Doctor-patient relationship: a game theoretical approach to explain non-adherence to recommendations. *

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Abstract

Economic models that intent to understand the doctor-patient relationship and explain the patient's behaviour have incorporated the notion of anticipatory beliefs –such as anxiety about the future- into the patient's utility function. These models assume that the doctor is entirely empathetic to the patient and shares the same utility function with him. The aim of the present paper is to extend previous models of doctor-patient interaction and examine how the actions of the two parts change when the notion of doctor's effort enters their utility functions. I assume that the doctor has organizational constraints that put restrictions in the time he can spend with the patient. The model examines how the introduction of the concept of effort may explain why patients fail to adhere to medical recommendations.

1. Introduction

Economic models that describe doctor-patient interaction and patient's behaviour have incorporated the notion of beliefs into the patient's utility function and try to explain how these beliefs may lead to suboptimal behaviours such as avoiding going to the doctor to seek information (Köszegi, 2003).

These models are based on the Psychological Expected Utility theory (henceforth PEU theory) introduced by Caplin and Leahy (henceforth CL) (Caplin and Leahy, 2001). The theory is an extension of expected utility theory to situations in which agents experience feelings of anticipation regarding future states. When applied to health behaviour the PEU theory allows for the patient's utility function depending not only on physical outcomes but also on *beliefs* about future physical outcomes. The PEU seems compatible with a number of psychological models that examine the extent to which *health beliefs* can predict health behaviours, including the Health Belief Model, the Theory of Reasoned Action and the Theory of Planned Behaviour. All the previous models have been used extensively to examine non-adherence to medical recommendations (Budd et al., 1996, Hounsa et al., 1993).

Derived from the PEU theory Köszegi presented a decision-making model for the patient when anxiety enters his utility function (Köszegi, 2003). He demonstrates that anxiety can lead the patient to avoid doctor's visits or other easily available information about his health status. Köszegi has also proposed a model describing the doctor-patient relationship when the doctor makes choices of actions taking into consideration the patient's emotions (Köszegi, 2004). The model identifies a

number of complications in the doctor-patient interaction that are attributed to anxiety, such as the paradox of the emotional patients getting less useful information. Caplin and Leahy have also applied the PEU theory in a model describing doctor-patient interaction but in a way different than the one presented in Köszegi's paper. They explore the optimal procedure for supplying information to a patient who experiences anticipatory emotions regarding a future health status, given that the patient has sent a signal regarding her emotional status (Caplin and Leahy, 2004).

However, all the above attempts to model the doctor-patient relationship are based on the assumption that the doctor is entirely empathetic to the patient and he maximises the patient's utility function as if it is his.

Evidence from the medical literature demonstrates contradictory results. The doctor-patient relationship is often characterised by antagonism and conflicts. Both parts have different expectations and different agendas that they bring to the consultations which may be in conflict leading to sub-optimal results such as non-adherence to medical recommendations (Britten et al., 2000). The consultation however is influenced not only by the specific characteristics of the doctor and the patient but also by the context and the setting where the consultation occurs, such as the time the doctor spends with the patient (Weinmann, 1997).

Time has been a key topic of research in the doctor-patient interaction. Longer consultations do not necessary lead to better outcomes but clearly indicate that more information is transferred to the patient. Also and most importantly, when doctors spend more time with the patient they are more likely to discuss psycho-social issues, i.e. deal with their beliefs (Brown, 2004). Patients' beliefs have been shown to be a strong determinant of non-adherence to medical advice, a problem of great magnitude as it decreases health outcomes and increases future health costs. Therefore, the doctor by passing to the patient the right information can change patient's beliefs and consequently can make the patient adhere to recommendations.

Two aspects of the doctor-patient relationship are thus important at this point. First, information about his health affects the patient's emotions. This concept had not received adequate attention in economics until recently when Caplin and Leahy (2003) introduced it in their model of doctor-patient relationship. Second, organisational constraints may restrict doctors from spending time with the patient and this may well have complications on the doctor-patient interaction. This aspect has attracted less attention in economic models as they mainly introduce into the physician's utility

function arguments related to either the doctor but they do not explain how this affects the doctor-patient interaction.

The aim of the present paper is to extend previous economic models of doctor-patient interaction and examine how the actions of the two parts change when the notion of time is incorporated in the model, as a variable that proxies the effort of the doctor in meeting the beliefs of the patient that will lead to follow the medical treatment. Also, and most importantly, the model will try to examine whether the introduction of the concept of time may explain why consultations do not reach the optimal outcomes and lead patients to fail to adhere to medical recommendations.

I start with some motivating facts from the medical literature on doctor-patient relationship and present the factors that have been shown to influence the consultation with a particular focus on the notion of time. I then build on previous economic models to generate a new model intending to explain the doctor-patient interaction by introducing time as a new variable. I later discuss how the model can provide useful insight to medical providers and policy makers to direct patients to behave optimally and follow recommendations. Limitations as well as directions for future research are presented after the discussion section. Finally, the last part summarizes and concludes.

2. Motivating facts

The doctor-patient relationship lies at the heart of medical practice. The flow of information exchanged during the consultation is very critical in the formulation of diagnosis and in the organisation of treatment. Thus effective communication is necessary to ensure not only that the doctor understands the patients' problems and concerns but also that relevant information on diagnosis and treatment is accurately transferred to the patient such that the patient benefits from the consultation.

A lot of research interest has focused on the effect that the doctor-patient relationship has on the patient's decision to adhere to medical advice. Adherence (or compliance) is defined as "the extent to which a person's behaviour (in terms of taking medication, following a diet, modifying habits or attending clinics) coincides with medical or health advice" (Haynes et al., 1979). Patient's non-adherence is considered an issue of significant magnitude as it leads to reduced health outcomes, higher

risk of complications (Psaty et al., 1990) and increased health care costs due to relapses and re-hospitalization (Liebl et al., 2002) (2002).

Traditionally, non-adherence has been approached as a patient-driven problem. However, this misconception has been overcome and there is an increasing interest from researchers to conduct studies on the effects of the doctor-patient relationship on the patient's decision to adhere or not. (Mullen, 1997) (Royal Pharmaceutical Society of Great Britain, 1997). Evidence has shown that good physician-patient communication is a predictor of better medication adherence in the treatment of long-term conditions including depression (Bultman and Svarstad, 2000), diabetes (Ciechanowski et al., 2001), AIDS (Schneider et al., 2004), epilepsy (Buck et al., 1997), hypertension (Kjellgren et al., 1998), and Hormone Replacement Therapy (Bond and Bywaters, 1999). In primary care, doctor-patient communication problems were further confirmed to lead to poor outcomes in non-adherence both in qualitative (Britten et al., 2000) and quantitative studies (Jenkins et al., 2003).

Therefore, emphasis has been put in understanding what affects the doctor-patient relationship and how this may lead to non-adherence. Input factors which influence the consultation include not only aspects of the doctor and the patient (i.e. the attitudes, beliefs, expectations which patient and doctor bring to the consultation) but also the context and setting in which the consultation occurs (i.e. the length of the appointment) (Weinmann, 1997).

Following the above, two aspects of the doctor-patient relationship that affect non-adherence are important at this point and are discuss below. First, information regarding patient's health affects emotions. And second, time constraints during the consultation restrict the doctor from providing always the optimal information.

Information affects patient's emotions

There is consistent evidence that information regarding their health affects patients' emotions and that patients vary in their preferences regarding information. The prominent work by Miller and Mangan distinguished between 'monitors' and 'blunters'(Miller and Mangan, 1983). The former group of patients prefers to receive a lot of information regarding their state and treatment while the latter would prefer to receive relatively limited information. Patients also vary in their expectations from the consultation. Some may be seeking attention on the medical part of their treatment while some others visit the doctor to seek for treatment of psychological aspects. All these differences between patient characteristics are important because when not met they may lead to lower satisfaction with consultation and a potential to non-adherence to medical advice.

Time constraints affect doctors decisions

On the other hand, the time that the doctor spends with the patient during the consultation has also been an important aspect of the consultation and has been shown to affect the doctor-patient interaction. There is conflicting literature on how much time is 'enough time' for a consultation. Some studies show that more time does not necessarily lead to better outcomes while other researchers suggest that optimal patient-provider communication requires longer consultations (Brown, 2004). However, evidence is more clear regarding some factors that determine the length of the consultation. It seems that consultations in which psychosocial problem were considered important by the doctor and the patient last longer than consultations about biomedical problems only (Deveugele et al., 2002).

What is more, doctors often face time constraints imposed by the regulations of the health care systems in which they practice and argue that this put pressure during consultation. They must see as many patients as possible per day, which can be interpreted as minimizing the time he spends with every patient. Therefore, they often may fail to listen to patients and explore their views on their disease and medication.

3. Model

The players

The doctor (player 1) is an informed individual who makes the initial diagnosis and reveals information that may affect the decision of the patient (player 2) who moves later. At this stage I accept that the doctor observes the patient's health status in a way that cannot be wrong, i.e. the model does not consider the case of medical errors or ambiguous diagnosis.[1] Therefore, player 1 holds perfect information regarding player's 2 health status.

The doctor has an incentive to manipulate the information he passes to the patient, in order to persuade the patient to adhere to his recommendations. He therefore needs to decide the level of effort in the consultation, that is, how much information to send, as this information affects patient's emotions and the emotions will consequently influence the patient's action. I accept –in a way that is crucial for the model and that distinguishes it from previous doctor-patient models- that dealing

[1] This assumption is commonly accepted in the literature of non-adherence as well.

with emotions requires extra physical and mental activity from the doctor's side. Given that the effort may be a rather abstract concept that is hard to measure I introduce as a simplifying assumption that effort is measured by time. Hereafter, effort and time will be used interchangeably. It is therefore assumed that dealing with emotions by passing adequate information requires more time from the doctor's side. *In other words, more information is equivalent to more time.*

More information = = More time

Having accepted the above assumption, the doctor needs to think strategically on how much time to spend with the patient given the organisational constraints that bound his consultation time. To illustrate this better, let us consider the case of a busy hospital as an example. The doctor needs to see as many patients as possible. Having to deal not only with the patient's health status but also with the patient's emotional state will require a level of effort. This is a costly activity that the doctor would prefer to minimize.

That the doctor has organisational constraints putting pressure on him does not mean that he would always minimise the time he spends with the patient. He will consider the case of spending more time and dealing with patient's beliefs if he discounts the benefits of present effort that will avoid future consultations resulting from relapses due to non-adherence to recommendations. This will save him time on a long-term basis. However, if he believes that he is dealing with a difficult patient he may consider pointless to spend time with this particular patient, and may decide to spend more time with the next patient.

Let us now consider the patient. A key feature of the game is that the choice of the first player (doctor) affects the follower not only directly through payoffs, but also –and most importantly for the model- by affecting the follower's assessment of the likelihood of different states. In our model this latter statement means that the doctor can change the way the patient perceives his health in the future by changing his emotions. Therefore, beliefs about the future health turn out to play an important role in describing equilibrium.

The patient will interpret the action taken by the doctor as a signal regarding his status. I use the terms 'blunters' (B) and 'monitors' (M) based on the work by Miller and Mangan (Miller and Mangan, 1983) to categorise patients according to their preferences regarding information. The flow from the doctor to the patient of high levels of information lowers the anxiety level regarding future health of monitors while it raises the anxiety levels of 'blunters'. I accept that a 'monitor' will

receive doctor's effort to spend more time explaining more things as a good sign. On the contrary, a 'blunter' will receive the same effort from the doctor's side as a bad sign because this will increase his anxiety regarding his health status.

Utilities

I begin by defining patient's utility function building on the model proposed by Köszesgi (Köszegi, 2003). In his model patient's utility function is defined not over physical outcomes but over *beliefs* about future physical outcomes. Given that there are two periods, 1 and 2, the model assumes that the patient's utility is ultimately derived from health outcomes in period 2. Health outcomes in period 2 depend on health state in period 1 s and the action t taken by the patient. Let s (standing for "symptoms") be defined in the interval (A, B) with probability distribution function $f(s)$ and cumulative distribution function $F(s)$. The action t can mean both a recommendation by the doctor, such as taking a specific medication, changing lifestyle or an action decided by the patient, such as changing lifestyle, doing nothing and so on. The action t can take any value in the compact set $T \subset R$. The patient's level of health is then $s - l(s,t)$, with $l(s,t) \geq 0$ for all s, t, l continuous, and $\min_{t \in T} l(s,t) = 0$. Koszegi interprets $s - l(s,t)$ in the following way: depending on the initial diagnosis s there is some maximum level of health the patient can achieve if the appropriate action is taken. If the treatment is not appropriate for the symptoms, the patient will get worse off and this is captured by the loss function $l(s,t)$.

The analysis focuses on the behaviour in period 1 therefore identifies a way of incorporating future health in the first period, by assuming that the patient's first-period utility derives from her anticipation of health in the second period. Of course, this anticipation depends only on what she knows in period 1 about her status in period 2. The utility in the first period is a von-Neumann-Morgenstern utility function of the following form:

$$u(E[s - l(s,t) \mid \text{patient's information}])$$

Koszegi shows that u is increasing and that the shape of it determines the patient's preferences for information. If u is concave, the patient is information-averse (or as it is defined in this model, a 'blunter'). If u is convex, the patient is information-loving (or a 'monitor') and if u is linear then he is information-neutral.

The patient's decision-making problem varies from the one presented by Koszegi in a way that is important for our model. In period 1 the patient receives information from the doctor and decides whether to *accept* the information regarding s or to choose any of the other of the set of treatment available to the patient (which is independent of whether he learns s). For example, a patient diagnosed with hypertension and prescribed medication by the doctor, may choose to change his diet, take alternative medication or no take any action at all.

Note that we closely follow Koszegis notation mainly for two reasons: firstly, because the present model is a variant of his approach and secondly in order to make the model easily comparable to his model. The action t^* denotes the optimal choice when the patient does not follow s: $t^* = \arg\min_t E[l(s,t)]$ and t^* exists because l is continuous and T is compact. Therefore, if the patient chooses not to follow s her expected utility is $u(E[s - l(s,t^*)])$. However if he decides to follow s then he chooses $t = s$, giving her an expected utility $E[u(s)]$. Therefore, the patient will decide not to follow doctor's recommendation if:

$$u(E[s - l(s,t^*)]) > E[u(s)]$$

The above condition can be re-written as:

$$u(E[s]) - E[u(s)] \phi\ u(E[s]) - u(E[s - l(s,t^*)]) \qquad (2)$$

The above equation summarizes the trade off facing the patient. If he decides to take s this affects his knowledge about the future, and depending on her information preferences, it will in general change her utility from anticipation (left-hand side of the inequality). On the other hand, accepting s increases his health in the second period and in anticipation of the increased health also makes him feel better in the first period (right-hand side of the inequality). The right-hand side of eq. (1) is always non-negative. Therefore, if the left-hand side is negative or zero, the patient will accept s. The left-hand side is negative if the patient is information-loving (u is convex) and zero if he is information-neutral (u is linear). However, if he is information-averse (u is concave) he will prefer not to accept s. [2]

In order to define doctor's utility function I will accept two prepositions. First, the doctor cares for the patient, therefore he wants to maximize the patient's utility. Second, he need to put some effort to transfer information and this effort is negatively related to utility. One important characteristic is that the doctor will consider not only the effort he will put in this period, denoted here as e_1, but

[2] Note that t does not represent time but the patient's action. I include e as the cost derived from the effort and also to distinguish it from the action t.

also the effort e_2 that he needs to put if the patient does not adhere and as a result comes back to the doctor in the second period due to s relapse. This is a reasonable assumption because it allows to penalise the doctor if his action does not lead to the desirable outcome. Note that both e_1 and e_2 are non negative.

Therefore, if the doctor does not put effort in the consultation and the patient adheres, the doctor's utility will be $E[u(s)]$, however if the patient does not adhere then his utility will be $u(E[s-l(t^*,s)])-e_2$ as he will need to spend additional effort when the patient comes back.

If the doctor puts effort in the consultation and the patient adheres his utility will be $u(E[s-l(t^*,s)])-e_1$, while if the patient does not adhere then his utility is further reduced to $u(E[s-l(t^*,s)])-e_1-e_2$.

The game

Figure 1 summarises the game. The doctor (D) moves first and decides whether to put effort in transferring more information to the patient (T) or not (NT). I accept here that when the doctor decides to spend time he will spend the optimal time. As optimal time it is understood the optimal length of consultation that is though to lead to adherence and this is exogenously determined in the model.

Nature (N) makes the next move by deciding on the type of the patient. He can be a 'monitor' (M), that is information-loving or a 'blunter' (B), that is information-averse, depending on information preferences. At this stage I will assume that the probability of being either type is the same. Therefore I will assign a probability of 0.5 for the patient being a 'monitor' and 0.5 of being a 'blunter'. It is then the patient (P) who, having observed how much time the doctor has spent with him interprets it as a signal regarding his health status and decides whether to adhere (A) or nor (NA).

The payoffs shown in the tree of Figure 1 are for the doctor and patient respectively.

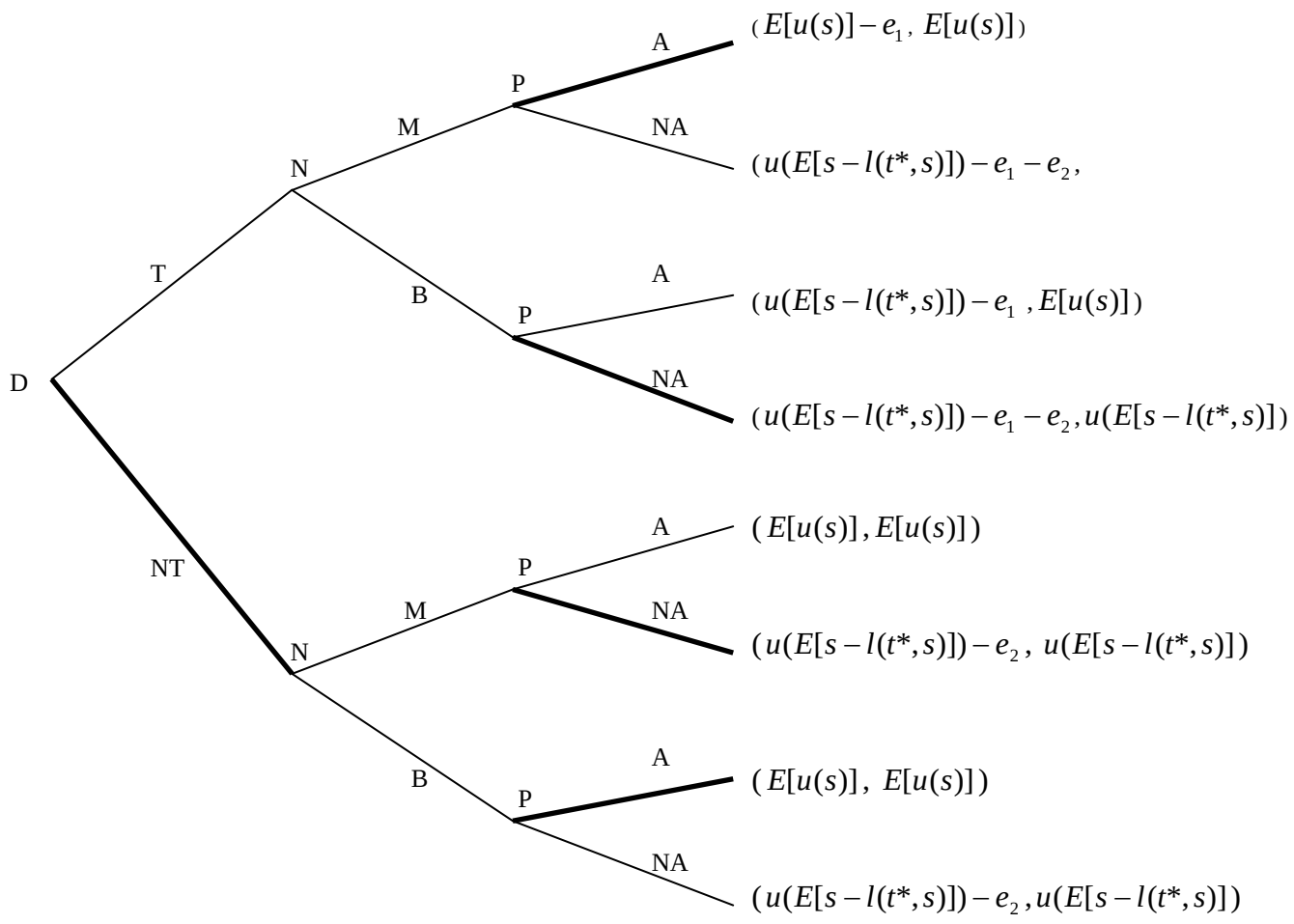

Figure 1. The doctor-patient game

The solution to the game

We will start solving the game backwards beginning with the decisions of the patient who moves second and therefore has already observed the action of the doctor. If the doctor decides to spend time with the patient (T) and give him more information regarding his state, then if the patient is a 'monitor', as proven by Koszegi and shown above he will decide to accept s and therefore adheres (A).

However, if the doctor spends time (T) but the patient is a 'blunter' he will prefer to take another action than the one suggested by the doctor, because as shown by Koszegi's more information leads this type of patient not to learn s. In this case the patient will non-adhere (NA).

Now, if the doctor does not spend time with the patient (NT), i.e. he does not give him all the information regarding his state, then if the patient is a 'monitor' he will prefer to take action t^* and

therefore non-adhere (NA). [3] Finally, if the doctor does not spend time (NT) and the patient is a 'blunter' he will prefer to do what the doctor suggested (A) rather than taking any other action.

The doctor's decision is made as following. Knowing the possible moves of the patient and the probabilities that the patient is a 'monitor' or a 'blunter', if he spends time with him his utility will be $0.5(E[u(s)]-e_1)+0.5(u(E[s-l(t^*,s)])-e_1-e_2)$. If he does not spend time his utility will be: $0.5(u(E[s-l(t*,s)])-e_2+0.5(E[u(s)])$. Therefore, he will decide to put effort if the former expression is greater than the latter. Or, in other words, if the following holds:

$$0.5(E[u(s)]-e_1)+0.5(u(E[s-l(t^*,s)])-e_1-e_2)>0.5(u(E[s-l(t*,s)])-e_2+0.5(E[u(s)]) \qquad (2)$$

Notice that after some manipulation the expression above is reduced to:

$$-2e_1 \phi 0$$

which does not hold because e is non negative. Therefore the doctor will decide not to put effort in this consultation.

To sum up, and as shown by the bold lines of figure 1, the above model shows that including effort in the doctor's utility function leads the doctor to choose not to spend time with the patient and then the patient depending on his information preference type he will adhere if he is an information-loving person but will non adhere if he is information-averse.

4. Limitations and directions for future research

The present paper presents a simple representation of the doctor-patient interaction with the aim of explaining how conflicts that occur during the consultation may lead to sub-optimal results such as non-adherence to recommendation. The introduction of the notion of effort is only an attempt to capture these conflicts; it is not the only issue of antagonism occurring between the two parts. Time is a rather clear, and easy to measure, concept that is used in the model to demonstrate that even the most altruistic doctor cannot act as a perfect agent for the patient and maximise the patient's utility

[3] Recall that $t*$ is the action the patient decides to take if he does not accept s, therefore means that the patient does not adhere to the doctor's recommendations.

function because he is often constrained by organisational factors that restrict him from doing so. Therefore, using more variables to measure effort could be a future step.

Another interesting conflicting point is the different way the two parties value present and future outcomes. Doctors are more future-oriented and want to maximize the patient's health outcome in the future and are less interested in patient's anticipatory feelings in the present. Their goal is to improve patient's health in the future rather than making a patient happy now. On the other hand, the patients are more present oriented and put more weight in leading a pleasant life now than thinking of future consequences in their health status. This is particularly true for life-style behaviours such as smoking. To model this conflict one could again build on Caplin and Leahy's Psychological Expected Utility theory (Caplin and Leahy, 2001). There are two periods, 1 and 2, and total utility is the sum of the utilities of the two periods. The conflict of time-preferences described above would be modelled by allowing doctors to put more weight in health outcomes in period two (future), while patients would give a higher weight to period 1 (present).

5. Conclusions

This paper described the doctor-patient relationship when the patient's beliefs enter his utility function but also organisational constraints affect the doctor's decision. The proposed model showed that the equilibrium is reached when the doctor does not spend time in the initial consultation and then depending on the nature of the patient, an information-loving patient will non-adhere to doctor's advice, while a information-averse patient will follow the doctor's recommendation.

The model gives useful insights to the doctors and the policy makers to understand not only how patient's beliefs affect their decision but also how the organisational constraints actions can be manipulated in order to persuade patients to adhere. One could use the model to see how, by incentivising doctors they may be able to lead patients to follow their recommendations.

Non-adherence to recommendation is increasingly attracting the attention of doctors, researchers and policy makers as it leads to relapses and rehospitalisation but also increases medical costs. Understanding the ways patients can adhere to medical recommendation, and most importantly how the doctors can help towards this direction is therefore an issue of significant importance.

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