Specialist Payment Schemes and Patient Selection in Private and Public Hospitals

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Abstract

It has been observed that specialist physicians who work in private hospitals are usually paid by fee-for-service while specialist physicians who work in public hospitals are usually paid by salary. This paper provides an explanation for this observation. Essentially, fee-for-service aligns the interests of income preferring specialist with profit maximizing private hospitals and results in private hospitals treating a high proportion of short stay patients. On the other hand, salary aligns the interests of fairness preferring specialists with welfare maximizing public hospital and results in public hospitals treating all patients irrespective of their length of stay.

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1. Introduction

In a recent study, Simoens and Giuffrida (2004), remarked that "OECD countries generally pay specialist physicians by either salary or fee-for-service, with salary payment being more common in the public sector." The recent efficiency-selection literature, Ellis and McGuire (1986), Newhouse (1996), Ma and McGuire (1997), and Chalkley and Malcomson (1998), has examined the choice of payment scheme by a purchaser of health services and in the context of specialist physicians found that payment by salary induces physicians to under-supply services or select low cost patients. On the other hand, fee-for-service induces specialist physicians to over-supply services. In this literature, hospitals can be profit maximizing (private), as in Ellis and McGuire (1986), or have a benevolent component (public), as in Chalkley and Malcomson (1998), but the interaction between these two types of hospitals in a mixed private / public system is not considered. Therefore, this literature is unable to explain the above remark by Simoens and Giuffrida that salary payment is more common in the public sector.

This paper develops a model that predicts private hospitals offer specialist physicians fee-for-service while public hospitals offer payment by salary. In this model, there are two types of patients who have different expected lengths of stay. There are two types of hospitals, private (profit maximizing) and public (welfare maximizing). The utility functions of specialist physicians differ according to the weight attached to income and fairness, where fairness involves treating all patients the same regardless of type. A critical assumption is that private hospital profit is a concave function of length of stay, that is, more profit is earned from the patients first day in hospital than the second and so on.

Given the concavity of profit with respect to length of stay, the private hospital maximizes profit by admitting as many short length of stay patients as possible. However, the private hospital can not observe patient type and it is assumed that it can not write contracts with specialists specifying that they only admit short stay patients. By offering specialists fee-for-service, the private hospital attracts specialist who place relatively more weight on income, Proposition 1, and these specialists admit a high proportion of short stay patients as this maximizes their income, Proposition 2. Essentially, fee-for-service aligns the interests of income liking specialists with those of the private hospital.

On the other hand, the public hospital maximizes welfare and does this by treating all patients equally and not discriminating between them according to type. By offering a payment of salary, the public hospital attracts specialists who place relatively more weight on fairness, Proposition 1, and these specialist admit all patients regardless of type. In this case, payment by salary has aligned the interests of fairness liking specialists with those of the public hospital.

These results complement the existing literature on specialist physician payment schemes by showing that in addition to providing incentives for appropriate treatment they also provide a mechanism whereby the hospitals and the specialists interests, with regard to patient mix, can be aligned.

2. Participants

2.1. Patients

There are two types of patients, 1 and 2. Both have medical condition k for which they seek treatment. Type 1 patients only have condition k while type 2 patients have additional medical conditions to condition k. The proportion of type 1 patients in the population of those with condition k is θ_1 and the proportion of type 2 patients is $\theta_2 = 1 - \theta_1$. Every period, K new patients have condition k.

Let $l \in (0, L]$ be the length of stay in hospital and $f_i(l),\ i = 1, 2$ be the probability density function for a type i patient. Let $F_i(l)$ be the probability that $v \leq l$, that is $F_i(l) = \int_0^l f_i(v)dv$. It is assumed that F_2 has first-order stochastic dominance over F_1, that is,

$$1 - F_1(l) \leq 1 - F_2(l),\ \textit{all}\ l \in (0, L]\ \textit{with}\ 1 - F_1(l) < 1 - F_2(l),\ \textit{some}\ l \in (0, L]. \tag{1}$$

In words, the probability that a patient has a length of stay greater than l is greater for a type 2 patient than a type 1 patient. The rationale being that a type 2 patient has extra medical conditions that lead to a longer period of recovery following treatment. Given these assumptions, it is well known that a type 2 patient has a longer expected length of stay than a type 1 patient, that is,

$$E_2(l) > E_1(l), \tag{2}$$

where E is the expectation operator. For simplicity, $E_1(l)$ is normalized to 1.

It is assumed that all patients are indifferent between which specialist treats them and in what type of hospital they are treated. In addition, all patients are assumed to suffer disutility from being referred to a specialist that on observing their type, refuses to treat them.[1]

2.2. General Practitioner

It is assumed that the general practitioner acts in the patients interest, that is, acts to maximize the patients' utility. Therefore, the general practitioner

[1]This disutility arises because of the delay in treatment that such a referral causes, or because of the inconvenience of attending an additional specialist appointment.

acts to minimize the extent of treatment delays and inconvenience through there choice of referral specialist.

2.3. Private Hospital

It is assumed that private hospital profit, π, from treating a patient is a function of length of stay, $\pi(l)$, with $\pi'(l) > 0$ and $\pi''(l) < 0$. That is, private hospital profit increases with length of stay but at a decreasing rate. The rationale for this assumption being that more hospital services are used on the first day in hospital, operating theatres, staff, etc. and so more profit is generated than on the following days in hospital with the least amount of services used and profit generated on the last day in hospital.[2] It is assumed that the capacity of the private hospital is fixed at N^{pri} beds and that the private hospital maximizes profit.

2.4. Public Hospital

The public hospital is assumed to be indifferent about the type of patient admitted to it. This is consistent with notions of equity of access and fairness.[3] The capacity of the public hospital is fixed at N^{pub} beds. It is assumed that

$$N^{pri} + N^{pub} = K + (1 - \frac{1}{E_2(l)})\theta_2 K. \tag{3}$$

The first term on the right hand side of (3) is the number of new sick patients every period and the second term is the expected number of type two patients that are still being treated from previous periods. Condition

[2] Carey (2000) demonstrates that length of stay reductions yield greater cost saving in hospitals that have smaller length of stays than those that have larger length of stays. This is evidence that more hospital services are used in the first day of stay than the last. A similar result can be found in Polverejan et al (2003) and in Evans (1984, p193). If it is assumed that profit is generated in proportion to services provided, then more profit is generated on the first day of the stay than the second, and so on. This profit should be distinguished from accounting profit as the latter depends very much on how the hospital is reimbursed.

[3] In the terminology of Chalkley and Malcomson (1998 p15), the public hospital is a benevolent hospital and "it is supposed to be treating all those who want treatment."

(3) states that the total number of beds in hospitals of any type equals the total expected number of patients requiring beds.[4]

2.5. Specialists

Specialists observe patient type and maximize utility which is not only a function of their income, but also a function of the extent to which they treat all patients equally regardless of type. The latter reflects the specialists preferences over fairness, to some extent all patients are worthy of treatment by them. To capture these two influences it is assumed that specialists utility functions are a weighted average of income and a measure of fairness.[5] Specialist $j's$ income, Y, is a function of the number of patients of each type the specialist treats, (n_1^j, n_2^j). Define n_i^* as the number of type i patients a specialist expects to treat if the specialist does not discriminate between patients. That is, the specialist acts fairly. Fairness, Z, is measured by the extent that the specialist's choices of n_1 and n_2 deviate from n_1^* and n_2^*. Specifically, the utility of specialist j is given by

$$U^j(n_1^j, n_2^j) = \alpha^j Y(n_1^j, n_2^j) - (1-\alpha^j) Z(n_1^j - n_1^{*j}, n_2^j - n_2^{*j}), \qquad (4)$$

where $\alpha^j \in [0,1]$ is the weight attached to income, Y is increasing in n_1^j and n_2^j, and Z reaches a maximum at $n_1^j = n_1^{*j}$, and $n_2^j = n_2^{*j}$. The functions $Y(\cdot)$ and $Z(\cdot)$ are the same for all specialists.

The total number of specialists is given by M and α is distributed over $[0,1]$ with density $g(\alpha)$ and distribution function $G(\alpha)$.

[4]Although the total number of hospital beds is exogenous in this paper, (3) can be viewed as a long run equilibrium condition.

[5]The assumption that specialists care about their patients' welfare is common in the literature and can be found in Chalkley and Malcomson (1998), Ellis and McGuire (1986) and Ma and McGuire (1997).

3. The Game

In the first stage, the private and public hospitals choose payment schemes for specialists. These schemes are restricted to be either (i) a fixed salary, or (ii) fee-for-service. In the second stage, specialists choose in which type of hospital to work. In stage three, specialists choose which type of patients to treat and in stage four, general practitioners choose which specialist to refer a particular type of patient to.

3.1. Stage Four - General Practitioner Referral

The general practitioner observes patient type, knows where each specialist works, and what type of patients they accept. They are assumed to act in the patients interest and so choose referral specialist to minimize delays in treatment and inconvenience. Therefore, if a specialist only accepts type 1 patients, then general practitioners never refer type 2 patients to them. It turns out that different specialists accept different proportions of type 1 and 2 patients and so an individual general practitioner might refer a patient to a specialist who already is treating their preferred number of that type of patient. To avoid complication and given this stage of the game is not the central focus of the paper, it is assumed that the referral process is optimal in the sense that patients are referred to specialists who will accept them as patients.

3.2. Stage Three - Specialist Choice of Patients to Treat

Given payments schemes and the type of hospital at which the specialist works, the specialist chooses which type/s of patients to treat.

Private Hospital: Assume that the private hospital allocates all specialists $A \leq N^{pri}$ beds for T periods. The specialist's choice of the numbers of patients to treat must satisfy the following constraint

$$n_1^j + n_2^j E_2(l) = AT. \tag{5}$$

Substituting this constraint into the specialist's utility function, gives utility as a function solely of n_1^j. That is,

$$u(n_1^j) = \alpha^j y(n_1^j) + (1-\alpha^j) z(n_1^j - n_1^{*j}), \tag{6}$$

where z reaches a maximum at $n_1^j = n_1^*$ and the derivative is given by

$$\frac{du}{dn_1^j} = \alpha^j \frac{dy}{dn_1^j} + (1-\alpha^j)\frac{dz}{dn_1^j}. \tag{7}$$

(i) Fixed Salary, S: The specialist's income is independent of the type of patient treated so $y(n_1^j) = S$. If specialist j cares about fairness at all, $\alpha^j < 1$, then specialist j will choose $n_1^j = n_1^*$, that is, the specialist will not discriminate between types of patients. In fact, even if $\alpha^j = 1$, given S is fixed, the specialist will not discriminate between patients. The specialist's maximized utility is $v^j = \alpha^j S + (1-\alpha^j)z(0)$.

ii) Fee-for-Service: Assume that all patients, regardless of type, pay the same fee to the specialist for treatment. In this case, $Y = n_1 + n_2$, where the fee is normalized to one. Substituting constraint, (5), gives $y = \frac{AT}{E_2(l)} + n_1^j(1 - \frac{1}{E_2(l)})$.

(a) If $\alpha^j = 1$, the specialist only values income and chooses n_1^j to maximize y^j. As $E_2(l) > 1$, $(1 - \frac{1}{E_2(l)}) > 0$ and $\frac{dy^j}{dn_1^j}$ is monotonically increasing in n_1^j. Therefore, income is maximized with $n_1^j = AT$ and $n_2^j = 0$. Maximized utility is $v^j = AT$.

(b) If $\alpha^j = 0$, the specialist only values fairness and chooses $n_1^j = n_1^{*j}$. Maximized utility is $v^j = z(0)$.

(c) If $0 < \alpha^j < 1$, then the specialist chooses $n_1^j > n_1^{*j}$ because the derivative in (7) is greater than zero at $n_1^j = n_1^{*j}$. As α^j varies between

0 and 1, n_1^j varies between n_1^* and AT. That is, $n_1^j(\alpha^j)$, where $\frac{dn_1^j}{d\alpha^j} > 0$. Maximized utility is

$$v^j(\alpha^j) = \alpha^j y(n_1^j(\alpha^j)) + (1-\alpha^j)z(n_1^j(\alpha^j) - n_1^*). \tag{8}$$

Public Hospital: The problem for a specialist working in the public hospital is identical in structure to that of a specialist working in the private hospital.

3.3. Stage Two - Specialist Choice of Hospital to Work At

Given the payment schemes offered by each type of hospital, the specialist works at that hospital which yields the greatest utility. Essentially the choice is not between hospitals, but between payment schemes. Specialist j will choose to work under fee-for-service if

$$\alpha^j y(n_1^j(\alpha^j)) + (1-\alpha^j)z(n_1^j(\alpha^j) - n_1^*) \geq \alpha^j S + (1-\alpha^j)z(0). \tag{9}$$

The LHS of (9) is maximized utility under fee-for-service while the RHS is maximized utility under salary.

Maximized utility under salary is a linear function of α^j, as S and $z(0)$ are constants. It has slope $S - z(0)$ and is shown in Figure 1. It is assumed that $S > z(0)$.

Using familiar techniques it can be shown that maximized utility under fee-for-service is a convex function of α^j. Applying the envelope theorem, its slope is given by

$$\frac{dv^j(\alpha^j)}{d\alpha^j} = y(n_1^j(\alpha^j)) - z(n_1^j(\alpha^j) - n_1^*). \tag{10}$$

It is assumed that $AT > S$ and that $y(n_1^*) < S$. The first assumption guarantees that at $\alpha^j = 1$ maximized utility under fee-for-service is greater than under salary, while the latter assumption guarantees that at $\alpha^j = 0$

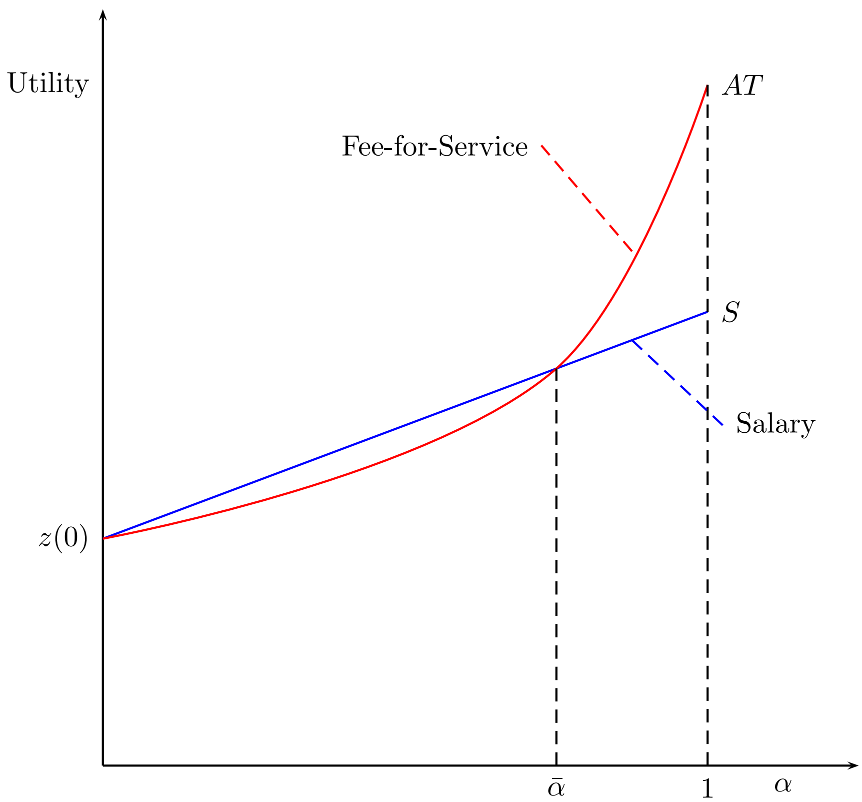
the slope of maximized utility under fee-for-service is less than under salary. Maximized utility under fee-for-service is also drawn in Figure 1.

As drawn, Figure 1 reveals that there is an $\bar{\alpha}$ defined by $\bar{\alpha}y(n_1(\bar{\alpha})) + (1-\bar{\alpha})z(n_1(\bar{\alpha}) - n_1^*) \equiv \bar{\alpha}S + (1-\bar{\alpha})z(0)$ such that for those specialists with $\bar{\alpha} \leq \alpha^j \leq 1$ fee-for-service is preferred to salary while for those specialists with $0 \leq \alpha^j < \bar{\alpha}$ salary is preferred to fee-for-service. Note that $\bar{\alpha}(S)$ is an increasing function of S. This is summarized in the following proposition.

Proposition 1: *Given* $S > z(0)$, $AT > S$, *and* $y(n_1^*) < S$, *specialists who attach a relatively high weight to income,* $\bar{\alpha} \leq \alpha^j \leq 1$, *prefer to work under fee-for-service while specialists who attach a relatively high weight to fairness,* $0 \leq \alpha^j < \bar{\alpha}$, *prefer to work under salary.*

Figure 1

Salary vs. Fee-for-Service



3.4. Stage One - Hospital Choice of Specialist Payment Scheme

Private Hospital: First consider the problem of a private hospital if it could choose the numbers and types of patients it treats. In this case, the private hospital chooses the number of patients of each type to maximize expected profit over the horizon of the hospital, T, given the number of beds, N^{pri}. Its problem is

$$\max_{n_1,n_2} \; E\Pi^{pri} \equiv n_1 E_1(\pi) + n_2 E_2(\pi) \tag{11}$$

subject to

$$n_1 + n_2 E_2(l) = N^{pri} T, \tag{12}$$

where $E_i(\pi) = \int_0^L \pi(l) f_i(l) \; i = 1, 2$. Substituting the constraint yields

$$\max_{n_1} \; E\Pi^{pri} \equiv n_1 E_1(\pi) + \big(\frac{N^{pri}T}{E_2(l)} - \frac{n_1}{E_2(l)}\big) E_2(\pi). \tag{13}$$

Differentiation gives

$$\frac{dE\Pi^{pri}}{dn_1} = E_1(\pi) - \frac{E_2(\pi)}{E_2(l)}) > 0, \tag{14}$$

because $E_1(\pi) > E_2(\pi) > \frac{E_2(\pi)}{E_2(l)}$. The first inequality follows from the stochastic dominance of F_2 over F_1 and the concavity of $\pi(l)$. The second follows because $E_1(l) = 1 < E_2(l)$. Therefore, the solution is to make n_1 as large as possible, that is, $n_1 = N^{pri}T$, and $n_2 = 0$. As expected, the profit maximizing solution is to fill the hospital with as many type 1 patients as possible because they have greater turnover and more profit is generated at the beginning of a hospital stay than the end.

Now, the private hospital does not choose patient type as it does not observe it. The specialist observes it. It is assumed that it is too costly for the private hospital to write contracts with specialists that specify the type of patients that can be admitted. The stochastic nature of length of stay means that even if a specialist did choose to admit only type 1 patients to the private hospital, actual average length of stay might be relatively long. Given this, negotiating a contract, monitoring length of stay, and establishing the type of patients treated ex-post is costly. A less costly alternative might be to offer a payment scheme to the specialist that aligns the interests of the specialist with that of the private hospital. Can the private hospital's choice of payment scheme influence the type of patients admitted to it?

It was seen above that if a hospital offers fee-for-service, then specialists with α^j such that $\bar{\alpha} \leq \alpha^j \leq 1$, choose to work at it. It was also seen that $\frac{dn_1^j}{d\alpha^j} > 0$, that is, the number of type 1 patients treated by the specialist is increasing in α^j. Therefore, a hospital that offers fee-for-service admits more type 1 patients than a hospital that offers salary as the specialists that choose to work for salary have lower α^j's than the ones that work for fee-for-service. As the private hospital wants as many type 1 patients as possible it offers fee-for-service.

Public Hospital:

The public hospital maximizes social welfare and does so by not discriminating between patient types. As salary is independent of patients type, it does not provide an incentive for specialists to discriminate between patient types. Therefore, public hospitals offer salary.

3.5. Equilibrium

It is assumed that the total number of specialists is such that all patients can be treated in a hospital. As A is the number of beds allocated to each specialist, this requires

$$M = \frac{N^{pri} + N^{pub}}{A} \tag{15}$$

Equilibrium in the allocation of specialists to hospitals is achieved when salary, S^e, is such that private hospital demand for specialists equals the supply of specialists to the private hospital, that is,

$$\frac{N^{pri}}{A} = \int_{\bar{\alpha}(S^e)}^{1} g(v)dv. \tag{16}$$

The left hand side of (16) is private hospital demand for specialists while the right hand side is the supply of specialists to the private hospital. An excess supply of specialists to the private hospital is equivalent to an excess demand for specialists by the public hospital. In this case, S would increase, and so $\bar{\alpha}$ would increase until the excess supply of specialists to the private hospital is eliminated.

Proposition 1 required that $AT > S$ and $y(n_1^*) < S$. As long as there are both private and public hospital beds, these conditions will be satisfied in equilibrium. If $AT \leq S$, then all specialists would want to work for salary in the public hospital, there would be an excess supply of specialists to the public hospital.[6] If $y \geq S$, then all specialists would want to work for fee-for-service in the private hospital, there would be an excess supply of specialists to the private hospital.[7] Therefore, in equilibrium $AT > S^e$ and $y(n_1^*) < S^e$. The above is summarized in the following proposition.

Proposition 2: *In equilibrium,* $\frac{N^{pri}}{A}$ *specialists work in the private hospital for fee-for-service while* $\frac{N^{pub}}{A}$ *specialists work in the public hospital and are paid a salary of* S^e*. The proportion of type 1 patients treated at the private hospital is greater than the population proportion* θ_1*.*

In equilibrium, specialists who work in private profit maximizing hospitals are paid fee-for-service and treat a high proportion of type 1 patients, patients with only one condition. This maximizes not only the profit of the private hospital, but also the utility of these specialists as they weigh

[6]If $AT \leq S$, the concavity of $v(\alpha)$ ensures $y(n_1^*) < S$.
[7]If $y \geq S$, the concavity of $v(\alpha)$ ensures $AT > S$.

income relatively more highly than fairness. Fee-for-service aligns the interests of these specialists with those of the private hospital. On the other hand, specialist who work in the public hospital are paid a salary and do not discriminate between the type of patients they treat. These specialists weigh fairness relatively more highly than income. Salary aligns the interests of these specialists with those of the public hospital.

These results complement those found in Ellis and McGuire (1986), where profit maximizing hospitals that receive a prospective payment have an incentive to employ specialists that place little weight on patient welfare. These specialists order few hospital services and so are very profitable from the hospitals perspective. On the other hand, hospitals that receive cost-plus reimbursement have an incentive to employ specialists that place a lot of weight on patient welfare as these specialists order many hospital services and so are very profitable. Ellis and McGuire stress the importance of how the hospital is paid in determining which specialists it would like to hire. The current paper stresses the importance of how specialists are paid in determining which specialists different types of hospitals hire.

4. Conclusion

This paper has shown that hospitals can select their patient mix by offering specialists different payment schemes. In equilibrium, profit maximizing private hospitals offer fee-for-service and employ specialist who value income more highly than fairness. To maximize income these specialists admit short stay patients to the private hospital and so also maximize the profit of the private hospital. Fee-for-service aligns the interests of income preferring specialists with those of the private hospital. On the other hand, in equilibrium, welfare maximizing public hospitals offer payment by salary and employ specialists who value fairness more highly than income. To maximize utility, these specialists admit patients of all types without discrimination and so also maximize the objective function of the public hospital. Salary aligns the interests of fairness preferring specialists with those of the public hospital.

In the traditional selection literature, payment by salary leads income preferring specialists to select low cost patients (ones who require little effort or services) as this increases there surplus. Assuming patients that are low cost to the specialist are also low cost and so highly profitable to a hospital, suggests profit maximizing private hospitals should offer specialists payment by salary. This is not the prediction of this paper. The difference arises because this paper assumes the specialist puts in the same effort or supplies the same services regardless of patient type. In this paper, it is fee-for-service that leads the income preferring specialist to select patients that are most profitable to the profit maximizing private hospital. This paper, therefore, complements the existing selection literature.

A crucial assumption in this paper has been that the private hospital allocates all specialists the same fixed number of beds, A. Clearly it would prefer to allocate more beds to doctors with a greater preference for income as more short stay patients would be admitted to it. However, once this insight is gained nothing further is added, except a lot of complication, by making the number of beds allocated to specialists endogenous.

This paper has a number of interesting empirical implications. The first is that in a mixed private / public hospital system, patients with few complicating conditions should be observed to be treated in private hospitals while patients with many complicating conditions should be observed to be treated in public hospitals. In addition, as it is often the case that patients can insure against treatment costs in private hospitals, patients with few complicating conditions should be observed to be privately insured while those with many complicating conditions should be uninsured. Given data availability, testing the predictions of this model provides a rich vein for further research.

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