

Effects of a fixed-payment method on demand for imaging tests in a university hospital

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ABSTRACT

Background In 2006, a new medical payment framework such as fixed-payment method was implemented in Turkey and then cancelled 5 months later. The aim of this study was to explore the effects of this payment method on the demand for imaging tests.

Methods Data were obtained retrospectively from electronic medical records. The main outcome measures were the number of imaging tests, the payment per outpatient and the rate of negative results of imaging tests.

Results The overall mean number of imaging tests per outpatient was 0.75 ± 0.13 . This value decreased significantly after implementation of the fixed-payment method, and then increased after its cancellation ($P < 0.01$). The overall mean payment per outpatient was $\$14.1 \pm 2.3$. For patients with social security, there was a significant decrease in the mean payment after implementation of the new method, followed by an increase after its cancellation ($P = 0.02$); in contrast, no significant changes were observed in patients not covered by social security ($P > 0.05$). No significant differences were observed in the rate of negative results for imaging tests ($P > 0.05$).

Conclusions The use of a fixed-payment method reduces the demand for imaging tests when there is a strong financial relationship between the hospital and its personnel.

Keywords fixed-payment method, hospitals, imaging tests, overuse

Introduction

Medical technology plays a critical role in health care and quality of life. However, technology is not always used efficiently or wisely,^{1–4} and its overuse and misuse increase the overall cost of health care and reduce the quality of health-care services. For this reason, the inappropriate use of medical technology is a topic of global interest.²

The field of radiology requires advanced technological tools and is an important part of medical practice. However, in this field, the overuse or misuse of imaging tests may also cause harmful side effects to both health personnel and patients through exposure to unnecessary radiation.^{3–8} Therefore, the appropriate use of imaging tests is crucial to conserve valuable resources and maintain the quality of clinical care. Appropriate use is influenced by many factors, including medical education, the fear of malpractice, the national technology policy, reimbursement models, incentives, the ownership of radiological equipment and models for payment of providers.^{3,4,9} Physicians tend to use the

latest technology rather than the most appropriate technology. Similarly, patients also prefer the latest and most advanced technology.¹⁰ To maximize the benefits of radiological technology, specific strategies are required to promote the rational use of imaging tests, striving for safety, efficiency and cost-effectiveness.^{1,3,5} Financial regulation, evidence-based medicine, appropriateness criteria and utilization management are important tools in this regard.

In Turkey, medical technology is particularly controversial, and the overuse, underuse and misuse of imaging tests are matters of public interest. However, very little scientific information is available on this issue.^{10–12} When using the fee-for-service payment method, the cost of all procedures

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performed for one outpatient is summarized and paid to the hospital, and the income of the hospital and incentives to personnel are positively related to the number of procedures performed per patient. Historically, hospitals have tended to increase the number of procedures per outpatient to maximize profit. In a fixed-payment scheme, a fixed amount per outpatient is paid to the hospital according to the discipline, regardless of the number of procedures carried out. With this system, hospitals must reduce the number of procedures per outpatient to maximize the profit.

In mid-2006, the fee-for-service method previously used in Turkish hospitals was replaced by a policy of a fixed payment per outpatient. Five months later, this new policy was cancelled by the State Council and the payment structure was restored to the previous method. The reason given for this reversal was an incongruity between the constitution and the method: the new policy included only outpatients who belonged to a social-security institution. This situation provided an opportunity to evaluate the effect of payment methods on medical practice.

The health financing system in Turkey is fragmented, and nearly 15% of the population is not covered by any social-security institution. Hospitals have two major financial resources: general budget allocation and revolving funds. Within the hospital, physicians and other personnel are paid based on a mixed-payment model involving both salaries and financial incentives drawn from the revolving funds of the hospital. These financial incentives are intended to encourage physicians and personnel to maximize institutional profits. Therefore, there is a strong positive financial relationship between personnel and the institution.

The aim of the study was to examine the effects of a fixed-payment model on the utilization of radiology services and patient care. We hypothesized that such a change in payment policy would significantly affect the utilization of radiology services and patient care.

Methods

This longitudinal and interventional study used patients covered by some form of social security as a control group. The intervention was the implementation of a new payment method, shifting from a fee-for-service method to a fixed payment per outpatient policy. Personnel were paid in the same manner throughout the study period. The intervention was implemented by the government, and the design of the study occurred spontaneously in routine practice.

The data were obtained retrospectively from Mustafa Kemal University Hospital records in 2007. This hospital

was founded in 2003, and is equipped with nine pieces of radiological equipment, including two ultrasound (US) machines, two X-ray systems, one computed tomography (CT) system, one open 0.2 T magnetic resonance imaging (MRI) system, one fluoroscope, one mammography machine and a dual-energy X-ray absorptiometry system to determine bone mineral density. The hospital has an electronic automation system, and the data in this study were drawn from this system. Gender, age, outpatient number, social-security coverage, records of all imaging tests, the results of those tests and payments for imaging tests were examined in this study.

Records were obtained for a total of 109 665 outpatients over a 15-month period. Among these, 82 890 patients had social security and 26 775 did not. Three main outcome measures were examined: the number of imaging tests per outpatient, the payment per outpatient for imaging tests and the rate of negative results for imaging tests. An imaging test was deemed negative when no evidence of any pathological condition was observed. These outcome measures were compared before, during and after the intervention.

Differences in the mean values for the procedure number and cost per outpatient were analyzed using Student's *t*-test, Mann – Whitney *U*-test and Kruskal – Wallis *H*-test. A *P*-value of <0.05 was deemed statistically significant. Linear regression using the 'enter' method was performed to provide a multivariate analysis. In this model, the procedure number per outpatient was a dependent variable, and the payment method, social-security coverage status, outpatient number and negative result rate were independent variables. Payment method and social-security status were coded as binary (dummy) variables. EPI Info ver. 3.4.3 software was used for data analysis.

Results

The descriptive statistics for the outpatients are summarized in Table 1. Over the course of 15 months, a total of 109 665 outpatients were admitted to the hospital, and 75.6% of these patients belonged to a social-security institution. The mean age was 33.8 ± 15.4 years; 61.3% were female and 38.7% were male. During the same period, a total of 82 784 imaging tests were performed for these outpatients, 78.7% of which were performed for outpatients with social security. The most commonly used imaging methods were X-ray (57.6%), US (16.1%) and MRI (10.0%).

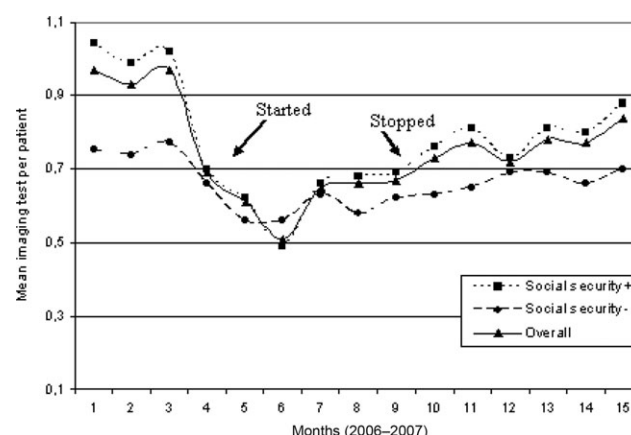
The overall mean imaging test number per outpatient was 0.75 ± 0.13 (Table 2). In outpatients covered by social security, the mean test number was 0.78 ± 0.15 , compared with 0.66 ± 0.06 tests per outpatient not covered by social

Table 1 Descriptive statistics of the outpatients

	Mean	Standard deviation
Age	33.8	15.4
Gender	Number	%
Male	42 440	38.7
Female	67 225	61.3
Total	109 665	100.0
Social security		
Yes	82 890	75.6
No	26 775	24.4
Total	109 665	100.0
Imaging tests		
X-ray	47 684	57.6
Ultrasonography	13 328	16.1
Magnetic resonance imaging	8278	10.0
Computerized tomography	6954	8.4
Mammography	2235	2.7
Others	4305	5.2
Total	82 784	100.0

security. Statistical analysis revealed that the mean imaging test number was significantly higher among patients with social-security coverage ($t = 2.8$, $P < 0.02$). The overall mean imaging test number significantly decreased after the implementation of the fixed-payment method, and then increased slightly after the return to the fee-for-service method ($X^2 = 10.1$, $P < 0.01$). These changes were more marked in the group covered by social security than in the uninsured group (Fig. 1).

The overall mean payment per imaging test per outpatient was $\$14.1 \pm 2.3$ USD (Table 2). The mean payment was $\$15.2 \pm 2.7$ for outpatients who belonged to a social-security institution, but only $\$10.8 \pm 1.1$ for outpatients who were not covered. The mean payment was significantly higher among outpatients who had social security ($t = 5.8$,

**Fig. 1** Imaging test number per patient by the months.

$P < 0.001$). The overall mean payment per outpatient decreased after the implementation of the fixed-payment method, and then increased again after returning to the fee-for-service method ($X^2 = 9.0$, $P < 0.02$). However, social-security coverage affected this payment pattern. Among the patients with social security, the mean payment per outpatient dropped significantly during the intervention, and then increased significantly after returning to the previous payment policy ($X^2 = 8.8$, $P < 0.02$). In contrast, this value did not change significantly over the intervention period for outpatients who did not have social-security coverage ($X^2 = 2.5$, $P > 0.05$).

Figure 2 shows the rates of negative results calculated for three imaging tests based on month. No significant changes in the negative result rates were observed for US, CT or MRI.

A regression analysis revealed significant relationships between the mean payment per outpatient and the payment method or the number of imaging tests per outpatient. In contrast, the negative result rate, outpatient number and social-security status had no significant relationship with the mean payment per outpatient ($P < 0.05$).

Table 2 Mean imaging test and mean payment per patient by the social security and periods

Time interval	Mean imaging test per patient			Mean payment (\$) per patient		
	Social security (+)	Social security (–)	Total	Social security (+)	Social security (–)	Total
Before	0.94 ± 0.16	0.73 ± 0.05	0.89 ± 0.13	17.3 ± 2.4	11.5 ± 1.9	16.0 ± 2.3
During	0.63 ± 0.08	0.59 ± 0.03	0.62 ± 0.07	12.4 ± 2.1	10.3 ± 0.4	11.8 ± 1.6
After	0.80 ± 0.05	0.67 ± 0.03	0.77 ± 0.04	16.1 ± 0.9	10.8 ± 0.8	14.8 ± 0.9
Total	0.78 ± 0.15	0.66 ± 0.06	0.75 ± 0.13	15.2 ± 2.7	10.8 ± 1.1	14.1 ± 2.3
P-values ^a	<0.01	<0.01	<0.01	<0.02	>0.05	<0.03

Bold values are statistically significant.

^aKruskal–Wallis test.

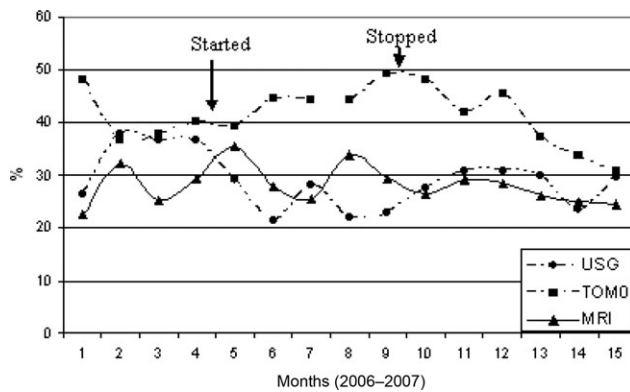


Fig. 2 Percentage of the negative results of USG, TOMO and MRI.

Discussion

Main findings

X-ray imaging accounted for more than half of all tests performed in the radiology department of the hospital, followed by ultrasonography. The results are consistent with a previous study carried out in another university hospital in Turkey.¹¹ In the present study, MRI is the third most common method, followed by CT, whereas Semin *et al.*¹¹ reported that 4 years ago CT and MRI were the third and fourth most common methods, respectively. The authors also noted an increase in the use of MRI imaging.¹¹ On basis of these data, it appears that the use of MRI has continued to increase in medical practice in university hospitals.

Our data indicate that the fixed-payment method significantly reduced the number of imaging tests per outpatient. After reverting to the fee-for-service method, the demand approached the level observed prior to the intervention. These changes were similar in both insured and uninsured groups, although the initial decrease was more evident in outpatients covered by social security. The mean payment per outpatient also decreased significantly in the group covered by social security compared with the uninsured group.

Although the number of imaging tests per outpatient decreased by 30% during the intervention, the percentage of positive results did not change significantly. The number of imaging tests per patient was significantly correlated with the fixed-payment method and the mean payment per patient.

What is known?

Many factors, including financial interest, fear of malpractice, lack of knowledge, repeat examination and patient expectations, influence the demand for imaging tests.^{1,3,4,9} It was previously reported that 'the most egregious cause of inappropriate use arises when an ordering physician has a

financial interest in the entity performing the examination',⁹ and previous studies indicated that ownership of a technology is an important factor in overuse.^{3,13} In various nations, an estimated 10 – 30% of the imaging tests ordered are unnecessary.¹⁴ In Turkey, a previous study reported substantial inappropriate hospital utilization (24.6 – 34.2%) in two major hospitals.¹⁵ In brief, inappropriate use (overuse, underuse or misuse) is a major problem in health care services.^{2,6,15}

What this study adds?

Our findings indicate that financial regulation decreases the demand for imaging tests, consistent with the results of previous studies.^{3,9,13,16} This decrease may result from a strong financial relationship between hospital personnel and the hospital, in that some of the hospital revenue, which can be increased by eliminating unnecessary tests, came back to health personnel as incentives. These results demonstrate that financial incentive for hospital personnel is an important factor in the demand for imaging tests.

Initially, we expected that the overall demand for imaging tests would decrease as a result of decreased physician-induced demand. In such a situation, the rate of positive results would increase over the intervention period. Instead, the rate of positive results did not change, indicating that the implementation of a fixed-payment method did not affect physician-induced demand. However, it is also possible that this lack of change in the rate of positive results reflects an increase in unmet needs, supported by the fact that the general demand for imaging tests decreased significantly while the rate of positive results remained the same. On the basis of these results, the implementation of a fixed-payment method may have increased the number of patients who did not receive the required diagnostic procedures.

Limitations of this study

One limitation of this study is that the sample was drawn exclusively from a university hospital. To clarify the relationship between the demand for imaging tests and the payment method, studies with larger samples are required.

Conclusions

The fixed-payment method has a significant effect on the demand for imaging tests when there is a strong positive financial relationship between the hospital and personnel. This result is consistent with those of previous studies that compared the effects of various payment methods.^{13,17,18} Our results also indicate that the decreased demand

observed after implementation of the fixed-payment method was not the result of changes in supplier-induced demand.

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