

A study on the introduction of mixed payment compensation system through top-down cost information analysis in Korea

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Abstract: This study aims to identify the problems of the Korean health insurance fee system and to suggest a reasonable insurance fee construction alternative using the cost analysis data of hospitals. To this end, the characteristics of the medical fee payment system and hospital cost analysis were examined, and the cost data of one national public general hospital were used for the analysis. The cost allocation criteria were divided into labor costs, material costs, pharmaceutical costs, equipment costs, and overhead costs, and a top-down cost analysis was conducted. The analysis results showed that the cost was greater than the income in the case of outpatient and inpatient treatment performance, and the analysis results on the amount of physician workload showed that the relative value of physician workload calculated based on the cost was analyzed to require an increase of 1.52 times for hospitalization fees and 1.72 times for examination fees. The main factor affecting the cost compensation rate was that when the proportion of examination fees was high, the cost compensation level increased, while on the other hand, the cost compensation rate decreased as the proportion of physician labor costs increased or the length of stay increased. In order to resolve the ongoing complaints of medical service providers under the current fee-for-service system and secure the appropriateness of health insurance compensation rates, compensation for physician fees should be induced to realize the level of cost compensation through cost-based, per-service fee calculations, and the rationality of the payment compensation system can be secured by securing autonomy of providers through bundled fees for hospital costs and changing the payment method.

Keywords: *Fee for service, Healthcare compensation system, Hospital cost, Prospective payment system, Resource-based relative value scale.*

1. Introduction

Many countries operating health insurance systems are pursuing reforms to rationally spend the costs required for health insurance benefits. In order to rationally spend costs, many countries are attempting to reform their payment systems, but the reality is that reforming an already established payment system is not easy due to conflicts between stakeholders and social conflicts. In the case of Korea, since the introduction of health insurance in 1963, a payment and compensation system based on Fee for Service (hereinafter referred to as FFS) has been maintained, but in order to increase the efficiency of spending on medical care benefits, the Prospective Payment System (hereinafter referred to as PPS) was first introduced in 2002 as an optional participation form. Since July 2012, the prospective payment system for hospitalization costs for seven disease groups (cataract, tonsil, appendix, anus, hernia, uterus, and cesarean section) has been fully implemented, and in 2009, the new prospective payment system for all inpatients has been implemented for public hospitals. The new prospective system considers the aspect of supplier acceptance compared to the prospective fee system for seven disease groups and divides fee items into prospective and non-prospective fees and pays compensation [1].

The hospital industry is a representative industry with a very high fixed cost ratio, and it must be

able to cover the investment cost for high fixed costs in order to operate the hospital. However, in order to solve the problem of inefficiency in medical institutions, it is most important to design an appropriate fee compensation system that reflects the cost structure of the hospital.

The reason why cost calculation of hospitals is important is that it can be used as a basis for establishing a reasonable health insurance fee from the perspective of health insurance policy, and it can be used as effective resource allocation and evaluation data by objectively identifying resource consumption activities compared to input in terms of medical institution operation.

The purpose of this study is to examine the cost investigation methodology based on the Resource-Based Relative Value Scale (hereinafter referred to as RBRVS) and PPS currently applied to the health insurance fee system in Korea, and to analyze the compensation level for the fee through cost information analysis targeting a general hospital, and to suggest problems and alternatives in the current health insurance fee system.

2. Theoretical Considerations

2.1. Types of Payment Systems

The medical payment system is a general term for a system in which a third party pays medical fees in return for medical services provided to patients by medical providers. The core content of provider medical fee payment is “How much will be compensated?” and “How will it be compensated?” In other words, the former question is related to the level of compensation, and the latter question is related to the compensation method.

First, the compensation method refers to a method in which medical fees are paid based on the medical treatment performed by the provider, the patient’s diagnosis, the number of patients, etc. Each payment method causes differences in the provider’s treatment behavior depending on the payment method institutionally provided. For example, in the FFS system, the price of the medical service provided to the patient (medical fee) is multiplied by the amount of medical services provided, and the provider increases its production and income by overproviding medical services in order to increase its income. On the other hand, in the PPS and Capitation System, which comprehensively cover medical fee payment units such as diagnosis and number of patients, the supply of medical services increases the cost per unit, which increases the possibility of underprovision of medical services.

Each country applies various provider payment methods based on its own characteristics such as the shared values and culture of its citizens, income level, and policy priorities. The UK applies a capitation system for basic medical care and primary care in the National Health Service (NHS), while France applies a single payment system such as a salary system. In some countries, different payment system types are applied according to the functional characteristics of medical providers. For example, in the US, a mixed payment system is operated in which a bundled payment system is applied to hospital costs for the treatment of the same patient, and a FFS fee is applied to the professional services of doctors. The characteristic of the mixed payment system is that it is a method to minimize side effects by utilizing the characteristics of the payment compensation system according to the function of the provider. For example, it is operated in a way that reduces the risk of over-utilization in FFS and the risk of under-utilization of resources in Capitation by integrating the capitation and FFS systems [2].

Table 1.
Different approaches to collecting cost data in Europe.

Classification	Mandatory cost-accounting system	National costing guidelines	Cost-accounting data used for developing DRG prices
Austria	-	-	X
England	X	X	X
Estonia	-	-	X
Finland	-	-	X

France	-	X	X
Germany	-	X	X
Ireland	-	X	-
Portugal	X	X	-
Netherlands	X	X	X
Sweden	-	X	X

The basic model of the PPS-based hospital payment system is to collect personal characteristics, treatment data, cost data, etc. through a patient classification system according to diagnosis, surgery, severity, etc., and to set prices by applying weights, etc., and to pay hospitals. Many European countries are regularly collecting cost calculation data from sample hospitals and using the results of analysis to continuously improve the PPS system [3]. Comparative studies on patient cost calculation based on PPS have been actively conducted since 2006 [4, 5], and have recently been developed mainly in the United States and Europe [6, 7].

2.2. Hospital Cost Analysis and Payment System

The second key element of the medical payment system is the question of “How much will I pay to the health care provider?” The question of the level of compensation for medical expenses is closely related to the level of cost required to provide medical services. Therefore, the question of how much compensation will be provided compared to the cost level is determined by policy according to the status of each country’s health insurance or tax finances. Therefore, many countries are attempting to assess the cost levels of medical providers at a macro level in order to set the prices of health insurance [8]. In terms of hospital cost accounting, there are two main methods for analyzing hospital costs: top-down cost analysis and bottom-up cost analysis [9]. The difference between bottom-up and top-down cost methodologies is explained by the difference in how information on costs is collected.

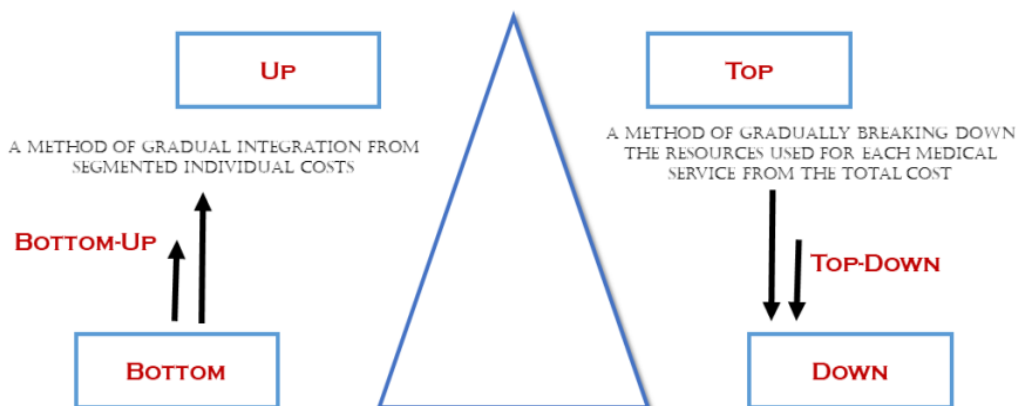


Figure 1.
Difference between bottom-up and top-down costing methods.

First, the top-down cost calculation model is a calculation model that approaches the cost information (cost accounting data) of the entire hospital at a macro level based on the allocation criteria to the detailed cost objects. In general, top-down cost calculation is accurate in cost analysis when detailed cost allocation criteria can be set and professional accounting knowledge is available. However, there is a possibility that cost information of individual medical treatment units may be diluted by over all cost information, and inaccuracy in cost calculation exists when the allocation criteria of individual units are inaccurate.

On the other hand, the bottom-up cost calculation model is a cost calculation method that builds

micro-level detailed cost information and integrates and approaches the macro-level cost. Bottom-up cost calculation builds cost information of individual treatments to enable cost tracking of the corresponding cost calculation object, but the integration of costs of individual treatment units can cause differences between overall costs, which can lead to cost distortion. In addition, knowledge based on expertise in the relevant field (medical knowledge) is required rather than the cost allocation criteria. In this study, the top-down cost analysis methodology using cost accounting information was used up to the cost center point, and the bottom-up cost was used as the distribution standard for the cost of each medical procedure.

In general, countries that apply the bundled payment system use the top-down cost analysis methodology, and countries that use the fee per service system and the total budget as the distribution standard calculate hospital costs according to the bottom-up cost analysis methodology.

3. Materials and Methods

3.1. Data Sets

The analysis target was the financial statements and supplementary statements of one public general hospital for one year (16.1.1~12.31), and the National Health Insurance Service cost and revenue data by patient/procedure. The number of beds was 466 beds in 14 wards (including 26 beds in 2 intensive care wards), and the total number of personnel was 814 (specialists 114, residents 70, nurses 355, health workers 137, administrative workers 98, and other workers 40).

Actual data showed that as of 2016, the actual number of inpatients was 11,515 (122,677 annual patients), the number of outpatients was 327,335, and the total medical (procedure) revenue was 88.3 billion won (50.2 billion won in hospitalization revenue, 38.1 billion won in outpatient revenue). Cost data were used from the income statement, financial statements, personnel and labor costs by department in the entire hospital (personnel department), material cost usage details (central supply office), and medical equipment management details (medical device management department). Revenue data were used from the medical revenue details by department and treatment subject, and the service provision details and treatment revenue details by inpatient in 2016 for calculating the bundled payment by patient. Data on the disease group of inpatients were used from the treatment records of 8,879 inpatients for whom Korea Diagnosis Related Groups (DRGs) numbers were generated (excluding dentistry, oriental medicine, and error DRGs), and data on the relative value by procedure were used from the 2014 relative value score calculation basis data presented by the Health Insurance Review and Agency.

3.2. Medical Fee Development Method Through Cost Analysis

3.2.1. Cost Allocation Criteria by Type

3.2.1.1. Labor Cost Allocation Criteria

In the case of medical institutions, the job types vary depending on the work, and the salary system for each job type also differs, so the cost distribution criteria for each job type were subdivided. In the case of doctors, they were divided into specialists, residents, and interns, and they were classified into nurses, general department nurses, medical technicians, and administrative staff.

The cost aggregation and allocation of specialists was allocated by labor costs according to the activity definition and activity time (ratio), and the activity unit of the main treatment doctor was defined, and labor costs were allocated to the implementing department according to the activity ratio.

The cost of residents was collected and allocated according to the labor cost ratio of the specialist in the relevant department. Since residents are highly related to the education and training and clinical assistance activities of the relevant department, labor costs were allocated by applying the labor cost ratio of the specialist in the relevant department. In the case of interns, labor costs were allocated according to the labor cost ratio of all specialists, and since they are not affiliated with the relevant department, labor costs were allocated according to the labor cost ratio of all doctors.

In the case of nurses, the number of personnel and labor costs of the nursing staff in the implementing department were collected (however, the labor costs of nurses in the insurance review department, etc. were collected as indirect costs and allocated according to the income ratio of each implementing

department) and allocated. The labor costs of nurses in the outpatient common department, ward nursing team, etc. who do not work in the implementing department and implementing department were allocated according to the nursing labor cost ratio of the implementing department.

The cost aggregation and allocation of medical technician personnel expenses were calculated by aggregating the personnel expenses of clinical personnel in the implementing department, and the number of clinical personnel and personnel expenses of the implementing department were aggregated. The personnel expenses of radiology and radiologist were allocated to the implementing department according to the revenue ratio of X-ray CT, MRI rooms, etc. (Diagnostic laboratory medicine and clinical pathologists were also distributed according to the revenue ratio of each implementing department). For office work, the personnel number and personnel expenses of administrative support departments (administrative affairs department, general affairs department, personnel department, planning department, hospital director, labor union department, etc.) were aggregated through the personnel expense's aggregation of the administrative administration department, and the personnel expenses were allocated according to the revenue ratio of the implementing department.

3.2.1.2. Material and Drug Cost Allocation Criteria

The aggregation of material costs and pharmaceutical costs by implementing department was targeted at compensable material costs and pharmaceutical costs, and was allocated for materials and pharmaceuticals that are separately compensated for outside of the treatment fee as material costs borne by the patient or the insurer. Non-compensable material costs and pharmaceutical costs were set as cost allocation criteria for non-compensable materials and pharmaceuticals (material and pharmaceutical costs included in the calculation of the fee) that are not separately compensated to the patient or the insurer and are provided as part of the treatment fee.

3.2.1.3. Equipment Cost Allocation Criteria

The equipment cost by implementing department was calculated by compensating for the medical practice fees, and the depreciation cost of the equipment (applying the depreciation method of the relevant hospital) and the repair and maintenance cost of the equipment were calculated for the medical equipment used in the implementing department. The depreciation cost by medical equipment other than the implementing department was allocated based on the revenue composition ratio. In addition, the medical equipment repair cost was calculated by utilizing the medical equipment repair cost by implementing department.

3.2.1.4. Overhead Cost Allocation Criteria

The overhead cost allocation criteria were set according to the allocation criteria for 30 items based on the accounting criteria for medical institutions. However, in the case of depreciation and repair costs of medical equipment, distribution was made after deducting the cost of the corresponding item.

3.2.2. Medical Fee Calculation Model

Based on the cost allocation criteria presented above, the method of calculating the medical fees based on RBRVS and PPS is as shown in <Fig. 2> and <Fig. 3>.

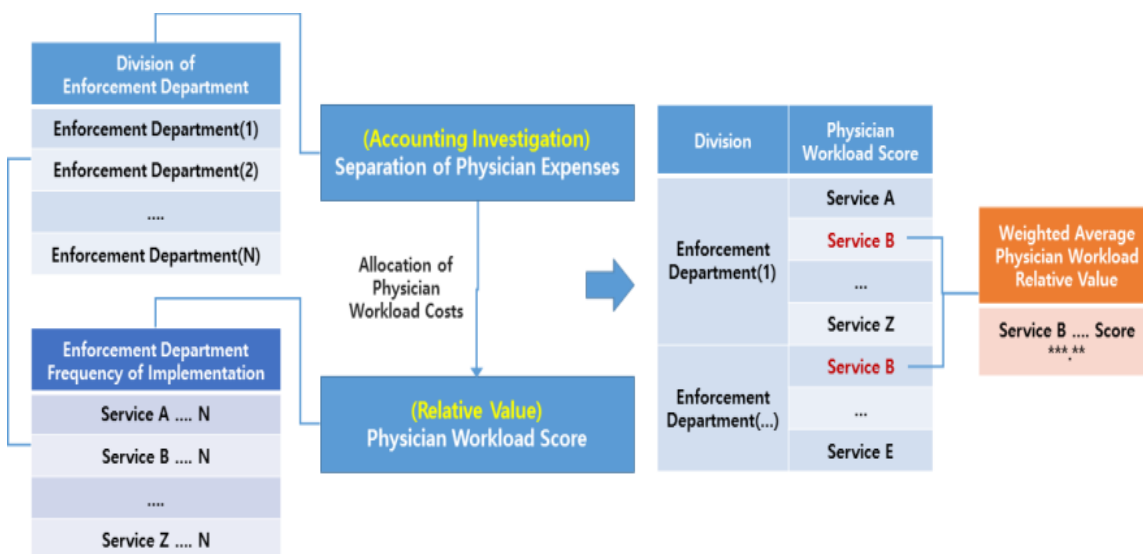


Figure 2. Medical fee calculation model based on RBRVS.

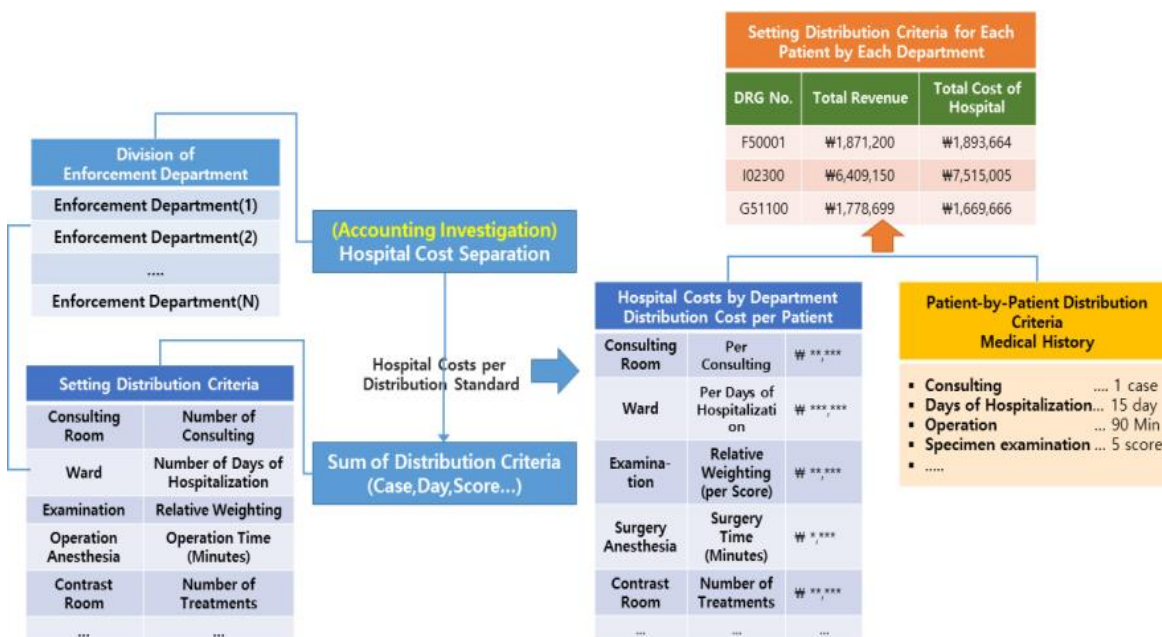


Figure 3. Medical fee calculation model based on PPS.

4. Results

4.1. Cost Compensation Level Analysis Results

In order to derive an appropriate level of cost compensation, the analysis was conducted by dividing it into outpatient and inpatient performance. In the case of surgery, it was divided into internal medicine, surgery, and other departments, and the cost per examination was calculated by reflecting the procedure income and total cost by department. The result of calculating the procedure income per case by reflecting the total number of consultations on the procedure income is as shown in (Table 2), and the result was that the cost was greater than the income in all departments. The same method as for outpatient

performance was applied to the inpatient performance, and the result was that the cost was greater than the income when analyzed by dividing it into general wards and intensive care units, as in the result of the analysis of outpatient performance (see Table 3).

Table 2.
Profit performance per case by outpatient department.

Consulting room	Medical service income (million ₩)	Expense (Million ₩)			Total number of consultations (Case)	Cost per consultation (₩)			Service income per case (₩)
		Doctor expense	Hospital expense	Total expense		Doctor expense	Hospital expense	Total expense	
Internal medicine department subtotal	2,144	4,024	2,722	4,024	117,174	11,109	23,231	34,340	18,296
Surgery department subtotal	1,234	2,783	2,179	2,783	46,206	13,077	47,150	60,227	26,705
Other medical departments subtotal	2,496	1,667	3,383	5,050	122,564	13,598	27,605	41,203	20,366
Total	5,874	3,573	8,284	11,857	285,944	12,494	28,971	41,465	20,542

Table 3.
Daily profit performance by hospitalization general ward and intensive care ward.

Inpatient ward	Medical service income (Million ₩)	Expense (Million ₩)			Hospitalization days (Day)	Cost per day(₩)			Service income per day (₩)
		Doctor expense	Hospital expense	Total expense		Doctor expense	Hospital expense	Total expense	
General ward subtotal	16,892	2,933	21,123	24,056	114,269	25,667	184,850	210,518	147,829
Intensive care ward subtotal	1,928	215	3,615	3,830	5,946	36,135	607,971	644,106	324,222
Total	19,043	3,247	25,510	28,757	122,414	106,774	208,389	234,912	155,562

4.2. Results of Analysis of Physician Work in Response to Specialist Labor Costs

In order to analyze the appropriateness of compensation according to the workload of specialists who are the main practitioners of medical services, the number of fee items according to the type of medical service act was calculated and the increase rate according to the workload was analyzed. The relative value of the workload of doctors calculated on the basis of cost was analyzed to require an increase of 1.52 times for hospitalization fees and 1.72 times for consultation fees compared to the relative value of the workload of doctors as of 2014. In the case of some tests, the results showed that the price had to be reduced by 2.0 times, so it was found that there was an imbalance in the doctor's workload. In other words, it is judged that it would be appropriate to compensate for the labor provided by specialists who are the main practitioners with RBRVS rather than PPS, and it is necessary to realize the current low level of the relative value score of the workload of doctors.

Table 4.
Results of specialist workload by type of medical service activity.

Classification of service type	Number of services	Workload increase rate
Basic medical consulting	4	1.72
Basic hospitalization	4	1.52
Clinical specimen test	436	4.38
Functional check	160	0.96
Operation	597	2.09
Radiology	377	3.09
Treatment	262	1.96
Total	1,840	2.73

4.3. Influencing Factors of Cost Compensation Rate

In order to analyze the relationship with the major factors affecting the cost compensation rate, the cost compensation rate was set as the dependent variable, and multiple regression analysis was conducted by entering the physician labor cost, examination fee, and number of days of hospital stay as independent variables. The analysis results showed that the examination fee factor had the greatest effect on the cost compensation rate, followed by the proportion of physician labor cost and the number of days of hospital stay. In particular, when the proportion of examination fee was high, the cost compensation level increased, and on the other hand, when the proportion of physician labor cost increased or the length of stay increased, the cost compensation rate decreased.

Table 5.
Relationship between cost compensation rate and influencing factors.

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	S. E			
(Constant)	1.038	0.022		46.884	0.000
Proportion of doctor labor costs (%)	- 2.460	0.182	- 0.153	- 13.509	0.000
Proportion of clinical examination fee (%)	0.992	0.052	0.216	19.098	0.000
Length of stay (LOS)	- 0.003	0.001	- 0.064	- 6.034	0.000

5. Discussion

This study examined the cost investigation methodology based on RBRVS and PPS currently applied to the Korean health insurance payment system, and analyzed the compensation level for the fee through cost information analysis targeting a general hospital. The cost analysis method utilized the European patient-based cost calculation method rather than the fee-based cost calculation method to perform patient-based cost calculation for hospital costs. The patient-based cost calculation method utilized the cost-centered unit and allocation criteria established by the Institute for the Hospital Remuneration System (InEK), a German hospital compensation system specialized organization with a relatively well-established patient-based cost calculation system [10].

As a result of analyzing the level of health insurance payment through hospital cost analysis, first, the revenue per outpatient treatment was greater than the cost in all departments, and in the case of hospitalization, the result of analyzing by dividing into general wards and intensive care wards was the same as the result of analyzing the outpatient performance, the cost was greater than the income. This is because the current outpatient and hospitalization fee structure does not sufficiently compensate for physician fees or hospital costs, and it is necessary to introduce a method of differentiating consultation

fees and hospitalization fees by department, and because there is a difference in the cost compensation ratio depending on the implementing department, it is necessary to reorganize the fee structure by procedure.

Second, as a result of analyzing the amount of physician workload in response to the personnel expenses of specialists, it was analyzed that the relative value of physician workload calculated based on cost is 1.52 times higher for hospitalization fees and 1.72 times higher for consultation fees. In other words, it is judged that it would be appropriate to compensate for the labor provided by specialists, who are the main practitioners, with RBRVS rather than PPS, and it is necessary to realize the current low level of relative value score of physician workload.

Third, as a result of analyzing the relationship with the main factors affecting the cost compensation rate, the examination fee factor had the greatest effect on the cost compensation rate, followed by the proportion of physician labor costs and the length of stay. In particular, the higher the proportion of examination fees, the higher the level of cost compensation. On the other hand, the higher the proportion of physician labor costs or the longer the length of stay, the lower the cost compensation rate. This was a result similar to the study on Kim. et al [11].

Korea's FFS is a system that sets the service price for all medical practice and compensates by multiplying the amount of service provided. On the other hand, PPS is a system that pays a fixed amount of medical expenses to medical institutions based on the type or amount of medical services provided to the patient, regardless of the disease for which the patient was hospitalized. The main problem identified in the current fee system is that, from the supplier side, the provider payment compensation system is below cost compensation, which has led to continuous complaints from medical service providers, and from the insurer's (National Health Insurance Service) standpoint, the distortion of the provider income structure due to the imbalance between fees and the uncertainty regarding the sustainability of health insurance finances have not been resolved [12].

In the case of the Health Insurance Review and Agency, the review and evaluation and payment of medical expenses under the FFS system are overburdened, and in the case of the public (patients), the appropriateness of the payment amount for medical services provided may be questioned. In order to resolve these problems, it is necessary to examine the possibility of reorganizing the payment system into a dual fee structure. For example, compensation for medical expenses can be applied to the FFS system in addition to the hospital expenses for medical service providers and facilities as a bundled payment system, thereby inducing the realization of the cost compensation level through cost-based DRG and FFS calculation, and securing the autonomy of suppliers through the bundled payment system for hospital expenses and considering a change in payment method. Through this, citizens will be able to expand the predictability of payment levels as compensation for the provision of medical services, and expand the sustainability and predictability of health insurance finances.

Reform of the payment system means changes in payment methods and payment levels. Reform of the payment method will affect the form of medical service provision for consumers and providers, and the payment level will affect the financial soundness of insurers as well as the entire health care industry. Nevertheless, discussions to date have only discussed payment methods. Therefore, a payment method that can cover the level of fixed costs in terms of payment levels and a fee policy that can secure the rationality of the payment system by considering performance-based factors in the case of variable costs are necessary.

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