

Original Article

The Effect of the Payment System of Diagnosis-Related Groups on the Treatment Costs of Cardiovascular Patients, Admitted to the Selected Hospitals of Tehran in 2018

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Abstract

Introduction: Today, financing the treatment of cardiovascular diseases is one of the main problems of low-income and middle-income families. The aim of this study was to determine the effect of the payment system of diagnostic-related groups on the treatment costs of cardiovascular patients admitted to the selected hospitals in Tehran.

Materials and Methods: The present study was a descriptive-correlational study. The study population included cardiovascular patients admitted to specialized teaching hospitals in cardiovascular diseases affiliated to Tehran University of Medical Sciences and Health Services (Tehran Heart Center), Shahid Beheshti (Shahid Rajaei Heart) and also 502 Army Heart Hospital and Tehran Bu Ali Hospital, affiliated to the Islamic Azad University of Medical Sciences. The cluster sampling method was used and samples were systematically selected within the clusters.

Results: Implementation of payment system related to diagnosis is effective on the variables of number of days of hospitalization, drug costs and medical equipment, costs of nursing services and medical costs of cardiovascular patients hospitalized in selected hospitals in Tehran, with their relationship being at the level of $p < 0.001$.

Conclusion: It seems that the implementation of the payment system related to the diagnosis could be used to reduce the cost of treatment and the number of days of hospitalization of cardiovascular patients admitted to selected hospitals. Diagnostic-related groups system can significantly affect the financial health of hospitals and the availability of quality patient-care.

Keywords: Payment System for Diagnosis-Related Groups (DRG), Treatment Costs, Cardiovascular Patients

1. Introduction

Health is to great degree precious to human being and its value and importance is higher than the value of other things owned. Humans gain naught by spending money on books, art, clothing and cars if they are sick or dying. People are willing to spend whatever amount of money they earn on their own health [1]. When a child's life is at stake, the cost of missing an opportunity to bargain is very high. People

do not want to be involved in difficult decisions about compromising money over health. Hence, almost every modern economy offers health care and extensive health insurance programs on demand [1]. In order to control and maintain the efficiency of payments in health care centers, various reimbursement systems have been created in different countries such as the United States, because for insurances to be able to cover the costs of

health care services performed in inpatient and outpatient wards, they have sought to use appropriate payment approaches and systems [4-5,2]. In order to calculate the health care costs in each reimbursement system, a special approach has been used which are classified into two main categories: Fee- For-Service (FFS) and episode of care. In the FFS payment system, the final payment to the medical services provided before the end of the service is not clear. Some of the most common methods used in this group include retrospective payment and managed care. On the other hand, in paying for care activities for each situation or disease, a certain amount has been determined and in this regard, various methods such as per capita and futuristic payment have been used. At the federal level, there are various systems for prospective payments, such as ambulatory surgery centers (ASCs), Resource utilization groups (RUGs) for nursing homes and specialist nursing institutions, and home health resource groups (HHRGs) at care centers in Ambulatory Payment Classification (APC) for outpatient hospital services and Diagnosis related groups (DRGs) are used for acute inpatient care and long-term care in hospitals [6-5]. All members of a community have the right to receive the high quality health care they need without fearing the crushing financial costs. The objective of many countries across the world has been to design their health financing system in such a way to protect people against health insurance costs. According to the main messages of the World Health Organization report in 2010, this can be considered as the result of reviewing, analyzing and modification of the organization of health financing of those countries [7].

After financing, payment method is the second control button in the health system. The government and insurance companies decide how and how much to pay for the purchase of services from various public and private sectors. In fact, the type of

decision on payment method has a powerful effect on stimulating and undermining the motivations of service providers [8]. Impacts and incentives from the implementation of the payment system are important for providers and recipients of health services in terms of supply and demand. On the demand side, for instance, when patients are not required to pay for health services, they demand higher service volumes. Also, the price paid by patients has affected the time and place of their request for care. Even when there is no alternative provider, the right to more expensive visits has led patients to refuse visiting a doctor and to practice self-medicate for minor illnesses [9]. In terms of supply, the payment system has also led to complex responses from physicians and hospitals. Payment incentives have been able to motivate physicians to change the total number of hours they work and the number of patients they visit per hour and even their place of work. The payment method has also created strong incentives under the influence of which the physician can make appropriate decisions about how to treat his patients (outpatient treatment, hospitalization, surgery, etc.) [9].

The payment system affects the volume of care since physicians can induce their services. Due to their obvious superiority over patients in terms of medical knowledge, physicians have the power to induce a positive or negative demand through recommending methods such as the time of the next visit to patients, the type of medication prescribed for them, referral to other specialists, and laboratory tests or surgical treatments [10]. In Iran, the payment system has always been the most common payment method for doctors and hospital centers, as it is one of the most profitable, simplest and most flexible payment methods. The payment system has created induction services and the service provider has not incurred any risk in terms of medical expenses. Conversely, insurance companies and even patients have been at

greater risk of extra paying due to increased service volumes and health care cost [8].

In addition to the payment system, there are other methods such as: salary, per capita, payment per day of hospitalization, budget system, linear budget and payment based on affiliated diagnostic groups, etc., which are among the different types of payment methods, which have recently been considered by the Minister of Health of our country, and has been on the run by Medicare (one of the insurance and protection systems in the United States of America) since 1983[8].

According to statistics reported in 2016 by the Ministry of Health, Treatment and Medical Education, the most important cause of death in the country has been cardiovascular diseases. Since 2005, ischemic heart disease has been the leading cause of death in Iran. In 2016, the disease accounted for more than 25 percent of all deaths (equivalent to more than 90000 deaths). In other words, out of every 4 deaths in Iran, one is due to ischemic heart disease, with no priority over men or women. In 2016, about 72% of all deaths in the world were due to chronic non-communicable diseases, and among chronic non-communicable diseases, ischemic heart disease is the leading cause of premature death in most parts of the world, accounting for 9.48 million deaths in 2016, with an increase of about 19 percent compared to 2006 [11].

The diagnosis-related groups system has two important advantages in addition to repayment, the first of which is the evaluation of the quality of medical care through reducing unnecessary services and preventing induced demand from health care providers. The second advantage is the recognition of service evaluation through increasing the satisfaction of recipients and health care providers and preventing a sharp increase in treatment costs. Having an accurate information system in the registration of cardiovascular disease services and data analysis, for planning in

the payment and reimbursement system according to the services provided plays a crucial role here. Considering the importance and necessity of paying attention to and processing the cardiovascular diseases in the Iranian health care system, conducting research on the system of cardiovascular related diagnostic groups in Iran seemed quite important.

In Iran, the incidence and mortality rate of cardiovascular diseases has increased significantly in recent years and as the first cause of death in the country has imposed huge costs on the treatment system and at the same time has caused devastating costs for patients. The financial cost of cardiovascular disease plays an important role in total health care costs, household costs, and drug and hospital costs, and is a serious problem in public health and disease burden for social security institutions, households, and the community. Given that the Diagnosis-related groups (DRGs)-based payment is increasingly used worldwide to control hospital costs. In the presene study, the effect of the payment system of diagnostically related groups on hospitalization costs in cardiovascular patients was investigated in order to reduce medical costs, improve hospitals productivity and reduce financial pressure on patients by changing the payment system.

2. Materials and Methods

The present study is a retrospective descriptive-correlational study. The statistical population included patients with cardiovascular diseases admitted to 4 groups of common heart diseases (coronary artery disease, heart failure, hypertension and arrhythmias) in selected hospitals in Tehran (502 Cardiac Hospital affiliated to Army University of Medical Sciences, Educational-Research and Treatment Center, Cardiovascular Shahid Rajaei Cardiology, affiliated to Iran University of Medical Sciences and Health Services, Tehran Heart Center, affiliated to Tehran

University of Medical Sciences and Health Services and Bu Ali Hospital, affiliated to Tehran Islamic Azad University of Medical Sciences.

The samples were systematically selected within the clusters according to the characteristics of the statistical population, through cluster sampling. Sample size was selected, using the following formula, with 400 people from a population of 13,324 .

$$n = \frac{Nz^2pq}{Nd^2 + z^2pq} = \frac{13324 \times (1.96)^2 \times 0.25}{(13324 \times 0.0025) + (1.96)^2 \times 0.25} = 373$$

Z=1.96

Accuracy d=0.05

Ratio of the desired attribute (cost reduction)

p=q= 0.5

To conduct the research, first an information form was prepared in which the variables required for the research (number of days of hospitalization, cost of medicine and equipment, medical cost and cost of nursing) were determined. In order to facilitate the entry of data to the computer and reduce the possibility of error, all information forms were identified with a field called identification number, and all fields and their related options were given numbers and codes. Then, after obtaining permission from the officials of the target hospitals and referring to the medical records and accounting units using HIS hospital software and filtering the group of diseases and time range, access was granted to the list of hospitalized patients and the information required for statistical studies in the relevant forms records were registered. In the first stage, the required data on the actual costs and length of stay of patients in all files were extracted from the hospital information system in the study period and in the second stage, the average cost of treatment and patient's stay were calculated by the cost and average stay of the patient. Based on the payment system, the groups related to the diagnosis were compared. Finally, to compare the mean cost and

length of stay, the significance of the difference between the mean cost and average stay of the patient in the two communities was examined and analyzed, using Kolmogorov-Smirnov test and Wilcoxon test in version 26 of SPSS software. Also, diagrams were designed and drawn using Excel 2007 software. After data collection and coding, the research data were statistically analyzed using SPSS software version 26. In this regard, to study and describe the general characteristics of the samples, the methods available in descriptive statistics such as frequency distribution tables, frequency percentage, cumulative frequency percentage and average were used and then the Wilcoxon test was used to test the surrounding hypothesis according to the level of measurement of variables. As for the mean of the populations, Kruskal-Wallis multivariate analysis of variance was used to examine the difference between several mean costs of several statistical communities. In this study, the proposed ethical codes were considered and implemented. Also, all ethical considerations regarding the confidentiality of information were obtained from hospital records and information systems and not mentioning patients' names when reporting research results and the researcher's obligation not to be biased in dealing with data were observed.

3. Results

In the present study, the total number of cases of patients in the study groups was 400 with an age range of 45 years and above, with the highest percentage related to hypertension with a frequency of 26.82 and the lowest percentage related to heart failure with 23.3%. Be. The mean central index for the age variable was 60, which indicates that most patients were under 50 years of age (29.5%) and the lowest were over 80 (8.3%).

The value of the central fashion index (view) for the gender variable is 1, which

shows that the highest frequency is related to men (55%) and most of the patients were men.

Table 1. Average of dependent variables in the two current payment systems and groups related to diagnosis

Variable	Average (Days)	Standard Deviation	Least	Most	p-value
Day of hospitalization in the current payment system	3.93	1.66	1	12	p< 0.001
Day of hospitalization of the payment system of the diagnosis-related group	3.43	1.23	1	8	p< 0.001
Cost of medicine and equipment in the current payment system	24596648	91877507	26832	1045732607	p< 0.001
The cost of medicine and equipment in the payment system of the diagnosis-related group	23185756	89313151	26832	1042408000	p< 0.001
The cost of nursing services in the current payment system	1094051	1248421	62480	12295040	p< 0.001
The cost of nursing services in the diagnosis-related group	1217981	540079	106800	3526100	p< 0.001
The cost of K in the current payment system	18712787	23134064	33000	145169000	p< 0.001
The cost of K in the diagnosis-related group	16087969	20479820	33000	73806000	p< 0.001

To investigate the effect of the payment system of diagnosis-related groups on the treatment costs of cardiovascular patients admitted to selected hospitals in Tehran, dependent variables including components (number of hospital days, drug and equipment costs, nursing costs and treatment costs) and independent variable (Payment system) were used. Using Kolmogorov-Smirnov test in SPSS software, it was found that inpatient data with an average of 3.93 and standard deviation of 1.66, drug and equipment costs

with an average of 24596648 and standard deviation of 91877507, the cost of nursing with an average of 1094051 and standard deviation 1248421 and the cost of treatment with an average of 18712787 and standard deviation of 23134064 had an abnormal distribution ($p < 0.001$) (Table 1). Hence, for statistical analysis, the nonparametric Wilcoxon test was used to compare the means of the two groups (current payment system method and diagnosis-related group).

Table 2. Comparison of the average number of hospital days with the average number of hospital stays in the DRG system

Disease type	Average days of hospitalization in the current payment system	SD	Average days of hospitalization in DRG system	SD	p-value
Coronary-Artery Diseases	4	1.712	3.44	1.321	p< 0.001
Heart failure	4.10	1.547	3.65	1.290	p< 0.001
Hypertension	3.84	1.600	3.18	0.989	p< 0.001
Arrhythmias	3.77	1.808	3.07	1.241	p< 0.001

The results (Table 2) show that the payment system of the groups related to the diagnosis is effective on the number of days of

hospitalization of cardiovascular patients admitted to the target hospitals, thus reducing the number of hospitalization days

in four groups of common cardiovascular diseases. It indicates that the payment system of diagnosis-related group is related to the number of days of hospitalization of

cardiovascular patients. That is, the payment system of diagnosis-related group affects the number of days of hospitalization of cardiovascular patients.

Table 3. Comparison of the average cost of medicine and equipment in the current payment system with the DRG system

Disease type	Average cost of medicine and equipment in the current payment system	SD	Average cost of medicine and equipment for days in the DRG system	SD	p-value
Coronary-Artery Diseases	42155107	24384291	39607410	23778911	p< 0.001
Heart failure	7257571	11208053	6599907	10451966	p< 0.001
Hypertension	4494526	10069597	4181154	9731827	p< 0.001
Arrhythmias	44479388	17826247	42354553	173474633	p< 0.001

As can be seen in Table 3, the DRG payment system has been effective on the cost of medicine and equipment of cardiovascular patients admitted to the target hospitals, and thus reducing the cost of medicine and equipment in four groups of common cardiovascular diseases. It

indicates that the DRG payment system is related to the cost of medication and equipment for cardiovascular patients. That is, the DRG payment system affects the cost of medication and equipment for cardiovascular patients.

Table 4. Comparison of the average cost of nursing services in the current payment system with the DRG system

Disease type	The average cost of nursing services in the current payment system	SD	The average cost of nursing services in the DRG system	SD	p-value
Coronary-Artery Diseases	1104681	1242652	1360089	590541	p< 0.001
Heart failure	1074193	1150146	1281075	462830	p< 0.001
Hypertension	1280621	1698705	1112577	446097	p< 0.001
Arrhythmias	916709	679255	1118182	606566	p< 0.001

As can be seen in Table 4, the DRG payment system has been effective on the cost of nursing services of cardiovascular patients admitted to the target hospitals, thus reducing the cost of nursing services in four groups of common cardiovascular

diseases. It indicates that the DRG payment system is related to the cost of nursing services for cardiovascular patients. That is, the DRG payment system affects the cost of nursing services for cardiovascular patients.

Table 5. Comparison of the average cost of medical K in the current payment system with the DRG system

Disease type	The average cost of medical K in the current payment system	SD	The average cost of medical K in DRG payment system	SD	p-value
Coronary-Artery Diseases	35736638	23886031	30825683	19540532	p< 0.001
Heart failure	8154568	13845962	6384732	10910511	p< 0.001
Hypertension	5826130	8531828	3903970	4963477	p< 0.001
Arrhythmias	25133814	26592892	23237493	25471843	p< 0.001

As can be seen in Table 5, the DRG payment system has been effective on the cost of medical K of cardiovascular patients admitted to the target hospitals, thus reducing the cost of medical K in four groups of common cardiovascular diseases.

It indicates that the DRG payment system is related to the cost of medical K for cardiovascular patients. That is, the DRG payment system affects the cost of medical K for cardiovascular patients.

Table 6. Comparison of the average total costs in the current payment system with the DRG system

Disease type	Average total cost in the current payment system	SD	Average total cost in DRG system	SD	p-value)(
Coronary-Artery Diseases	78996427	38502967	71793184	35368110	p< 0.001
Heart failure	16486333	23152975	14265714	18684579	p< 0.001
Hypertension	11601278	17392442	9197701	13955083	p< 0.001
Arrhythmias	70529911	185372943	66710229	180931814	p< 0.001
Total	44403487	100189756	40491707	96971797	p< 0.001

Finally, with respect to the reduction in cost in Hypotheses 1, 2, 4 and the increase in cost in Hypothesis 3, the researchers concluded that the final effect of the DRG payment system should be checked on the treatment costs of cardiovascular patients admitted to target hospitals over the total costs. Using Kolmogorov-Smirnov test, it was revealed that the sum of costs with an average of 44403487 and standard deviation of 100189756 had an abnormal distribution ($p<0.001$). Therefore, for statistical analysis, Wilcoxon test was used to compare the means of the two groups (before and after). As can be seen in Table 6, the Payment System of Diagnosis-Related Groups has been effective on the treatment costs of cardiovascular patients admitted to the target hospitals in a way that it has reduced treatment costs in four groups of common cardiovascular diseases. It is noted that the payment system of diagnosis-related groups is related to the K medical costs of cardiovascular patients. That is, the payment system of diagnosis-related group affects the medical costs of cardiovascular patients.

4. Discussion

According to the research conducted over 189 cases of cardiovascular patients admitted to the target hospitals, the DRG payment system reduced the number of

days of hospitalization and in 173 cases the days of hospitalization in the current system and the DRG system was equal and in 38 cases the number of hospitalization days in the current system was less than the number of hospitalization days in the DRG system. In general, the average number of days of hospitalization in the current payment system was 3.93, which was decreased to 3.34 in the DRG payment system. Our results showed that the length of hospital stay was crucial, influencing factors for inpatient medical expenditure among cardiovascular patients. The length of hospital stay was widely recognized as an important factor in medical cost. An extended hospitalization would therefore increase the medical costs of patients. The result of a study conducted by Hosseini-Eshpala et al. in 2014 entitled "Comparison of the cost of hospitalized cases in the global system with the retrospective repayment system of a case study in Iran" indicates that the mechanism of reimbursement of medical expenses is one of the important factors that directly and indirectly affect the financial management and control of hospital expenses. Due to the reduction in the length of stay of patients in surgeries in the global payment system, a review of the current repayment system seems necessary and the implementation of a prospective repayment system for other

diagnoses and surgeries is recommended [11]. A 2018 study by Jung et al. entitled "The Effect of Diagnosis-Related Group Payment System on Quality of Care in the Field of Obstetrics and Gynecology among Korean Tertiary Hospitals" conclude that DRG significantly reduced the length of stay of patients with hysterectomy and adnexectomy [12], which is consistent with the result of the above hypothesis and confirms it.

Also, in 176 of the reviewed cases of cardiovascular patients admitted to the target hospitals, the diagnosis-related payment system reduced the average cost of medicine and equipment, and in 197 cases, the average cost of medicine and equipment in the current system and the diagnosis-related system of diagnosis-related groups is equal and in 27 cases the cost of medicine and equipment in the current system was less than the cost of medicine and equipment in the DRG system. In total, the average cost of medicine and equipment in the current payment system was 24596648 Rials, which has been reduced to 23186756 Rials in the DRG payment system with a decrease in the average cost of medicine and equipment. A 2015 study by Kim et al. entitled "Impact of the new payment system on laparoscopic appendectomy in Korea" suggests that After the introduction of K-DRG, the costs of medications and diet during the initial hospital stay have also decreased significantly[13]. Wu et al. in a study entitled "Research on diagnosis-related group grouping of inpatient medical expenditure in colorectal cancer patients based on a decision tree model" reported that according to epidemiological statistics, the incidence and mortality of CRC has been increasing in China over the past few years. It has become a serious threat to public health, and has led to an escalation of medical cost that poses economic burden on patients and society. The results of this study showed that during 2014-2018, t and the average inpatient medical expenditure in CRC patients was 57872.4 yuan. It was also

revealed that the overall medical cost for CRC patients mainly included drug cost, surgery cost, treatment cost, and examination cost. Among them, drug cost accounted for the highest proportion of the overall medical cost, [14] which is consistent with the above hypothesis and confirms the above hypothesis. Hospitals to survive in a competitive market, hospitals have responded to lower health care tariffs by taking more money from patients, overusing advanced diagnostic equipment, and selling more drugs. Therefore, it is necessary for medical institutions to strengthen clinical drug management and place more emphasis on rational drug use in clinical practice.

In 176 cases of cardiovascular patients admitted to the target hospitals, the DRG payment system reduced the cost of nursing services, and in 197 cases, the cost of nursing services in the current system and the DRG system were equal. In 27 cases in the current system, the cost of nursing services in the DRG system proved to be lower. In total, the average cost of medicine and equipment in the current payment system was 24596648 Rials, which has been reduced to 23186756 Rials in the DRG payment system with a decrease in the average number of hospital days. Despite using strategic search techniques in Google Scholar, etc., no study was found in this regard.

In 291 of the reviewed cases of cardiovascular patients admitted to the target hospitals, the DRG payment system reduced the average cost of treatment, and in 22 cases average cost of treatment in the current system and the DRG system were equal. In 87 cases, the cost of treatment in the current system was less than the cost of treatment in DRG system. In total, the average cost of treatment in the current payment system was 18712787 Rials, which in DRG payment system it has been reduced to 16087969 Rials. The results of a 2017 study conducted by Rui Liu et al. entitled "Charting a path forward: policy analysis of

China's evolved DRG-based hospital payment system " aiming at investigating the impact of DRG on reducing medical costs in China revealed that in studies conducted in 12 Chinese provinces, 95.80 percent of DRG systems were useful for controlling hospital costs [15]. Also, a 2017 study by Kwak et al. entitled " Impact of the Korean Diagnosis-Related Groups payment system on the outcomes of adenotonsillectomy: A single center experience" concluded that the Korean DRG system for adenotonsillectomy and tonsillectomy reduced medical costs and clinical outcomes. The total cost of DRG-AT medicine was significantly lower than that of the FFS-AT group, and the Korean DRG system for adenotonsillectomy and tonsillectomy reduced the treatment costs and clinical outcomes [16], which is consistent with the hypothesis and confirms the above hypothesis.

The aim of DRG is to classify and combine disease categories with similar diagnoses and treatments, and set a payment standard for each group. In this study analyzed the influencing factors on inpatient medical expenditure in cardiovascular patients and the grouping results of DRGs payment. In order to strengthen cost management, it is suggested that medical institutions should attach greater importance to the process of diagnosis and treatment, emphasize rational drug use, shorten the average length of hospital stay to effectively control hospitalization cost in cardiovascular patients, and reduce the financial burden on families and society.

5. Conclusion

Given the fact that cardiovascular diseases in Iran and the world rank first in terms of mortality, and given that cardiovascular diseases ask for high costs and are also heavy economic burdens on society, the need to reduce out-of-pocket payments through strengthening insurance coverage and more government assistance, including coverage of these patients'

medicines in the public sector and exemption schemes for the poor and lower-income households are proposed as essential diagnostic and therapeutic measures. Based on the findings of the present study, it was revealed that there is a relationship between the implementation of the DRG payment system and the number of hospitalization days, costs of drugs and medical items, costs of nursing services and medical costs of cardiovascular patients admitted to selected hospitals in Tehran. Therefore, it seems that choosing and applying the appropriate costing method to calculate and estimate the costs associated with cardiovascular disease in hospitals is of utmost importance.

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Conflict of interest

The authors declare no conflict of interest.

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