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**PATIENT DUMPING, OUTLIER PAYMENT,  
AND OPTIMAL HEALTHCARE PAYMENT POLICY  
UNDER ASYMMETRIC INFORMATION**

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# Patient Dumping, Outlier Payment, and Optimal Healthcare Payment Policy under Asymmetric Information\*

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## Abstract

We analyze the rationale for official authorization of patient dumping in the prospective-payment policy framework. We show that when the insurer designs the healthcare payment policy to let hospitals dump high-cost patients, there is a trade-off between the disutility of dumped patients (changes in hospitals' rent extracting due to low-severity patients) and the shift in the cost-reduction effort level for high-severity patients. We also clarify the welfare-improving conditions by allowing hospitals to dump high-severity patients. Finally, we show that if the efficiency of the cost-reduction effort varies by much and the healthcare payment cost is large, or if there exist many private hospitals, the insurer can improve social welfare in a wider environment.

**JEL Classification Code:** I13, I18, L51

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# 1 Introduction

In many countries, government agencies like to introduce social security systems that decrease healthcare payment while providing high-quality medical services. There are two types of healthcare reimbursement policies to achieve this end: the retrospective-payment system and the prospective-payment system.<sup>1</sup> The retrospective-payment system is a cost-based payment system, that is, insurers pay the whole treatment cost to hospitals. The prospective-payment system is such that insurers pay a fixed payment, defined by a government agency, for each diagnosis per admission. This payment system gives a strong incentive to hospitals to reduce the treatment cost, and may yield socially optimal cost reductions in hospitals.<sup>2</sup> Accordingly, in some countries, prospective payment has been introduced to reduce the cost of social security.<sup>3</sup>

Under the prospective-payment system, however, hospitals must incur some risk when treating extraordinarily costly patients (also called “outlier patients”). If hospitals admit outlier patients, they make losses even if they make socially optimal efforts to reduce the treatment cost. There then naturally arises an incentive for hospitals to refuse medical treatment to avoid this financial risk: this problem is known as the “dumping problem” in the literature.<sup>4</sup> The social cost of patient dumping is obvious as, for one thing, it triggers treatment delays that can be fatal. Further, as pointed out by Newhouse (1983), the dumping problem stimulates patient convergence on particular hospitals such as public hospitals, leading to crowding therein and even higher treatment delays.

Given this cost associated with the possibility of patient dumping, a clear alternative is to insure hospitals for some fraction of the extra costs needed to treat each outlier patient.<sup>5</sup> We call this the outlier payment policy for expositional clarity. This is precisely what was adopted in the United States in 1990s to alleviate the dumping problem. Under this policy, when

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<sup>1</sup>For instance, see Newhouse (1996) for this classification.

<sup>2</sup>Stephen and Berger (2003) point out that a patient’s path way (preclinical medical plan) shortens the length of hospital stay, and reduces the total treatment cost.

<sup>3</sup>The prospective-payment system was, for instance, adopted in 1983 in the United States. In contrast, there are still some countries, such as Japan, which adopt the retrospective-payment system.

<sup>4</sup>This problem is discussed in Ma (1994).

<sup>5</sup>If insurers pay all of the treatment cost, hospitals take no risk, and such a healthcare payment system is equivalent to the retrospective-payment system.

hospitals admit outlier patients, the insurer pays an additional payment equal to some part of the excess cost over the fixed payment. This additional payment can reduce the financial risk faced by hospitals, thereby contributing to a decrease in the number of dumped patients.

The overall welfare effect of the outlier payment policy is, however, not necessarily clear as there may be potential gains from letting hospitals dump their patients as they wish. We argue that the adoption of the outlier payment policy is not always justified even though hospitals are less likely to dump their patients when they are insured against outlier patients. To make this point, we consider a canonical model of adverse selection in which there are two hospitals, called private and public for expositional purposes. The only difference between the two hospitals is that the insurer may induce the private hospital to dump its patients whereas she cannot allow the public hospital to do so, perhaps due to some legal restrictions. We assume that patients randomly visit one of the hospitals that privately observes the treatment cost for each patient.<sup>6</sup> In this setting, the insurer devises a contract on healthcare payment that is based on the hospitals' effort levels. Given the contract, the hospitals then decide which patients are to be dumped, and set their cost-reduction effort levels.

To see the potential welfare consequences of patient dumping, suppose that the insurer chooses not to adopt the outlier payment policy and instead allows the private hospital to selectively dump its high-severity patients. Under this policy, which we call the patient dumping policy throughout the analysis, it is too costly for the private hospital to provide medical treatment to high-severity patients, and a bulk of those high-severity patients are eventually transferred to the public hospital as a consequence. Although patient dumping itself is welfare-reducing, it also endogenously changes the distribution of patients across hospitals and gives rise to a sorting effect that substantially alleviates information asymmetry regarding the patients' types. This sorting effect is potentially welfare-improving because it is instrumental in reducing the amount of information rent and consequently realizing a more efficient level of cost reduction for high-severity patients in equilibrium. We show that the social cost of patient dumping can be outweighed by the gain from the sorting effect under some conditions, suggesting that there are situations in which some degree of patient dumping should be

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<sup>6</sup>This assumption of asymmetric information is a common assumption in the literatures; see Mougeot and Naegelen (2008); Sappington and Lewis (1999); Beitia (2003); Siciliani (2006); Chalkley and Khalil (2005); Marchand *et al.* (2003); Glazer and McGuire (2000); Chalkley and Malcomson (1998).

tolerated for the betterment of society.

There are several findings. First, if the difference in terms of cost-reduction efficiency between high-severity patients and low-severity patients is large, even when the ratio of high-severity patients is large, the patient dumping policy is optimal in a wider environment.<sup>7</sup> Intuitively, under this circumstance, separating the payment for high-/low-severity patients is too costly due to increased information rent, and the patient dumping policy is advantageous as a healthcare payment policy. Second, if the healthcare payment cost (administrative cost for a healthcare system) is large, the outlier payment policy is more preferred over the patient dumping policy.<sup>8</sup> This is because under this condition, the optimal information rent under the outlier payment policy is small, and the information-rent saving effect of introducing the patient dumping policy is small. Third, if the number of patient-dumping hospitals, such as private hospitals, is large, the patient dumping policy is more welfare-improving. If government agencies adopt the patient dumping policy, they need not pay information rent to the hospitals that dump high-severity patients, while in the outlier payment policy, government agencies need to pay information rent to all hospitals. As such, we insist that when choosing between the outlier payment policy and the patient dumping policy, insurers should make a decision considering the circularity of the private hospitals.<sup>9</sup>

Our main contribution in this paper is to show the possibility that the patient dumping policy can be an optimal healthcare payment policy. Many works analyze patient dumping (Newhouse (1983), Dranove (1987), Eze and Wolfe (1993), Newhouse (1996), and Meltzer *et al.* (2002)). Newhouse (1983) shows the possibility that patient dumping may occur under the prospective-payment system, and under competition between hospitals. Dranove (1987) shows that the patient dumping policy can be efficient due to the specialization of hospitals

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<sup>7</sup>The difference in cost-reduction efficiency is, for instance, actuated by preventive medicine. The effect of preventive medicine on the treatment cost is studied in Cohen *et al.* (2008) with data from the Tufts-New England Medical Center.

<sup>8</sup>Woolhandler and Himmelstein (1991) and Woolhandler *et al.* (2003) compare the administrative cost for healthcare program per capita between the United States and Canada. Skinner *et al.* (2005) investigates the determinant of the inefficiency of the Medicare program in the United States.

<sup>9</sup>In any region in United States, The Emergency Medical Treatment and Active Labor Act inhibits patient dumping, and Centers for Medicare and Medicaid Services, which is a division of United States Department of Health and Human Service, reimburses the treatment cost under the Medicare program. (This payment can be considered to be an outlier payment.)

and the concentration of patients. Eze and Wolfe (1993) also shows the optimality of the patient dumping policy using the example of the United States Veterans Affairs hospital in-patient services. The results of these two research works are similar to ours. However, in the two researches, the source of efficiency by patient dumping is from “gains from specialization,” while in my paper, the consequence of efficiency by patient dumping is “gains from information.”

This article assumes that insurers offer severity-dependent contracts to hospitals as a healthcare payment policy. Allen and Gertler (1991) discusses the optimality of this selective payment policy.<sup>10</sup> We too assume that the hospitals treat patients selectively. This assumption is consistent with the theoretical conclusion of Ellis (1998).<sup>11</sup>

The outlier payment can be interpreted as a severity-dependent contract. Keeler *et al.* (1998) show that the outlier payment policy acts as an insurance for hospitals.<sup>12</sup> Many prior works investigate the optimal scheme under outlier payment (Ellis and McGuire (1990), Ma (1994), Mougeot and Naegelen (2008), Jack (2005), and Jack (2006)). Ellis and McGuire (1990)) analyze consumer-welfare-maximizing outlier-payment scheme. Other previous works study the optimal ratio of the outlier payment. Ma (1994) investigates optimal outlier payment under the assumption of 2-dimensional efforts (cost reduction and treatment quality) by hospitals: he reveals that the insurers should reimburse all of the treatment cost. Mougeot and Naegelen (2008) study the optimal outlier payment under asymmetric information between insurers and hospitals, and conclude that the insurers should reimburse all of the treatment cost even under asymmetric information.

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<sup>10</sup>There exist many works on the optimality of outlier payment: Glazer and McGuire (2002); Ellis and McGuire (1986); Selden (1990); Ellis (1998); Newhouse (1996); Meltzer *et al.* (2002); Glazer and McGuire (2000); Barros (2003); Keeler *et al.* (1998); Jack (2006); Chalkley and Malcomson (1998); Eggleston (2005); Glazer and McGuire (2000).

<sup>11</sup>See also Frank *et al.* (2000), Ellis and McGuire (1996), Ellis and McGuire (1996), Siciliani (2006), and Eggleston (2000).

<sup>12</sup>See also Marchand *et al.* (2003).

## 2 Model

### 2.1 Environment

We consider a healthcare payment system in which a public insurer offers contracts to a private hospital and a public hospital for treatment of patients with a specific diagnosis. Throughout the analysis, we denote each hospital by  $j$ , where  $j = pr$  indicates the private hospital and  $j = pu$ , the public hospital. As stated, the only difference between the two hospitals is that the insurer may induce the private hospital to selectively dump its patients whereas it is not allowed to do so for the public hospital. The reason underlying this assumption is that if a public hospital dumps a specific type of patient, he is unlikely to receive any medical attention; in fact, in the United States, public hospitals cannot dump any patient. Aside from this, the two hospitals are assumed to be identical and have the same technological acumen.

To keep the matter simple, we assume that decision making by patients is given exogenously:  $\lambda \in (0, 1)$  people go to the private hospital, and  $(1 - \lambda)$  people go to the public hospital.<sup>13</sup> After a patient chooses a hospital, the chosen hospital privately observes patient severity  $i \in \{H, L\}$ , where  $i = H$  denotes a high-severity patient and  $i = L$ , a low-severity patient. The insurer knows that any given patient is of the high-severity type with probability  $\phi \in (0, 1)$ , which is common knowledge.

### 2.2 Hospitals

Each hospital can decrease the treatment cost by exerting cost-reducing effort.<sup>14</sup> The marginal productivity of cost-reducing effort depends on patient severity, and we assume that for the same effort level, cost reduction is higher for low-severity patients as compared to high-severity ones. Cost-reduction effort has potentially adverse consequences for hospitals, such as via extended duty hours. For a hospital with patient severity  $i$ , total cost  $C(i, e)$  can be written as

$$C(i, e) = c - \theta_i e + \frac{1}{2} e^2, \quad i \in \{L, H\}. \quad (1)$$

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<sup>13</sup>We assume that each patient does not know his or her severity and simply chooses a hospital based solely on exogenous factors such as geographical proximity. Of course, we can obtain qualitatively similar results as long as exogenous factors play some effect.

<sup>14</sup>For example, the degree of preventive care by doctors can be interpreted as such a variable.

Here,  $c$  is the common cost of treatment for any patient type, and is assumed to be sufficiently large. We also assume that  $\theta_L > \theta_H > 0$ , which means that it is easier to reduce the treatment cost for low-severity patients. The last term represents the hospital's disutility from exerting cost-reduction effort. Letting  $w$  denote the healthcare payment collected from the insurer, the payoff function of a hospital with a type- $i$  patient can be written as<sup>15</sup>

$$\tilde{\pi}(i, w, e) = w - c + \theta_i e - \frac{1}{2}e^2, \quad i \in \{L, H\}. \quad (2)$$

### 2.3 Insurer

The insurer offers a take-it-or-leave-it contract to each hospital that specifies a healthcare payment and a cost-reduction effort level for each patient severity as reported by the hospital. The contract specifies the healthcare payment  $w_i^j$  and the cost-reduction effort level  $e_i^j$  for a given report  $\hat{i}$ . Define  $\omega_i^j \equiv (e_i^j, w_i^j)$  and  $\omega^j \equiv (\omega_H^j, \omega_L^j)$ .

The objective of the insurer is to maximize social welfare, assumed to consist of (i) the patients' utility, (ii) the social cost of treatment, and (iii) the payment made by the insurer. To achieve this, the insurer devises a contract contingent on the hospital's report  $\hat{i}$  about patient severity. Given the pair of menu contracts  $(\omega^{pr}, \omega^{pu})$ , assuming truth-telling, the insurer's payoff is given by

$$\begin{aligned} W(\omega^{pr}, \omega^{pu}) = & \lambda \{ \phi [ [1 - C(H, e_H^{pr}) - \eta w_H^{pr}] (1 - d) \\ & + [\gamma - C(H, e_H^{pu}) - \eta w_H^{pu}] d ] + (1 - \phi) [1 - C(L, e_L^{pr}) - \eta w_L^{pr}] \} \\ & + (1 - \lambda) \{ \phi [1 - C(H, e_H^{pu}) - \eta w_H^{pu}] + (1 - \phi) [1 - C(L, e_L^{pu}) - \eta w_L^{pu}] \}, \quad (3) \end{aligned}$$

where  $d$  is an indicator function that takes  $d = 1$  when the private hospital dumps high-severity patients and  $d = 0$  otherwise. We normalize patients' utility when they receive immediate medical treatment to 1. In contrast, the utility of dumped patients is given by  $\gamma \in (-\infty, 1)$  which captures the ill-effects of patient dumping, such as delayed attention and additional treatment cost.<sup>16</sup> Finally,  $\eta \in [1, \infty)$  represents a healthcare payment cost.

<sup>15</sup>All propositions hold as long as the hospital's payoff function has the Spence-Mirrlees single crossing property.

<sup>16</sup>This additional treatment cost contains the social cost pointed out by Newhouse (1983).



## 2.4 Timing

The timing of the game is summarized as follows:

1. the insurer offers contracts to the hospitals;
2. a fraction  $\lambda$  of patients go to the private hospital and the remaining fraction  $1 - \lambda$  of patients go to the public hospital, with no patient being aware of his severity;
3. the hospitals observe the severity of the patients;
4. they decide whether or not to dump the patients, and if yes, which patients to dump;
5. they choose the cost-reduction effort level;
6. they report patients' severity to and charge healthcare payments from the insurer, and the contract is implemented.

## 3 Optimal Healthcare Payment under Symmetric Information

In this section, we characterize the first-best healthcare payment system as a benchmark. With symmetric information, we suppose that the insurer can observe patient severity, thereby being able to impose its preferred cost-reduction effort level on the hospital without information rent. It is easy to see that the insurer would prefer no patient dumping, and the first-best contract must satisfy the following participation constraint for each  $i = L, H$  and each  $j = pr, pu$ :

$$w_i^j - c + \theta_i e_i^j - \frac{1}{2} e_i^{j2} \geq 0. \quad (PC_i^j)$$

For each  $i = L, H$  and each  $j = pr, pu$ , the insurer's problem is defined as follows:

$$\begin{aligned} \max_{\omega_i^j} \quad & \lambda \{ \phi [1 - C(H, e_H^{pr}) - \eta w_H^{pr}] + (1 - \phi) [1 - C(L, e_L^{pr}) - \eta w_L^{pr}] \} \\ & + (1 - \lambda) \{ \phi [1 - C(H, e_H^{pu}) - \eta w_H^{pu}] + (1 - \phi) [1 - C(L, e_L^{pu}) - \eta w_L^{pu}] \}, \quad (4) \\ \text{subject to} \quad & (PC_i^j). \end{aligned}$$

It is obvious that at the optimal solution, all constraints are binding. Further, there is no reason to treat them differently, since the hospitals are symmetric. This implies that by substituting the participation constraint, the optimization problem for each hospital  $j$  can be rewritten as

$$\max_{e_H^j, e_L^j} \phi[1 - (1 + \eta)(c - \theta_H e_H^j + \frac{1}{2} e_H^{j2})] + (1 - \phi)[1 - (1 + \eta)(c - \theta_L e_L^j + \frac{1}{2} e_L^{j2})]. \quad (5)$$

Solving this optimization problem, we now obtain the first-best allocation. As we assume that there exists no disparity in technology, the solution is symmetric between hospitals.

**Proposition 1.** *If there is no asymmetric information between the insurer and the hospitals, the optimal cost-reduction effort and the optimal cost-reduction effort (the first-best contract) are as follows:*

$$e_H^{pr^{FB}} = e_H^{pu^{FB}} = \theta_H, \quad (6)$$

$$e_L^{pr^{FB}} = e_L^{pu^{FB}} = \theta_L, \quad (7)$$

$$w_H^{pr^{FB}} = w_H^{pu^{FB}} = c - \frac{1}{2} \theta_H^2, \quad (8)$$

$$w_L^{pr^{FB}} = w_L^{pu^{FB}} = c - \frac{1}{2} \theta_L^2. \quad (9)$$

## 4 Optimal Healthcare Payment under Asymmetric Information

### 4.1 Optimal outlier payment policy

In this subsection, we obtain the optimal healthcare payment with outlier payment, or simply the optimal outlier payment policy, under asymmetric information. Formally, any outlier payment policy requires that the insurer devise a contract that satisfies all the participation constraints. Furthermore, since the insurer cannot observe patient severity, the optimal contract must also satisfy the following incentive-compatibility constraint for each  $i = L, H$  and each  $j = pr, pu$ :

$$w_i^j + \theta_i e_i^j - \frac{1}{2} e_i^{j2} \geq w_i^{\tilde{j}} + \theta_i e_i^{\tilde{j}} - \frac{1}{2} e_i^{\tilde{j}2}, \quad i \neq \tilde{i}. \quad (IC_i^j)$$

Because the insurer designs the payment system to bar patient dumping,  $d = 0$  in (3), and the insurer's problem can be written as follows:

$$\begin{aligned} \max_{\omega_i^j} \quad & \lambda\{\phi[1 - C(H, e_H^{pr}) - \eta w_H^{pr}] + (1 - \phi)[1 - C(L, e_L^{pr}) - \eta w_L^{pr}]\} \\ & + (1 - \lambda)\{\phi[1 - C(H, e_H^{pu}) - \eta w_H^{pu}] + (1 - \phi)[1 - C(L, e_L^{pu}) - \eta w_L^{pu}]\}, \quad (10) \\ \text{subject to } & (PC_i^j) \text{ and } (IC_i^j), \end{aligned}$$

for each  $i = L, H$  and each  $j = pr, pu$ . The following lemma, which is well known in the literature,<sup>17</sup> is helpful in solving this optimization problem.

**Lemma 1.** *At the optimal solution,  $(PC_H^{pr})$ ,  $(PC_H^{pu})$ ,  $(IC_L^{pr})$ , and  $(IC_L^{pu})$  are binding.*

This lemma implies that the following equations must be satisfied:

$$w_H^j = c - \theta_H e_H^j + \frac{1}{2} e_H^{j^2}, \quad (11)$$

$$w_L^j = c - \theta_L e_L^j + \frac{1}{2} e_L^{j^2} + e_H^j \Delta\theta, \quad (12)$$

for  $j = pr, pu$ , where  $\Delta\theta \equiv \theta_L - \theta_H > 0$ . Note also that the problem faced by one hospital is again independent from and identical to the one faced by the other hospital since there exists no technology gap in treatment. Then, the optimization problem can be rewritten as

$$\begin{aligned} \max_{e_H^{pr}, e_L^{pr}, e_H^{pu}, e_L^{pu}} \quad & \lambda\{\phi[1 - (1 + \eta)(c - \theta_H e_H^{pr} + \frac{1}{2} e_H^{pr^2}) \\ & + (1 - \phi)[1 - (1 + \eta)(c - \theta_L e_L^{pr} + \frac{1}{2} e_L^{pr^2}) - \eta e_H^{pr} \Delta\theta]\} \\ & + (1 - \lambda)\{\phi[1 - (1 + \eta)(c - \theta_H e_H^{pu} + \frac{1}{2} e_H^{pu^2}) \\ & + (1 - \phi)[1 - (1 + \eta)(c - \theta_L e_L^{pu} + \frac{1}{2} e_L^{pu^2}) - \eta e_H^{pu} \Delta\theta]\}. \quad (13) \end{aligned}$$

Using the above, we obtain the optimal cost-reduction effort level in case of the outlier payment policy:

$$e_H^{pr, I^*} = e_H^{pu, I^*} = \theta_H - \frac{\eta}{1 + \eta} P \Delta\theta, \quad (14)$$

$$e_L^{pr, I^*} = e_L^{pu, I^*} = \theta_L, \quad (15)$$

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<sup>17</sup>For example, see Salanié (2005).

where  $P \equiv \frac{1-\phi}{\phi}$ . Here, we assume  $\theta_H - \frac{\eta}{1+\eta}P\Delta\theta > 0$  to assure the existence of an interior solution.

Next, we obtain the optimal healthcare payment using (11), (12), (14), and (15). It is straightforward to show that

$$w_H^{pr,I*} = w_H^{pu,I*} = c - \frac{1}{2}\theta_H^2 + \frac{1}{2}\left(\frac{\eta}{1+\eta}P\Delta\theta\right)^2, \quad (16)$$

$$w_L^{pr,I*} = w_L^{pu,I*} = c - \frac{1}{2}\theta_L^2 + \left(\theta_H - \frac{\eta}{1+\eta}P\Delta\theta\right). \quad (17)$$

Comparing (6) and (14), we can observe that the cost-reduction effort level for high-severity patients under the outlier payment policy is distorted downwards. Since the cost-reduction effort level under the outlier payment policy is smaller than the first-best level, the total treatment cost and the optimal healthcare payment for high-severity patients are larger (the third term in (16)). In contrast, while the optimal cost-reduction effort level for low-severity patients under the outlier payment policy is not distorted, the insurer needs to set a higher healthcare payment (the third term in (17)). This too is an effect of information asymmetry. We summarize the optimal contract under the outlier payment policy as follows.

**Proposition 2.** *When the insurer constructs the healthcare payment system to not dump any patients, the optimal healthcare payment compared to the first-best case is such that*

$$\begin{aligned} e_H^{pr,I*} &< e_H^{pr^{FB}} = e_H^{pu^{FB}}, \\ e_L^{pr,I*} &= e_L^{pu^{FB}}, \\ w_H^{pr,I*} &> w_H^{pr^{FB}} = w_H^{pu^{FB}}, \\ w_L^{pr,I*} &> w_L^{pr^{FB}} = w_L^{pu^{FB}}. \end{aligned}$$

## 4.2 Optimal Patient Dumping Policy

We now examine the optimal healthcare payment policy when the private hospital is induced to dump high-severity patients. In this case, the insurer sets the healthcare payment for the private hospital with a participation constraint with respect to only low-severity patients. The insurer then obviously offers the first-best contract for low-severity-patients. The profit of the

private hospital when it admits high-severity patients is given by

$$\pi(H, e_L^{FB}) = w_L^{FB} - c + \theta_H e_L^{FB} - \frac{1}{2} e_L^{FB} = \theta_L(\theta_H - \theta_L) < 0. \quad (18)$$

Hence, the private hospital would refuse to provide medical treatment to high-severity patients, which can be observed by the insurer. The objective function of the insurer can be then written as follows:

$$\begin{aligned} \max_{\omega_i^j} \quad & \lambda\{\phi[\gamma - C(H, e_H^{pu}) - \eta w_H^{pu}] + (1 - \phi)[1 - C(L, e_L^{pr}) - \eta w_L^{pr}]\} \\ & + (1 - \lambda)\{\phi[1 - C(H, e_H^{pu}) - \eta w_H^{pu}] + (1 - \phi)[1 - C(L, e_L^{pu}) - \eta w_L^{pu}]\}, \end{aligned} \quad (19)$$

subject to  $(PC_L^{pr})$ ,  $(IC_i^{pu})$ , and  $(PC_i^{pu})$ ,

for each  $i = L, H$  and each  $j = pr, pu$ . Note that the public hospital is still barred from patient dumping, and thus the participation constraint for high-severity patients must be satisfied for the public hospital.

To solve this problem, we use Lemma 1 again and obtain

$$w_L^{pr} = c - \theta_L e_H^{pr} + \frac{1}{2} e_L^{pr^2}, \quad (20)$$

$$w_H^{pu} = c - \theta_H e_H^{pu} + \frac{1}{2} e_H^{pu^2}, \quad (21)$$

$$w_L^{pu} = c - \theta_L e_L^{pu} + \frac{1}{2} e_L^{pu^2} + e_H^{pu} \Delta\theta. \quad (22)$$

Given these, the problem can now be rewritten as

$$\begin{aligned} \max_{e_L^{pr}, e_H^{pu}, e_L^{pu}} \quad & \lambda(1 - \phi)[1 - (1 + \eta)(c - \theta_L e_L^{pr} + \frac{1}{2} e_L^{pr^2})] \\ & + (1 - \lambda)(1 - \phi)[1 - (1 + \eta)(c - \theta_L e_L^{pu} + \frac{1}{2} e_L^{pu^2}) - \frac{1}{2} \eta e_H^{pu} \Delta\theta] \\ & + \phi[\lambda\gamma + (1 - \lambda) - (1 + \eta)(c - \theta_H e_H^{pr} + \frac{1}{2} e_H^{pr^2})]. \end{aligned} \quad (23)$$

This problem yields the optimal cost-reduction effort level under patient dumping policy:

$$e_L^{pr, II*} = \theta_L, \quad (24)$$

$$e_H^{pu, II*} = \theta_H - (1 - \lambda) \frac{\eta}{1 + \eta} P \Delta\theta, \quad (25)$$

$$e_L^{pu, II*} = \theta_L. \quad (26)$$

Further, the optimal healthcare payment can be obtained by substituting (24), (25), and (26) into (20), (21), and (22):

$$w_L^{pr,II*} = c - \frac{1}{2}\theta_L^2, \quad (27)$$

$$w_H^{pu,II*} = c - \frac{1}{2}[\theta_H - (1 - \lambda)\frac{\eta}{1 + \eta}P\Delta\theta][\theta_H + (1 - \lambda)\frac{\eta}{1 + \eta}P\Delta\theta], \quad (28)$$

$$w_L^{pu,II*} = c - \frac{1}{2}\theta_H^2 + [\theta_H - (1 - \lambda)\frac{\eta}{1 + \eta}P\Delta\theta]\Delta\theta. \quad (29)$$

In this case, unlike in the previous cases, the optimal contract is asymmetric between hospitals even though we do not assume technology asymmetry. The key here is that the insurer does not need to provide any information rent to the private hospital, but still pays it to the public hospital. Comparing (17) and (29), we can observe that the information rent for the public hospital is higher under the patient dumping policy than under the outlier payment policy. In contrast, comparing (14) and (25), we also show that the distortion in the cost-reduction effort level for high-severity patients is smaller under the patient dumping policy than under the outlier payment policy. The optimal healthcare payment system in case of the patient dumping policy is summarized by the following proposition.

**Proposition 3.** *The optimal healthcare payment policy under the patient dumping policy is such that*

$$\begin{aligned} e_L^{pr,II*} &= e_L^{pu,II*} = e_L^{pr,I*} = e_L^{pu,I*} = e_L^{pr^{FB}}, \\ e_H^{pu,II*} &> e_H^{pu,I*} > e_H^{pu^{FB}}, \\ w_L^{pr,II*} &= w_L^{pr^{FB}} < w_L^{pr,I*}, \\ w_H^{pu,I*} &> w_H^{pu,II*} > w_H^{pu^{FB}}, \\ w_L^{pu,II*} &> w_L^{pu,I*} > w_L^{pu^{FB}}. \end{aligned}$$

We term the optimized social welfare in case of the patient dumping policy as  $W^{II*}$ .

## 5 Welfare Analysis

### 5.1 Welfare Comparison

We have thus far characterized the optimal contracts under two distinct regimes: outlier payment and patient dumping. Given these results, we are now ready to compare the two policies in terms of social welfare to illustrate whether and when a degree of patient dumping should be tolerated. To this end, we first compute the welfare difference between the two policies (hereafter, welfare difference) as follows:

$$\begin{aligned}
 W^{H*} - W^{L*} = & \underbrace{\frac{1}{2}\phi\lambda(1+\eta)\left(\frac{\eta}{1+\eta}P\Delta\theta\right)^2(2-\lambda) - \phi\lambda(1-\gamma)}_{\text{Heavy-severity patients}} \\
 & + \underbrace{\lambda(1-\phi)\eta(\theta_H - \frac{\eta}{1+\eta}P\Delta\theta\Delta\theta)}_{\text{Low-severity patients in the private hospital}} \\
 & - \underbrace{(1-\lambda)(1-\phi)\eta\lambda\frac{\eta}{1+\eta}P\Delta\theta^2}_{\text{Low-severity patients in the public hospital}}. \tag{30}
 \end{aligned}$$

Obviously, the patient dumping policy is preferred over the outlier payment policy when this difference is strictly positive. The first term gives the welfare difference associated with the treatment cost and the payment cost when  $i = H$  (which we simply call the welfare difference for high-severity patients for expositional purposes). As mentioned above, the optimal cost-reduction effort level for high-severity patients is higher under the patient dumping policy, which always contributes to a welfare improvement. The second term gives the welfare difference associated with patients' utility when  $i = H$  and  $i = pr$  (the welfare difference for high-severity patients in the private hospital), which is always negative because the utility of dumped patients is discounted to  $\gamma$ . The third term gives the welfare difference when  $i = L$  and  $j = pr$  (the welfare difference for low-severity patients in the private hospital), which is always positive because the insurer does not pay any information rent to the private hospital under the patient dumping policy. Finally, the last term reflects the welfare difference when  $i = L$  and  $j = pu$  (the welfare difference for low-severity patients in the public hospital) which is negative because the insurer needs to provide a larger information rent in this contingency under the patient dumping policy.

It is clear that the patient dumping policy is less likely to be optimal when the cost of patient dumping is relatively large ( $\gamma$  is small). We can then conjecture that there exists a threshold level  $\bar{\gamma}$  such that the outlier payment policy is optimal if and only if  $\bar{\gamma} > \gamma$ . By rearranging (30), the threshold is computed as

$$\begin{aligned}\bar{\gamma} &= 1 - \underbrace{\frac{1}{2} \frac{\eta^2}{1+\eta} P^2 \Delta \theta^2 (2-\lambda)}_{\text{High-severity patients}} - \underbrace{\eta P (\theta_H - \frac{\eta}{1+\eta} P \Delta \theta) \Delta \theta}_{\text{Low-severity patients in the private hospital}} + \underbrace{(1-\lambda) P^2 \frac{\eta^2}{1+\eta} \Delta \theta^2}_{\text{Low-severity patients in the public hospital}} \\ &= 1 - \eta P \Delta \theta \left\{ \theta_H - \frac{\eta}{1+\eta} P \Delta \theta \left( 1 - \frac{1}{2} \lambda \right) \right\}.\end{aligned}\quad (31)$$

Since  $\theta_H - \frac{\eta}{1+\eta} P \Delta \theta > 0$  and  $\lambda \in (0, 1)$  by assumption,  $\theta_H - \frac{\eta}{1+\eta} P \Delta \theta > 0$ . We also assume that  $\eta$ ,  $\Delta$ , and  $\theta$  are positive, and by definition,  $P$  is positive as well. This implies that  $\bar{\gamma} \neq 1$ . Thus, we obtain the following proposition.

**Proposition 4.** *If the cost of patient dumping is small (i.e.,  $\gamma \rightarrow 1$ ), the insurer can improve social welfare by introducing the patient dumping policy instead of the outlier payment policy.*

## 5.2 Comparative Statics

We now assess the impact of changes in the external conditions on the optimal healthcare payment system. In particular, we focus on two factors: a change in the ratio of low-/high-severity patients, and a change in the ratio of public-/private-hospital patients.

### 5.2.1 Higher Ratio of High-Severity Patients

We start with the effect of the ratio of low-/high-severity patients, as captured by  $P$ , and examine how a change in  $P$  affects the threshold  $\bar{\gamma}$ . A change in  $P$  generally has three effects on social welfare. The first effect is the “number effect,” that is, the effect on the number of patients for which the insurer pays information rent to the hospital: if the number of high-severity patients increases, the number of patients for which the insurer pays information rent to the hospital decreases. The second effect is the “distortion effect,” which is shown in (14) and (25). It can be seen that the extent of distortion in the cost-reduction effort level reduces as the number of high-severity patients increases. Finally, the third effect is the “information-rent effect,” which is shown in (17) and (29). The size of information rent decreases with an increase (a decrease) in the number of high-severity (low-severity) patients.



To evaluate the welfare impact of a change in  $P$  more precisely, it is instructive to decompose the welfare difference into three elements as above: the welfare difference for (i) high-severity patients, (ii) low-severity patients in the private hospital, and (iii) low-severity patients in the public hospital. With some algebra, we obtain

$$-\frac{\partial \bar{\gamma}}{\partial P} = \underbrace{\frac{\eta^2}{1+\eta} P \Delta \theta^2 (2-\lambda)}_{\text{High-severity patients}} + \underbrace{[\eta \Delta \theta \theta_H - 2 \frac{\eta^2}{1+\eta} \Delta \theta^2 P]}_{\text{Low-severity patients in the private hospital}} - \underbrace{2(1-\lambda) P \frac{\eta^2}{1+\eta} \Delta \theta^2}_{\text{Low-severity patients in the public hospital}}. \quad (32)$$

1. For high-severity patients, only the distortion effect influences welfare. As seen in (14) and (25), the distortion effect is larger under the outlier payment policy. As such, if  $P$  decreases (i.e., there exist a large number of high-severity patients and a small number of low-severity patients), the gap in welfare under the two cases reduces, and  $\bar{\gamma}$  increases (shown by the first term in (32)).
2. For low-severity patients in the private hospital, the number effect and information-rent effect are influential. If there exist a large number of high-severity patients, the number of patients for which the insurer pays information rent to the private hospital is small. This effect moves  $\bar{\gamma}$  upward, since it increases social welfare under the outlier payment policy; however, this effect does not affect social welfare under the patient dumping policy. In contrast, the information-rent effect moves  $\bar{\gamma}$  downward, since it is milder under the outlier payment policy. Hence, if the number effect is weaker than the information-rent effect, a decrease in  $P$  moves  $\bar{\gamma}$  downward. When the information rent per patient is smaller (i.e.,  $\theta_H - \frac{\eta}{1+\eta} P \Delta \theta$  is small), the number effect is weaker (shown by the second term in (32)).
3. For low-severity patients in the public hospital, only the information-rent effect is applicable. As seen in (17) and (29), this effect is weaker under the outlier payment policy, which moves  $\bar{\gamma}$  downward.

The overall welfare impact of the patient dumping policy is determined by these tradeoffs.

In particular, one crucial factor yields the difference in the productive efficiency of cost-reduction effort between the two patient types. We summarize this observation as follows.

**Proposition 5.** *There exists  $\bar{\theta}_H$  such that if  $\theta_H > \bar{\theta}_H$ ,  $\frac{\partial \bar{\gamma}}{\partial P} \geq 0$ , and if  $\theta_H < \bar{\theta}_H$ ,  $\frac{\partial \bar{\gamma}}{\partial P} \leq 0$ .*

This result offers an important policy implication. From Proposition 5, we get that there exists a possibility of welfare improvement by the abolishment of the outlier payment policy even when the number of high-severity patients is large. If the variance of the efficiency of the cost-reduction effort is large (i.e.,  $\theta_H$  is small against  $\Delta\theta$ ), the patient dumping policy is preferred over the outlier payment policy in more diseases (i.e.,  $\bar{\gamma}$  moves downward).

According to Cohen *et al.* (2008), preventive care is largely more cost-reducing in the case of screening all 65-year-olds for diabetes (low-cost patients) than in the case of screening 65-year-olds with hypertension for diabetes (high-cost patients). This situation implies that in the case of diabetes,  $\theta_H$  is smaller than  $\Delta\theta$ . Then, in such a case, the patient dumping policy is preferred over the outlier payment policy even when the number of diabetes patients with hypertension is large.

Figure 1 depicts the region in which  $\frac{\partial \bar{\gamma}}{\partial P} < 0$  holds, and shows that the region tends to shrink as the healthcare payment cost  $\eta$  increases. Intuitively, if the healthcare payment cost is large, the optimal information rent is smaller, and the number effect weakens.

**Proposition 6.**  *$\bar{\gamma}$  rises as the healthcare payment cost  $\eta$  increases when  $P$  is high.*

According to Woolhandler and Himmelstein (1991) and Woolhandler *et al.* (2003), the administrative cost for the healthcare payment program per capita is larger in the United States than in Canada, and then, our model would imply that the patient dumping policy is more advantageous in Canada.

### 5.2.2 Higher Number of Patients in the Private Hospital

We now examine how a change in the proportion of patients who visit the private hospital, as captured by  $\lambda$ , affects the threshold. To this end, it is straightforward to obtain

$$\frac{\partial \bar{\gamma}}{\partial \lambda} = -\frac{1}{2} \frac{\eta^2}{1 + \eta} P^2 \Delta\theta^2 \leq 0. \quad (33)$$

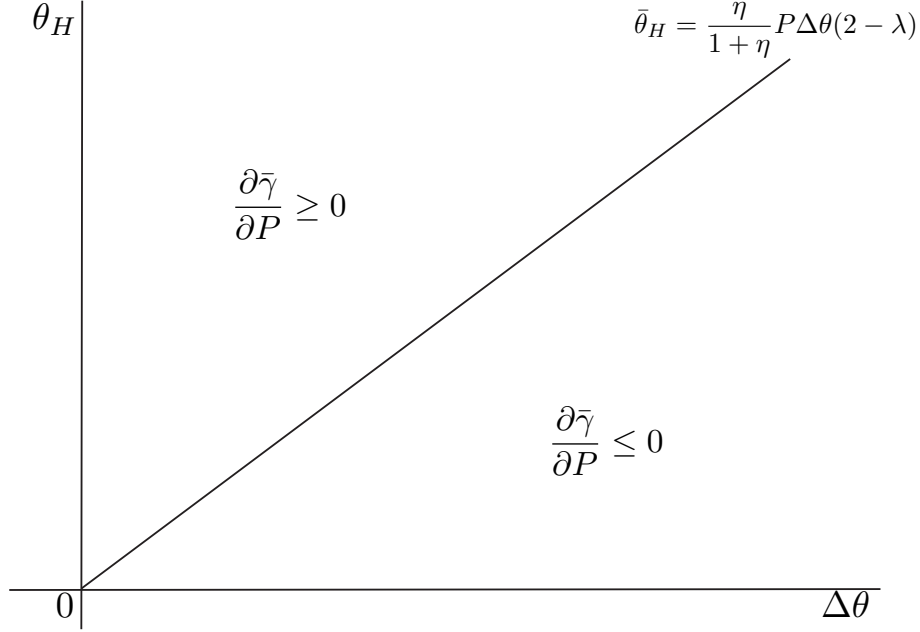


Figure 1: Effect of  $P$  on  $\bar{\gamma}$

Note that a change in  $\lambda$  has no effect on social welfare under the outlier payment policy, since the optimal contract is symmetric between the two hospitals and is hence independent of  $\lambda$ . This is not the case under the patient dumping policy, however, as the optimal contract is asymmetric. If the number of patients who go to the private hospital increases (i.e.,  $\lambda$  increases), the distortion in the cost-reduction effort decreases under the patient dumping policy (25). This moves  $\bar{\gamma}$  upward, thereby favoring the patient dumping policy over the outlier payment policy. However, as shown in (28), the optimal information rent increases as  $\lambda$  becomes larger, which yields a countervailing effect and moves  $\lambda$  downward. We can show that this latter effect is generally stronger than the former and hence an increase in  $\lambda$  always decreases  $\bar{\gamma}$  as shown in (33).

**Proposition 7.**  *$\bar{\gamma}$  decreases as  $\lambda$  increases.*

It is intuitively clear that patients' initial choice of hospitals, given exogenously in our model, could have an important impact on the optimal healthcare payment scheme. The proposition states that assuming that patient dumping is only allowed for private hospitals, it can improve social welfare by abolishing the outlier payment policy against many diseases in areas where more private hospitals operate.

As a practical implication, this means that the regulatory agency should admit some regional variations in the healthcare payment scheme, as we expect to find more private institutions in urban areas but certainly less in rural areas.

## 6 Conclusion

The main result of this paper is that there are cases in which insurers should not reimburse additional payment to hospitals who admit costly patients even though that may trigger patient dumping, which is socially costly. A payment scheme that insures against outlier patients exacerbates the extent of information asymmetry between insurers and hospitals, and consequently results in less-efficient effort for cost reduction. When this cost is significant enough, insurers should instead allow hospitals to dump costly patients to specific hospitals as a second-best alternative to the outlier payment policy. We show that such a payment scheme, which tolerates a degree of patient dumping, can ease the information asymmetry and improve efficiency under some conditions.

As a final note, one important limitation of our model is the assumption that patients are randomly allocated to hospitals. While we do not expect that relaxing this assumption alters our main contention in any qualitative way, the analysis would be more complete, though certainly more complicated, if we explicitly modeled patients' choice of hospitals. In the future, it might be of some interest to explore three-way interactions among insurers, hospitals, and patients.

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