Physician payment and medical malpractice mechanisms

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Abstract

In this paper, I derive simultaneously optimal payment contracts for the physician and optimal compensation for the patient given that he is injured by the physician’s action. The model predicts findings that are consistent with the real world observations. It predicts that the fees incurred by the patient decreases the suing probability and second the patient’s compensation is proportionate to the damage. I find that the risk aversion on patients’ side lowers the claiming rate. I also find that the patient is always better off if the suing responsibilities are transferred to a law firm; but the latter will only accept cases involving a seriously injury. Finally, the model also predicts that policies that tend to impose caps on medical malpractice awards will lower the claiming rate.

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1 Introduction

The patient-physician relationship is often characterized by asymmetric information. This information problem may lead the physician to recommend or to provide the quantity and quality of care that would not be chosen by a well-informed patient. To encourage efficiency, on the supply side, physician payment mechanisms are one potential instrument and they have received a lot of attention in the theoretical health economics literature. Another potential instrument is the monitoring and medical malpractice mechanisms.\footnote{Here, the monitoring mechanism is referred to a verification made by an internal member while the malpractice mechanism is referred to that made by an external member.} In fact, since the physician is responsible for two conflictual decisions (health cost containment and quality decisions), the utilization of two instruments may be more efficient. However, we do not often observe a combination of these two instruments. In light of this critique, the aim of this paper is to derive simultaneously optimal payment contracts for the physician and optimal compensation for the patient given that he is injured by the physician’s action. Also, once optimal parameters are derived, I compare two different systems. The first system is that in which the risk-averse patient takes all suing responsibilities; in the second one, the suing responsibilities are transferred to a risk-neutral law firm which also pays lawsuit costs but in exchange must receive a given proportion of the compensation.

Although physician compensation schemes may be one instrument to reach both the objectives of health-care costs reduction and health-care quality improvement, each payment mechanism has its drawbacks. The traditional fee-for-service (FFS) payment mechanism where (almost) all health-care costs reported by the physician are covered by the health insurance provider, gives strong incentives to provide high-quality care but no incentives to limit health-care costs, and health services may be provided beyond efficient levels. The prospective payment system (PPS) where the health insurer pays a fixed amount per patient enlisted into the physician’s practice, may be an effective way to deal with excessive health-care costs. However, the PPS may give strong incentives to underprovide health care and
thus to provide low-quality care especially in static models. As a result, the literature on the
design of optimal payment mechanisms for providers concludes that a combination of both
FFS and PPS may be optimal. That is a mixed payment scheme may be efficient (e.g., Ellis
and McGuire, (1986, 1990); Ma and McGuire, (1997); Selden, (1990)). These results, how-
ever, are sensitive to the models’ assumptions. More specifically, Ellis and McGuire (1990)
for example, assume that patients and physicians share the same level of information, that
is, they do not model the traditional information problems between patients and physicians.

In the theoretical literature on the optimal liability (see for example Becker, (1968); Shavell,
(1980, 1991)), the main goal of the liability is to provide incentives for an injurer to be-
have appropriately. Similarly, in the medical malpractice literature (see for example Danzon,
(1985, 2000)), malpractice liability plays two roles: it gives incentives to physicians to pro-
vide appropriate care and compensates patients for injuries caused to them by physicians’
inappropriate behaviour. Empirical evidence shows that malpractice risks affect physicians’
behaviour. In fact, in 2005, according to the national health expenditure data, the American
Medical Association reports that 76% of physicians believe that concern about medical liaibil-
ity litigation affects their treatment’s choice.\(^2\) Moreover, the risk of lawsuits has increased in
last decades. Danzon (2000) reports that, before 1960, only one in seven physicians had ever
been sued but now about one in seven physicians is sued per year. Hence, physicians may
take this risk into account when providing health care. There is also evidence that physicians
do respond to liability mechanisms. Using data on medicare patients treated for serious heart
attack, Kessler and McClellan (1996) find that malpractice reforms that directly reduce the
provider liability pressure lead to substantial reductions (up to 9%) in medical expenditures
without substantial effects on health outcome.

It is clear that both physician payment and medical liability mechanisms affect physician’s
behaviour. As a consequence, the objective of this paper is to consider a model in which these

\(^2\)Source: American Medical Association, "Medical Liability Reform-Now" (2008), available at
two instruments may serve as a way to provide efficiently health services. More specifically, in a model which is related to some papers (Arlen and MacLeod, (2005); Gal-Or, (1999); Léger, (2000); Zeiler (2008)), I examine how liability mechanisms influence the behaviour of the health insurer, the physician and the patient in a more flexible payment mechanisms setting.

Initially, by assuming that all agents in the model are risk neutral, I find as in Léger (2000) and Zeiler (2008) that, at the equilibrium, patient and physician use mixed strategy. That is, the physician will never cheat with certainty and as a consequence the patient also will never sue with certainty. However, in the present model, the flexibility of the payment mechanisms allows to derive a level of sanctions which is credible. The model also predicts findings that are consistent with the real world observations. First, it predicts that the fees incurred by the patient to sue a physician is negatively related to the suing probability; and second, the patient’s compensation is proportionate to the damage. By relaxing the risk neutrality assumption on patients’ side, I find that some patients who are treated inappropriately will not sue and as a consequence, the claiming rate will be low. I also find that a risk-averse patient will always prefer to transferate the suing responsibilities to a law firm; but the latter will only accept cases involving a seriously injury. Finally, the model also predicts that policies that tend to impose caps on medical malpractice awards will lower the claiming rate; this is because many cases will become unattractive for lawyers who accept the contingency fee contract.

The model is built on the approach taken by Zeiler (2008). The author, in a game-theoretical model, studies the effects of contract disclosure rules on the behaviour of health care markets’ actors. In her model, the Managed Care Organization (MCO) chooses a physician payment mechanism and the physician, after observing the type of contract, decides whether to treat compliantly the patient or not. After health care consumption and upon the realization of a bad outcome, the patient forms beliefs about his physician’s choice of treatment and
decides whether to sue or not the latter for medical malpractice. If the patient sues, the court perfectly verifies the physician’s action and sets the amount of damages if the physician is found liable. She finds under some assumptions that the regime in which MCO/physician contract terms are publicly observed is more efficient, i.e., the MCO can select a compensation scheme such that claiming rates will be lower and compliant treatment rates will be higher. In her model, the level of fine paid by the physician to compensate the patient is exogenous. The present work extends Zeiler’s model by endogenizing the level of the compensation. Also, the model differs from Zeiler’s by allowing risk aversion on patients’ side.

The paper is also related to Gal-Or (1999). In a theoretical model where the health insurer is assumed to take into account both patients and physicians’ welfare, and where the physician, who is a pure profit maximizer chooses an intensity of the treatment and a health care cost control effort, she derives the optimal reimbursement and payer-provider sharing rules of malpractice liabilities. She shows that the optimal contract depends on the insurer’s ability to control the provider’s choice of the treatment. More specifically, if the insurer can dictate the intensity of the treatment, then the optimal contract is the prospective payment system and all malpractice liability costs are covered by the insurer. If the insurer cannot enforce the type of treatment, a mixed payment system may be optimal and the insurer shares both treatment and liability costs with the provider. The present model differs from Gal-Or’s formulation in several aspects. First, Gal-Or assumes that the physician is found liable whenever his patient does not recover. In my model, I assume that the liability probability depends also on the patient’s beliefs about whether he was treated appropriately or not (as in Zeiler 2008), and on the court’s ability to verify the physician’s actions. In other words, the probability of liability depends not only on the physician’s behaviour, but also on other parameters. Second, in Gal-Or’s paper, it is the health insurer and not the court or the regulator who plays the role of inducing efficient behaviour on the part of the provider and thus the fine is considered as exogenous by the insurer. In the model proposed here, I assume that the fine is endogeneous and is chosen by the regulator in order to induce the physician
to behave optimally.

The paper is also related to Léger (2000). The author examines the physician’s treatment decision and the patient’s litigation decision in a model where physicians are paid by capitation. The present work extends Léger’s model by endogenizing the payment mechanism. Finally, the paper is also related to Arlen and MacLeod (2005) who derive the optimal liability rules in a setting where both the physician and the health insurer’s actions determine the care received by the patient. However, their model is silent on physician payment mechanisms.

The remainder of this paper is organized as follows. Section 2 presents the model. In section 3, I solve the model and present the results. In section 4, I compare two different systems: the plaintiff is a risk-averse patient versus a risk-neutral law firm. Finally, the last section concludes.

2 The model

In this section, I present a model in which many health care market actors interact. In the model, the health insurance provider collects premiums and pays physicians. The physician’s payment mechanism is either capitation, fee-for-service, or a mix of both. I assume that the health insurer signs contracts with the physician and the patient before the patient’s illness severity is revealed. If an individual becomes ill, then he seeks care from the physician. The physician perfectly and costlessly observes the patient’s illness severity and decides which type of treatment must be provided (so bad outcomes are not the result of ignorance but rather bad treatment). In the model, it is assumed that only the physician knows the true health condition of the patient. The other agents know only the distribution of the illness severity. Once health-care services are provided, the patient either recover or not his health state. If he does not recover, the patient decides whether or not to sue the physician. If the patient decides to sue, then he pays fixed lawsuit costs and the physician’s action is
audited. The patient’s true illness severity is (costly) revealed. If the court discovers that
the treatment provided by the physician was inappropriate, then it will set endogenously the
optimal level of fine that the physician must pay as compensation for the patient.

I describe in the following sections the timing of the model and the agents’ preferences.

2.1 Timing

The timing of the game (see Figure 1) is as follows:

Step 1

The health insurance provider offers contracts to the physician and the patient. These
contracts specify the payment parameters (a fixed payment \( p \) and a cost-sharing rate \( \gamma \)) for the
physician and the health insurance parameters (an insurance premium \( \alpha \) and a co-payment
rate \( \beta \)) for the insured individual.

Step 2

The patient becomes sick. He has either a low illness severity \( \theta_L \) which occurs with
probability \( p \), or a high illness severity \( \theta_H \) which occurs with probability \( 1 - p \). As in Léger
(2000), a patient with a high illness severity requires a treatment \( t_H \) which costs \( C(t_H) = C_H \)
to the physician. I refer to this as the expensive treatment. While a patient with a low
illness severity requires a treatment \( t_L \) which costs \( C(t_L) = C_L \) to the physician, which I refer
to as the inexpensive treatment.

Step 3

The physician perfectly observes the patient’s illness severity \( \theta \) and decides on whether or
not to treat appropriately the patient.\(^3\) Once health-care services are provided, the patient’s

\(^3\)It is important to note that in the model proposed here, the treatment is assumed to be appropriate
if a patient with low (high) illness severity receives the inexpensive (expensive) treatment. Otherwise, the
treatment is inappropriate.
post-treatment health is revealed and is either good or bad. If the patient is in a bad state, then he infers the probability (detailed below) that he was treated appropriately or not and decides either to sue or not the physician.

**Step 4**

Following the decision to sue the physician, the patient pays a fixed lawsuit costs and his true illness severity is revealed. If the court discovers that the physician behaves inappropriately, then the court sets the optimal level of compensation.

### 2.2 Patient

As noted above, the patient knows that he is sick but he does not know his illness severity. However, he knows the distribution of the severity: with probability $p$ his illness is of low severity, and with $(1 - p)$ the illness is of high severity. The patient, in the model proposed here, is assumed to be passive in the sense that he always follows his physician’s treatment recommendation. After health care consumption, if the patient is in a good state then the game ends. If however the bad state occurs, then he may decide either to sue or not his physician. More specifically, given that the patient is in a bad state, if he observes that $t = t_L$ was chosen then he sues with probability $f$. If however $t = t_H$ is observed, then the patient sues with probability $g$. The patient’s utility is assumed to depend on two elements: health state $h$ and income available for consumption goods $x$, and is increasing and concave in both elements. The patient’s utility function is thus given by:

$$U^P = U[h(\theta, t), x]$$

where $x = y - \alpha - \beta C(t)$; $y$ is the individual’s state-independent income.
2.3 Physician

As noted above, the physician perfectly observes the patient’s illness severity $\theta$ and decides which type of treatment must be provided. As in Léger (2000), once the patient’s true illness severity is observed, the physician decides whether to provide the expensive treatment or the inexpensive one. More specifically, I assume that, given that the patient’s illness severity is $\theta_L$, the physician chooses $t_L$ with probability $u$ and $t_H$ with probability $(1 - u)$. If the severity is $\theta_H$, I assume that the physician chooses $t_L$ with probability $v$ and $t_H$ with probability $(1 - v)$. In order to take into account the uncertainty between the effect of health-care services’ utilization and the health outcome, I assume that providing the appropriate treatment does not guaranty a full recovery of the patient’s health. Also, even if the patient is inappropriately treated, he may recover his health. More specifically, I assume that, if $\theta = \theta_L$ and the physician chooses $t = t_L$ then the patient recovers with probability $m$; if however $t = t_H$ is chosen, then the recovery probability is $n$. Similarly, if $\theta = \theta_H$ and the physician chooses $t = t_L$ then the patient recovers with probability $r$; if however $t = t_H$ is chosen, then the recovery probability is $s$. The physician receives a fixed fee $\rho$ which does not depend on the type of treatment provided and a share $\gamma$ of the treatment cost reported to the insurer. The physician’s utility function when he is not sued is given by:

$$V^P = V \left[ \rho - (1 - \gamma)C_t \right] \quad (2)$$

where $\rho - (1 - \gamma)C_t$ represents the financial gain: the physician receives $\rho$ as a fixed payment, pays $C_t$ for the treatment, and the third party reimburses $\gamma C_t$ (i.e., $\rho - C_t + \gamma C_t = \rho - (1 - \gamma)C_t$).

However, if the physician is sued and the court discovers that the treatment provided was
inappropriate, then the physician’s utility is given by:

\[ V^P = V \left[ \rho - (1 - \gamma)C_t - \phi_i \right] \]  

(3)

where \( \phi_i, i = 1, 2 \) denotes the fine paid by the physician to the patient given that the court finds that the physician behaves inappropriately. More specifically, \( \phi_1 \) denotes the fine if the physician provides the inexpensive treatment given that the patient has a high illness severity and \( \phi_2 \) the fine when the expensive treatment is provided to a patient who has a low illness severity.

2.4 Third party

The third party is thought of as an insurance provider and is assumed to operate in a competitive market. The third party, which is assumed to be a profit maximizing firm, collects premiums and pays physicians by a mixed payment mechanism. It chooses contract parameters to maximize its expected profits.

2.5 Court

The court acts as a regulator of health care. It chooses \( \phi_i \) to maximize the social welfare. More specifically, the court maximizes the patient’s expected utility subject to the constraints that the optimal liability mechanism must give a non-negative profit to the physician and the third party.

Figure 1: the timing.
3 Agents’ problem and equilibrium analysis

In this section, I formally write the maximization problem of the agents in the model and solve for the equilibrium behaviour of each agent using the Bayesian Nash equilibrium concept. I assume that all agents in the model are risk neutral. Later, I will relax the risk-neutral assumption on the patient’s side. I also make some simplifying assumptions: (i) the patient is fully insured ($\beta = 0$) and (ii) the physician cannot be fined by the court for an overtreatment ($\phi_2^* = 0$). Given that $C_L < C_H$, thus the probability that the physician will treat a patient who has a low illness severity with the expensive treatment is zero. As a consequence, the probability that the physician will appropriately treat a patient who has a low illness severity
is one, that is $u^* = 1$. Also, since the patient observes the treatment chosen by the physician, if he observes $t_H$ he will never sue (i.e., $g^* = 0$). This is because the patient knows that $C_L < C_H$ and as a consequence the physician will never choose $t_H$ for $\theta_L$. As the above cases are ruled out, the physician and the patient strategies are reduced to choose $v$ and $f$, respectively. Through sections 3.1 to 3.5, I solve the model. The equilibrium parameters are found as follows: (i) I solve for the patient’s, the physician’s and the third party’s optimal response given the level of the fine; (ii) I resolve the court’s problem given the behaviour of the patient, the physician and the third party; (iii) I substitute the optimal fine into the optimal responses of the other agents.

3.1 Physician’s behaviour

The physician who is assumed to be a pure income maximizer, chooses the cheating probability ($v$) to maximize his total expected utility. If the physician observes $\theta = \theta_H$ he may choose $t = t_L$ or $t = t_H$. Formally, conditional on observing $\theta = \theta_H$, the physician will choose $t = t_H$ if and only if:

$$V [\rho - (1 - \gamma)C_H] > V [\rho - (1 - \gamma)C_L - (1 - r)f \phi_1]$$

where $f$ denotes the probability that the patient will sue given that he was treated with $t_L$. By assuming that the physician’s utility is linear in his revenue, then:

$$f > \frac{(1 - \gamma)(C_H - C_L)}{(1 - r)\phi_1} = \bar{f}$$

where $\bar{f}$ denotes the patient’s threshold of indifference between suing or not. Equation (4′) states that:
i) if the probability that the patient will sue is higher than the patient’s threshold of indifference between suing or not \( (f > \bar{f}) \), then the physician will always provide the appropriate treatment \( (v = 0) \),

ii) if the patient is indifferent between suing or not \( (f = \bar{f}) \), then the physician is indifferent \( (v \in (0, 1)) \),

iii) if the probability that the patient will sue is lower than the patient’s threshold of indifference between suing or not \( (f < \bar{f}) \), then the physician will never provide the appropriate treatment \( (v = 1) \).

### 3.2 Patient’s behaviour

The patient’s problem is to choose the suing probability \( f \) to maximize his expected utility. Before writing the maximization problem, we need to define the probability that a patient has a illness severity \( \theta = (\theta_L, \theta_H) \) given that the treatment \( t = (t_L, t_H) \) was provided. Let denotes by \( P_{ij} = P(\theta = \theta_i/t = t_j) \) the probability that the patient has severity \( i \) given that the treatment \( j \) is observed, \( i, j = L, H \). Using Bayes’ rule and the fact that at the equilibrium \( u^* = 1 \), we have:

\[
P_{LL} = \frac{p}{p + (1-p)v}; \quad P_{HL} = \frac{(1-p)v}{p + (1-p)v}; \quad P_{HH} = 1; \quad P_{LH} = 0.4
\]

By assuming that the patient’s utility function is linear in its arguments; thus conditional on observing the inexpensive treatment \( (t_L) \), the patient will sue (given that he is in a bad state) if and only if \(^5\):

\[P_{HL} (1-r) \left[ L + y - \alpha - k + \phi \right] + P_{LL} (1-m) \left[ L + y - \alpha - k \right],\]

\(^4\)The probability that \( t = t_L \) is the sum of the probability that a patient with low illness severity is treated with the inexpensive treatment \( (pu) \) and the probability that a patient with high illness severity is treated with the inexpensive treatment \( ((1-p)v). \)

\(^5\)Given \( t_L \), if the patient sues, his expected utility is:
\[ v > \frac{p(1 - m)k}{(1 - p)(1 - r)[\phi_1 - k]} = \bar{v} \]  

(5)

where \( \bar{v} \) denotes the physician’s threshold of indifference between treating appropriately or not given that the patient has a high illness severity. Equation (5’) states that:

i) if the probability that the physician will provide the inappropriate treatment is higher than the physician’s threshold of indifference treating appropriately or not given that the patient has a high illness severity \( (v > \bar{v}) \), then the patient will always sue \( (f = 1) \),

ii) if the physician is indifferent between treating appropriately or not \( (v = \bar{v}) \), then the patient is indifferent \( (f \in (0, 1)) \),

iii) if the probability that the physician will provide the inappropriate treatment is lower than the physician’s threshold of indifference \( (v < \bar{v}) \), then the patient will never sue \( (f = 0) \).

### 3.3 Patient and physician equilibrium strategies

As shown by Léger (2000) and Zeiler (2008), at the equilibrium, patient and physician use mixed strategy.\(^6\) In fact, from the patient’s behaviour, we state that if the probability that the physician will cheat is higher than the physician’s threshold of indifference between treating appropriately or not \( (v > \bar{v}) \), then the patient will always sue \( (f = 1) \). The physician, knowing that the patient will sue with probability 1, will choose \( v \leq \bar{v} \). Hence \( v > \bar{v} \) cannot be an equilibrium. If however, \( v < \bar{v} \), then the patient will never sue, \( (f = 0) \). Knowing that the patient will never sue, the physician will choose \( v \geq \bar{v} \). Thus \( v < \bar{v} \) also cannot be an

\(^6\)Other equilibriums may exist. For details on them, see Léger, (2000).
equilibrium. The physician’s equilibrium strategy is $v^e = \bar{v}$.

Also, from the physician’s behaviour, we know that if the probability that the patient will sue is higher than the patient’s threshold of indifference between suing or not ($f > \bar{f}$), then the physician will provide the appropriate treatment ($v = 0$). But, knowing that the physician will provide the appropriate treatment, the patient will choose $f \leq \bar{f}$. Thus $f > \bar{f}$ cannot be an equilibrium. If $f < \bar{f}$, then the physician will provide the inappropriate treatment ($v = 1$). The patient, knowing that the physician will never provide the appropriate treatment, will choose $f \geq \bar{f}$. Hence, $f < \bar{f}$ also cannot be an equilibrium. The patient’s equilibrium strategy is $f^e = \bar{f}$.

Thus at the equilibrium,

$$f^e = \frac{(1 - \gamma)(C_H - C_L)}{(1 - r)\phi_1}, \quad (6)$$

and

$$v^e = \frac{p(1 - m)k}{(1 - p)(1 - r) [\phi_1 - k]} \quad (7)$$

Before moving to the third party’s behaviour, the patient’s expected utility ($EU$) can now be defined as:

$$EU = (y - \alpha) + [ph_L^H + (1 - p) \left( (1 - v^e)h_H^H + v^e h_H^L \right)] + f^e \left[ -p(1 - m)k + (1 - p) v^e (1 - r) (\phi_1 - k) \right] \quad (8)$$

where $h_L^H = h(\theta_L, t_L)$, $h_H^L = h(\theta_H, t_L)$ and $h_H^H = h(\theta_H, t_H)$. Equation (8) states that the patient’s expected utility is the sum of three elements. The first term $(y - \alpha)$ represents the income available for consumption goods after paying health insurance premium; the second $[ph_L^H + (1 - p) \left( (1 - v^e)h_H^H + v^e h_H^L \right)]$ represents the patient’s expected health benefit, and finally $f^e \left[ -p(1 - m)k + (1 - p) v^e (1 - r) (\phi_1 - k) \right]$ is the patient’s expected net gain from suing a physician given that he observes that the physician chooses $t_L$.\footnote{I showed that if $\theta = \theta_L$, the physician will always behave appropriately, hence the patient’s expected utility is determined by the first and second terms.}

14
The physician’s expected utility \((EV)\) is defined as:

\[
EV = \{\rho + \gamma [pC_L + (1 - p)((1 - v^e)C_H + v^e C_L)]\} -
\{[pC_L + (1 - p) ((1 - v^e) C_H + v^e C_L)] + (1 - p)v^e f^e (1 - r) \phi_1\}
\]

which can be rewritten as:

\[
EV = \rho - (1 - \gamma) [pC_L + (1 - p) ((1 - v^e) C_H + v^e C_L)] - (1 - p)v^e f^e (1 - r) \phi_1. \tag{9'}
\]

Equation (9) states that the physician’s expected utility is the difference between the expected reimbursement and the expected costs. The first is the sum of the fixed payment \(\rho\) and a share \(\gamma\) of the expected costs of the treatment; the latter is the sum of the expected costs of the treatment and the expected fine paid by the physician given that he behaved inappropriately and the patient sued.\(^8\)

### 3.4 The third party’s behaviour

As noted above, the health insurer chooses a fixed fee \((\rho)\) and a share \((\gamma)\) of the treatment cost reported by the physician. As assumed previously that the third operates in a competitive market, thus the patient’s premium \(\alpha\) equals the insurer’s expected reimbursement to the physician. Formally,

\[
\alpha = \rho + \gamma [pC_L + (1 - p)((1 - v^e)C_H + v^e C_L)]
\]

\(^8\)Given that if \(\theta = \theta_L\), the physician will always behave appropriately, then the expected costs of the treatment is \(pC_L\). If however \(\theta = \theta_H\), then the expected costs of the treatment is \((1 - p) ((1 - v^e) C_H + v^e C_L)\). Hence the expected cost of the treatment is: \([pC_L + (1 - p) ((1 - v^e) C_H + v^e C_L)]\).
Using equation (9') and the assumption that the physician also is in a competitive market (with the reservation utility normalized to zero), we have:

\[
\rho = (1 - \gamma) [pC_L + (1 - p) ((1 - v^e) C_H + v^e C_L)] + (1 - p)v^e f^e (1 - r) \phi_1
\]  

(11)

Using (11), (10) can be rewritten as:

\[
\alpha = [pC_L + (1 - p) C_H] - (1 - p)v^e [(C_H - C_L) - f^e (1 - r) \phi_1].
\]  

(10')

Substituting (6) and (7) into (10'), \( \gamma^e \) follows as:

\[
\gamma^e = \frac{(1 - r) (\phi_1 - k) [(pC_L + (1 - p) C_H) - \alpha]}{p (1 - m) k} \frac{(C_H - C_L)}{(C_H - C_L)} \]  

(12)

Using equation (12), (6) can be rewritten as:

\[
f^e = \left[ 1 - \frac{(1 - r) (\phi_1 - k) [(pC_L + (1 - p) C_H) - \alpha]}{p (1 - m) k} \frac{(C_H - C_L)}{(1 - r) \phi_1} \right] (C_H - C_L) \]  

(6')

Finally, substituting (6') into (11), \( \rho^e \) follows as:

\[
\rho^e = \left[ 1 - \frac{(1 - r) (\phi_1 - k) [(pC_L + (1 - p) C_H) - \alpha]}{p (1 - m) k} \frac{(C_H - C_L)}{(C_H - C_L)} \right] [pC_L + (1 - p) C_H].
\]  

(11')

### 3.5 The court’s behaviour

The court chooses \( \phi_1 \) to maximize the patient’s expected utility subject to \( EV \geq 0 \) and \( Z \geq 0 \). By assuming that, at the optimum, these constraints are binding; it can easily be
shown that the court’s objective function can be rewritten as:

\[
MaxEU = y + \left[ ph_L^L + (1 - p) h_H^H \right] - \left[ pC_L + (1 - p) C_H \right] + \\
(1 - p) v^e \left[ (C_H - C_L) - (h_H^H - h_H^H) \right] - f^e \left[ p(1 - m) + (1 - p) v^e (1 - r) \right]
\] (13)

For a given level of \( f^e \), the court will choose \( \phi_1^* \) such that the physician’s choice of \( v^e \) maximizes the patient’s expected utility and thus the social optimum.

The first-order conditions (F.O.C.) of maximization with respect to \( v^e \) is given by:

\[
\frac{\partial EU}{\partial v^e} = (1 - p) \left[ (C_H - C_L) - (s - r)(\bar{h} - \tilde{h}) \right] - f^e k (1 - p) (1 - r) = 0
\] (14)

where \( \bar{h} \) and \( \tilde{h} \) denote the health benefit associated with a good and a bad outcome (given that \( \theta = \theta_H \)), respectively.

From (14),

\[
f^* = \frac{c - (s - r)(\bar{h} - \tilde{h})}{(1 - r) k}
\] (15)

Using (6') and (15), it can easily be shown that the optimal \( \phi_1^* \) is given by (For the proof, see the Appendix A):

\[
\phi_1^* = k \frac{p(1 - m) c + (1 - r) [C_H - pc - \alpha]}{p(1 - m) \left[ c - (s - r)(\bar{h} - \tilde{h}) \right] + (1 - r) [C_H - pc - \alpha]}
\] (16)

where \( c = C_H - C_L \). Given that, conditional on \( \theta = \theta_H \) the probability that \( t_H \) will induce the good state is higher than the probability that \( t_L \) will induce it (i.e., \( s > r \)), it follows that \( p(1 - m) \left[ c - (s - r)(\bar{h} - \tilde{h}) \right] < p(1 - m) c \). We know from (10') that \( \alpha = pC_L + (1 - p) C_H \) if and only if \( v^e = 0 \), i.e., if and only if the physician will never cheat. Given that, we showed that, the physician uses a mixed strategy (i.e., \( v^e \in (0, 1) \)), thus \( \alpha \) cannot be equal
to \( pC_L + (1 - p)C_H \) (= \( C_H - pc \)). More specifically, \( \alpha < C_H - pc \), that is, the health insurance premium paid by the patient is less than the insurance premium which prevails in a competitive market with no cheating possibility. This result come from the fact that the third party knows that, for a patient who has a high illness severity, the physician will not provide the appropriate treatment with certainty. And, since the third party operates in a competitive market, it must adjust the level of the insurance premium paid by the patient. Since \( C_H - pc - \alpha > 0 \), it follows that \( \phi_1^* > k \) if and only if \( \left[ c - (s - r)(\tilde{h} - \bar{h}) \right] > 0 \) or equivalently if \( (\tilde{h} - \bar{h}) < \frac{c}{s - r} \); where \( (\tilde{h} - \bar{h}) \) represents the health damage.

From equation (15), \( \frac{\partial f^*}{\partial k} < 0 \), i.e., \( ceteris paribus \) the higher is the suing costs, the lower is the probability that the patient will sue. Also, from (16), \( \frac{\partial \phi_1^*}{\partial (h - h)} > 0 \), i.e., the higher is the damage, the higher is the compensation.

Substituting (16) into (7), (11′) and (12), physician and third party’s optimal choice are respectively given by:

\[
v^* = \frac{p(1-m)}{(1-p)(1-r)} \left[ c - (s - r)(\tilde{h} - \bar{h}) \right] + (1 - r) \left[ C_H - pc - \alpha \right] \frac{p(s - r)(\tilde{h} - \bar{h})}{p(s - r)(\tilde{h} - \bar{h})} \quad (17)
\]

\[
\gamma^* = \frac{(1-r)(s-r)(\tilde{h} - \bar{h})}{p(1-m) \left[ c - (s - r)(\tilde{h} - \bar{h}) \right] + (1 - r) \left[ C_H - pc - \alpha \right]} \quad (18)
\]

\[
\rho^* = (1 - \gamma^*) \left[ C_H - pc \right] \quad (19)
\]

It is easy to see that if \( \left[ c - (s - r)(\tilde{h} - \bar{h}) \right] > 0 \) then patient, physician and third party’s optimal choice are all non-negative. From equation (18), \( \gamma^* \) is different from 0 unless \( [C_H - pc - \alpha] = 0 \). But, as I showed above that \( [C_H - pc - \alpha] > 0 \), then \( \gamma^* \in (0, 1) \) and consequently \( \rho^* > 0 \).
To sum up, the set of equations 15-19 characterizes the equilibrium behaviour of the agents in the model. More specifically, if the health damage \((\bar{h} - \tilde{h})\) is lower than the difference between the cost of treating appropriately and that of not, adjusted by the difference between the probabilities that the appropriate treatment and the inappropriate one induce a good state (i.e., \((\bar{h} - \tilde{h}) < \frac{c}{\gamma_{\gamma_{\gamma_{\gamma}}}}\)), then the court who acts as a regulator of health care sets the compensation higher than the cost of litigation. The third party, given the level of compensation set by the court, and anticipating the physician’s reaction about the level of the optimal fine, chooses to remunerate the physician by combining a fixed and positive payment with a partial reimbursement for the cost of the treatment. The level of the fixed payment chosen by the third party is a fraction of the expected cost of the treatment if we were in a setting where the physician always behaves appropriately. That is, the physician always provides the inexpensive treatment given that the patient has a low-severity illness and the expensive one to a patient who has a high-severity illness. The contract is such that at the equilibrium, given that the third party operates in a competitive market, its expected profits are zero. The physician, given the reimbursement contract, randomizes between treating appropriately or not. More specifically, the physician will never treat appropriately with probability one, as he will also never cheat with certainty. At the equilibrium, the physician’s expected utility is equal to his reservation utility which is normalized to zero. Like the physician, the patient randomizes between suing or not. But unlike the physician, at the equilibrium, his expected utility is positive.

The model also predicts that the fees incurred by the patient to sue a physician are negatively related to the suing probability. More specifically, higher fees deter lawsuits behaviour. Finally, the model predicts that the patient’s compensation is proportionate to the harm.

In the next section, I relax the assumption that the patient is risk neutral and given the parameters of the model, I analyze the risk-averse patient’s suing behaviour and compare it with the suing behaviour of a risk-neutral law firm.
4 The plaintiff

In this section, given the above results, I compare two different systems. The first system is that in which a risk-averse patient takes all suing responsibilities. In the second one, the suing responsibilities are transferred to a risk-neutral attorney or more broadly a law firm which also pays lawsuit costs but in exchange must receive a given proportion of the compensation. For simplicity, let’s denote by $q$ the probability to win a medical malpractice claim and $\phi$ the corresponding award. Also, without loss of generality I rewrite the utility function as only a function of the individual’s monetary wealth. More specifically,

$$
U^P = \begin{cases} 
U(y - \alpha) & \text{if the patient does not sue} \\
U(y - \alpha + \phi - k) & \text{if the patient sues and win} \\
U(y - \alpha - k) & \text{if the patient sues but loss}
\end{cases}
$$

where $y - \alpha$: is the income available for consumption goods after paying health insurance premium $\alpha$, and $k$ is the lawsuit costs (as defined previously). In the next sections, I analyze a suing decision for a risk-averse patient and a risk-neutral law firm, respectively.

4.1 The risk-averse patient

As a benchmark, we know that a risk-neutral patient will sue if and only if the expected utility of suing is greater than or equal to the utility of not suing. Formally, the patient will sue if and only if:

$$
q [U(y - \alpha + \phi - k)] + (1 - q) [U(y - \alpha - k)] \geq U(y - \alpha) \tag{20}
$$

Ignoring the health state component in the utility function does not affect in any way the results.
Since the patient is risk neutral, equation (20) can be rewritten as:

\[ q(y - \alpha + \phi - k) + (1 - q)(y - \alpha - k) \geq (y - \alpha) \]

which reduces to:

\[ \phi \geq \frac{k}{q} = \tilde{\phi}_P \tag{21} \]

where \( \tilde{\phi}_P \) denotes a risk-neutral patient’s threshold of indifference between suing or not. In other words, Equation (21) states that a risk-neutral patient’s decision is as follows: sues if \( \phi > \tilde{\phi}_P \); does not sue if \( \phi < \tilde{\phi}_P \); and finally the patient is indifferent between suing and not if \( \phi = \tilde{\phi}_P \).

If however the patient is risk averse, his suing strategy is different and depends on his level of aversion. In fact, for a risk-averse patient, since the utility function is concave, we have:

\[
q \left[ U(y - \alpha + \phi - k) \right] + (1 - q) \left[ U(y - \alpha - k) \right] < U \left[ q(y - \alpha + \phi - k) + (1 - q)(y - \alpha - k) \right]
\]

that is, the expected utility is lower than the utility of the expected gain. If \( \phi = \frac{k}{q} \) then

\[
U \left[ q(y - \alpha + \phi - k) + (1 - q)(y - \alpha - k) \right] = U(y - \alpha) \text{ i.e., the utility of the expected gain is equal to the utility of the initial wealth (or equivalently, the expected gain is equal to the initial wealth). As a consequence, (22) can be rewritten as:}
\]

\[
q \left[ U(y - \alpha + \phi - k) \right] + (1 - q) \left[ U(y - \alpha - k) \right] < U(y - \alpha)
\]

\[ (22') \]

We know that a patient will sue if equation (20) is satisfied. Hence, comparing (20) and (22'), it is easy to see that, at the risk-neutral patient’s threshold of indifference between suing or not (i.e., at \( \tilde{\phi}_P = \frac{k}{q} \)), the risk-averse patient will not sue. In other words, the risk-averse
patient’s threshold of indifference between suing or not is higher than that of the risk-neutral patient. The fact that the patient knows that he must pay the lawsuit costs whether he wins or not, serves as a disincentive, especially when the expected award is relatively small. As a consequence, at the equilibrium, the claiming rate will be low and some risk-averse patients who are treated inappropriately will not sue.

In the next section, I analyze the case in which the patient makes an arrangement with a law firm and the latter undertakes all responsibilities with respect to the suing decision.

4.2 The risk-neutral law firm

In this section, I assume that the patient contracts with a law firm who decides either to sue or not. The law firm is responsible for the lawsuit costs and receives a proportion $\lambda$ of the patient’s compensation if the latter won against the physician or the physician’s attorney. If however, the law firm loses, the patient is not charged. This type of agreement between a law firm and a patient (more broadly a client) where the fee is only charged when the lawsuit is successful is termed in legal literature as \textit{contingency fee}. Most contingency fees can range from one-third to 50% of the award.\textsuperscript{10} This high percentage can be explained by the fact that, given that the law firm has many cases to defend, the expected gain when it win must compensate the expected costs in cases lost.

Formally, for a given level of compensation $\phi$, the law firm will sue if and only if: $\lambda q \phi - k \geq 0$, that is, $\phi \geq \frac{k}{\lambda q} = \phi^L$, where $\phi^L$ denotes a risk-neutral law firm’s threshold of indifference between suing or not. For the patient, if the law firm sues, his expected utility is $q [U(y - \alpha + (1 - \lambda)\phi)] + (1 - q) [U(y - \alpha)]$ which is always greater than $U(y - \alpha)$ if $\lambda \leq 1$. Since the optimal agreement between the patient and the law firm must be such as $\lambda^* \leq 1$, thus a risk-averse patient will always prefer to transferate the suing responsibilities to a law firm. But, as I showed above, the law firm’s suing decision depends on the value of his thresh-

\textsuperscript{10}Source: 'Medical Malpractice Law in the United States', Kaiser Family Foundation. May 2005.
old of indifference \((\tilde{\phi}^L)\) and thus he will not always accept to take the suing responsibilities.

Given that \(\lambda^* \leq 1\), then it follows that a (risk-neutral) patient’s threshold of indifference between suing and not (i.e., \(\tilde{\phi}^P\)) is lower than that of the law firm (i.e., \(\tilde{\phi}^L\)). In other words, the law firm will accept the contingency fee’s agreement if and only if \(\phi\) is sufficiently high. More specifically, if \(\phi \leq \tilde{\phi}^P\), then the risk-averse patient will never sue; if \(\phi \in (\tilde{\phi}^P, \tilde{\phi}^L)\), then the patient may sue; finally if \(\phi \geq \tilde{\phi}^L\), then the law firm will sue.

As a numerical example, assume that the probability to win a medical malpractice claim against a physician is 50% and if the latter is won, each party receives 50%. The litigation costs are assumed to be $10,000. It follows that the patient’s threshold of indifference is $20,000 (i.e., \(\frac{10000}{0.5}\)) and that of the law firm is $40,000 (i.e., \(\frac{10000}{0.5\times0.5}\)). As a consequence, if the award is lower than $20,000, then both the patient and the law firm will not sue. If the award is higher than $20,000 but lower than $40,000, then the patient may sue but the law firm will not. Finally, if the award is higher than $40,000, then the law firm will sue.

To sum up, the patient’s expected utility is always higher if a third party as a law firm undertakes all the suing responsibilities. But, since the law firm receives only a proportion of the award, it will accept the contingency fee contract if and only if the award is relatively high. Moreover, given that, I showed that the level of the patient’s compensation is proportionate to the harm, thus the law firm will only accept cases involving a seriously injury. It follows that, if the amount of compensation is reduced, then the lawyers will refuse some cases.
5 Conclusion

In this paper, I derive simultaneously in a game-theoretical model, optimal payment contracts for the physician and optimal compensation for the patient given that he is injured by the physician’s action. I find that the flexibility of the payment mechanisms allows to derive a level of sanctions which is credible. The model predicts some findings that are consistent with the real world observations. First, it predicts that the fees incurred by the patient to sue a physician is negatively related to the suing probability; and second, the patient’s compensation is proportionate to the damage. By relaxing the risk neutrality assumption on patients’ side, I find that some patients who are treated inappropriately will not sue and as a consequence, the claiming rate will be low. I also find that a risk-averse patient will always prefer to transferate the suing responsibilities to a law firm; but the latter will only accept cases involving a seriously injury. Finally, the model also predicts that policies that tend to impose caps on medical malpractice awards will lower the claiming rate; this is because many cases will become unattractive for lawyers who accept the contingency fee contract.
References


**Appendix A**: Proof of $\phi_1^*.$

\[
\frac{\partial W}{\partial v^*} = (1 - p) \left[ c - (s - r)(\tilde{h} - \bar{h}) \right] - f^e k (1 - p) (1 - r) = 0
\]

which is equivalent to:

\[
\left[ c - (s - r)(\tilde{h} - \bar{h}) \right] - f^e k (1 - r) = 0
\]

Substituting for $f^e$ and rearranging, we get:

\[
\phi_1^* p (1 - m) \left[ c - (s - r)(\tilde{h} - \bar{h}) \right] - [ckp (1 - m) - (1 - r) (\phi_1^* - k) [C_H - pc - \alpha]] = 0
\]

and $\phi_1^*$ follows as:

\[
\phi_1^* = k \frac{p (1 - m) c + (1 - r) [C_H - pc - \alpha]}{p (1 - m) \left[ c - (s - r)(\tilde{h} - \bar{h}) \right] + (1 - r) [C_H - pc - \alpha]}
\]