.

1.2 *Dynamic analysis under full information*

Now given that in each period the patient observes signal s and that over time, this information is aggregated into s_i, such that

$$s_i = s + s_{i-1} + \cdots s_1$$

where s indicates the amount of signals acquired in the present period, Then I can write the patients utility as

$$Eu(h_i - c_i(s); \pi(d_i \mid s_i))$$

Then clearly as $\pi(d \mid s_i) \leq \pi(d \mid s_{i-1})$ the amount of information optimally acquired acquired at time i is less that the amount of information optimally acquired at time $i-1$.

Proof. Assume that the same amount for information is acquired in each period, such that $\bar{c}(s) = c_i(s) = c_{i-1}(s)$. Then given definition 1 it must be true that

$$Eu(h_i - \bar{c}(s); \pi(d_i \mid s_i)) \geq Eu(h_{i-1} - \bar{c}(s); \pi(d_{i-1} \mid s_{i-1})) \tag{2}$$

However if (2) holds, then it must also be true that for

$$Eu(h_i - c_i(s); \pi(d_i \mid s_i)) = Eu(h_{i-1} - c_{i-1}(s); \pi(d_{i-1} \mid s_{i-1}))$$

$c_i(s) \leq c_{i-1}(s) \Leftrightarrow s_i \geq s_{i-1}$ or that s at time i is less than s at time $i-1$. □

2 THE INSURANCE

It is assumed that the cost of providing treatment t, C_t can be perfectly observed by the insurance, such that the price $P_t = C_t$. However, the cost of acquiring signals s (e.i. diagnosing the patient) $C(s)$ is unobserved. Therefore the payment for s is based on the average cost of diagnosing t over all time periods

$$\delta^* = \int_i \int_s C(s) d\pi(s \mid d) di$$

3 THE PHYSICIAN

The physician has a net income of

$$y(t,s) = P_t + \delta - C_t - C(s) + \lambda Eu$$

where P_t is the revenue generated for treatment t, δ is the per–patient, per–period fee and $C_t)$ is the cost of treatment t and $C(s)$ is the cost signals s. It is assumed that $C(s)$ is convex in s ($C'_s > 0, C''_s > 0$). This captures the idea that information acquisition is more costly, the more information is needed, due to fact that I assume that the physician acquires the least costly information first. The last term is the weight the physician puts on patient utility.

3.1 *Static analyzes*

Like the patient I assume that the physician knows $\pi(d)$, $\pi(s \mid d)$ and $\pi(s)$, but that d is unobserved.

As it is assumed that the insurance does not know $C(s)$, but can only infer the average cost of $C(s)$, δ^*. However, after δ^* is determined, each physician my choose a different level of s, depending on his level of altruism λ.

However, as the physician may acquire more or less signals than the average, the physician realized payment is

$$y(s,t) = \delta^* - C(s) + \lambda Eu, \text{ as } P_t = C_t$$

Assuming that the physician will only treat the patient if he makes a profit, I define the physicians participation constraint by

$$\delta^* + \lambda Eu \geq C(s)$$

As the only the patients expected utility and the physicians cost change with s, we must have that

$$\frac{\partial}{\partial s}(\delta^* - C(s)) = \lambda \frac{\partial Eu}{\partial s} \quad \text{and} \tag{3}$$

$$\delta^* + \lambda Eu \geq C(s) \tag{4}$$

Given (4), we know that no physician will ever acquire more signals than

$$\delta^* + \lambda Eu = C(s)$$

Solving for λ, I find that

$$\lambda = \frac{C(s) - \delta^*}{Eu}$$

Substituting into (3) I get

$$\frac{1}{Eu}\frac{\partial Eu}{\partial s} = -\frac{1}{(\delta^* - C(s))}\frac{\partial}{\partial s}(\delta^* - C(s)) \tag{5}$$

It is clear from (5) that the no physician will provide signals above the point where the semi elastic change in expected utility is equal to the loss in profit.

Her vil jeg gerne vise at lægen at lægen i visse tilfælde vil underbhandle, dat δ^*er baseret på gennemsnittet af omkostningerne og ikke de faktiske omkostninger. Så kun persone på venste side af fordelingen vil få optimal behandling. Har du nogen gode ideer?
Her ville jeg så gå videre til et dynamisk setting og vise at hvis patienten ser lægen mange gange, så vil alle få den korrekte behandling og lægen ville blive betalt mere en højest nødvendigt. Samtidigt er omkostningerne ved at skifte højere for patienten, da patientens omkostninger også falder med tiden. Så i det lange løb bliver de sammen. Men det hele kunne være gjort billigere.
En extension kunne være at lægen også havde en eller anden kvalitetsparamter. Så fordi det bliver dyrer for patienten at skifte læge, så kan lægen sænke kvaliteten over tid, eller givet at lægen har en eller anden grad a alturisme øge kvaliteten fordu de bliver billigere at få signaler.