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ORIGINAL ARTICLE

Association between Introduction of the Diagnosis-Related Groups System for Anal Operation and Length of Stay: Higher Effectiveness at Hospitals with Longer Length of Stay

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Background: We investigated association between introduction of the diagnosis-related groups (DRG) system for anal operation and length of stay. Also, we investigated how it is different among hospitals with longer length of stay and among hospitals with shorter length of stay before introduction of the DRG system.
Methods: We used data from Health Insurance Review and Assessment which were national health insurance claim data. Total 13,111 cases of anal surgery cases were included which were claimed by hospitals since July 2012 to June 2014. Two-level multivariable regression was conducted to analysis the association between length of stay and characteristics of hospital and patient.
Results: Before introducing DRGs, the average length of stay was 5.41 days. After introducing DRGs, average length of stay was decreased to 3.92 days. After introducing DRGs, length of stay has decreased ($\beta = -1.0450$, $p < 0.0001$) and it was statistically significant. Among hospitals which had short length of stay (shorter than mean of length of stay) before introducing DRGs, effect of introducing DRGs was smaller ($\beta = -0.4282$, $p < 0.0001$). On contrary, among hospitals which had long length of stay (longer than mean of length of stay) before introducing DRGs, effect of introducing DRGs was bigger ($\beta = -1.8280$, $p < 0.0001$).
Conclusion: Introducing DRGs was more effective to hospitals which had long length of stay before introducing DRGs.

Keywords: Characteristics of hospital; Length of stay; Anal surgery; Diagnosis-related groups

INTRODUCTION

Organization for Economic Cooperation and Development (OECD) pointed out that Korea's health spending growth was 8%, and it was almost double of the OECD average of 3.6%. Long hospital stay was cited for the reason of rapid growth of health spending in Korea [1]. In addition, OECD recommended expanding diagnosis-related groups (DRG) system as way of solution [1].

DRG presented as a containing method of constantly increased medical costs under fee-for service (FFS) system [2,3]. DRG is a payment system which pays the fixed amount of cost per DRG from admission to discharge [4,5]. In contrast with FFS, paying per each medical performance, the characteristic of DRG, fixed sum of money per DRG, contains medical costs as inducing minimizing unnecessary length of stay (LOS) or performances [6,7]. European countries went further and considered hospital transparency, efficiency, and improving quality as expected effect of DRG [6,8].

The main expected effect of DRG was reducing excessive treatment, but people, who against DRG, insisted that in the process of reducing, scanty treatment was caused and patients could not receive enough amount of treatment [9]. Representatively, as LOS increase, so do the expense per earning, because of that hospital dis-

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charges patients too early, it is called bloody discharge [10]. In addition, shifting to the ambulatory care sector also occur, so LOS is reduced and visiting of ambulatory care sector is increasing [9,10].

As mentioned above, reduced hospital length was included in both DRG's main advantages and side effects. LOS is typical index of measuring medical or hospital management, and reducing LOS is well known factor that increases hospital revenues as increasing operation efficiency and saving cost per case of operation [10]. LOS is due to personal characteristics or severity, but the characteristics of hospital, such as the number of doctors, beds, cases of operation, and the payment system were also known that impact on LOS [11-13]. So that, measuring changes of LOS, during assessment DRG, is important to understand positive and negative effect of DRG.

Since January 2002, after three times of demo business from 1997 to December 2001, Korea has implemented eight DRG targeted DRG to the hospitals which selected that system [14]. Since 2003, Korea had excluded vaginal delivery, so now Korean DRG included seven DRG: lens surgery, tonsillectomy and adenoidectomy, appendectomy, inguinal and femoral hernia surgery, anal surgery, uterus and uterus adnexa surgery, and cesarean section.

The Ministry of Health and Welfare (MHW) business report in 2011 started the discussion of expanding DRG on inpatient section for sustainability of financial of national health insurance. Since first of July 2012, MHW has conducted DRG to all hospital and clinic, and since first of July 2013, has conducted DRG to all general hospital and advanced general hospital.

Previous studies cited the LOS was reduced when DRG was conducted, and the reduced degree was different by the characteristics of hospitals [13,15,16]. In addition, previous studies suggested the characteristics of the LOS distribution in DRG target diseases, anal surgery had most plenty of operation cases, higher rate of extremely shorter LOS, and big LOS distribution between hospitals [17].

Meantime previous studies, which researched the changed of LOS during introducing DRG in Korea, were limited to a hospital or only part of patient, so it was hard to represent all cases [17]. Especially, general and advanced general hospital have not selected DRG mostly, typicality was treated [16]. However, since July 2013, DRG were conducted to all medical institution in Korea, finally could be verified the effect of DRG on general and advanced general hospitals.

In this study, we planned to analysis the changes of LOS of anal surgery patients during introducing DRG in FFS used institute. Especially, through analyzing the characteristics of hospital, which enlarge the change of LOS, we would imply propriety of the changes of LOS.

METHODS

1. Data collection and participants

We used Korean national health insurance claim data from July of 2012 to June of 2014. This data included all operation cases of DRG target diseases: lens surgery, tonsillectomy and adenoidectomy, appendectomy, inguinal and femoral hernia surgery, anal surgery, uterus and uterus adnexa surgery, and cesarean section in Korea.

Among those, we selected anal surgery, which was classed as the International Classification of Diseases (ICD)-10 code G10200, G10201, G10400, G10401, G10402, G10500, G10501, G10502, G10600, G10601, and G10602. We selected the general and advanced general hospital which claimed as FFS from July of 2012 to June of 2013 to exclude newly involved hospital after introducing DRGs in June of 2013 and used the cases from July of 2012 to June of 2014. Medical benefit patients were excluded and national hospital was excluded because there was only one national hospital in this study objects.

2. Study variables

We established from July 2012 to June 2013 as baseline, which before introducing DRG durations, and from July 2013 to June 2014 as second year. To adjust difference characteristics of hospitals and each cases, variables are divided into hospital characteristics and individual characteristics, and hospital characteristic variables were as in the following: advanced general hospitals are general hospitals offering medical performances, had high level of difficulty for high risk patient, and appointed by the MHW. Based on claim date, we divided hospitals into general and advanced general hospital.

The number of beds was divided into 500 beds or above, 300 to 499 beds, and 300 beds below. The location of hospital was divided into urban, located in "si", and rural, located in under "gun". Teaching and non-teaching hospital was divided. Divided the number of doctors by the number of beds and multiplied 100 to make the variable named doctors per 100 beds. We cumulated anal surgery cases by each hospital to make cumulated cases of operation. We included mean of LOS before introducing DRGs. "Short" indicate shorter mean of LOS than mean of LOS among same type of hospital, and "long" indicate longer mean of LOS

than mean of LOS among same type of hospital.

Individual characteristics were as in the following. We divided sex into male and female, and divided ages into 20 to 39, 40 to 64, and 65 and above. We classified patient clinical complexity level (PCCL) into 0 and 1 or above groups. In order to classify the DRG groups, we divided ICD-10 codes as follow: G10200 and G10201 to G102 (multi-anal surgery); G10400, G10401, and G10402 to G104 (other anal surgery); G10500, G10501, and G10502 to G105 (circular stapled hemorrhoidectomy); and G10600, G10601, and G10602 to G106 (main anal surgery).

In order to classify hospitals to "long LOS hospital" and "short LOS hospital," we divided baseline's cumulated LOS for each hospital and DRG by cumulated number of cases to obtain "average LOS by hospitals." As same like average LOS by hospitals, we obtained "average LOS by classes of hospitals," and compared with LOS by hospitals. The hospitals, which had longer average LOS by hospitals than average LOS by classes of hospitals, were classified into longer LOS hospital, and the hospitals, which had shorter average LOS by hospitals than average LOS by classes of hospitals, were classified into shorter LOS hospital. Average LOS for each DRGs were as follow: G10200, 4.13 days; G10201, 5.33 days; G10400, 3.48 days; G10401, 4.44 days; G10402, 5.36 days; G10500, 3.85 days; G10501, 4.08 days; G10502, 5.10 days; G10600, 4.33 days; G10601, 4.73 days; and G10602, 5.73 days.

3. Statistical analysis

We proposed the distribution of hospitals and patients characteristics and average length of hospital stay complied with the characteristics. In addition, 2-level multivariable regression analysis with mixed model was used to compare the different adjusted LOS by characteristics of hospitals and patients. One-level was cases of claim, and 2-level was hospital. Sub-groups analysis was conducted by relative length of hospital stay and diagnosis-based groups. All statistical analyses were performed using SAS ver. 9.4 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Table 1 indicates the distribution of hospital' and patient' characteristics at the baseline. Claimed anal surgery in advanced general hospitals were 2,642 cases, in general hospitals were 10,469 cases, and total cases were 13,111. Urban-located hospital claimed 93.7% of the cases. The average number of doctors per 100 beds was 20.7, and the average case of anal surgery was 115 cases. The distribution of DRG code, G102 (multi-anal surgery) was 582 cases, G104 (other anal surgery) was 2,309 cases, G105 (circular stapled hemorrhoidectomy) was 1,503 cases, and G106 (main anal surgery) was 8,717 cases. There were 7,518 cases of short LOS before introducing DRGs, and 5,598 cases of long LOS before introducing DRGs.

Table 1. Distribution of cases at baseline (2012. 7.–2013. 6.)

Characteristic	Value
Type of hospital	
Advanced general	2,642 (20.2)
General	10,469 (79.9)
No. of beds	
> 500	6,804 (51.9)
> 300	3,563 (27.2)
≤ 300	2,744 (20.9)
Hospital location	
Urban	12,279 (93.7)
Rural	832 (6.4)
Teaching	
Yes	7,392 (56.4)
No	5,719 (43.6)
Length of stay before introducing DRG	
Short	7,518 (57.3)
Long	5,593 (42.7)
Doctors per 100 beds	20.71 ± 14.80
No. of cases of operation	115.52 ± 121.03
Gender	
Male	8,397 (64.1)
Female	4,714 (36.0)
Age (yr)	
20–39	4,472 (34.1)
40–64	7,127 (54.4)
≥ 65	1,512 (11.5)
Patient clinical complexity level	
≥ 1	2,428 (18.5)
0	10,683 (81.5)
DRG*	
G102	582 (4.4)
G104	2,309 (17.6)
G105	1,503 (11.5)
G106	8,717 (66.5)
Total	13,111 (100.0)

VValues are presented as number (%) or mean ± standard deviation.
DRG, diagnosis-related groups.
*G102: multi-anal surgery, G104: other anal surgery, G105: circular stapled hemorrhoidectomy, G106: main anal surgery.

Table 2 shows the characteristics of hospitals. There were 44 advanced general hospitals, and 184 general hospitals. Among total of 228 hospitals, 208 were located in urban region, and 20 were located in rural region.

Table 3 shows the average LOS by hospital' and patient' characteristics. From July 2012 to June 2013, the average LOS was 5.41 days. General hospital's average LOS was 5.46 days, which was rela-

Table 2. Distribution of hospitals at baseline (2012. 7. –2013. 6.)

Variable	No. (%)
Type of hospital	
Advanced general	44 (19.3)
General	184 (80.7)
No. of beds	
>500	105 (46.1)
>300	70 (30.7)
≤300	53 (23.3)
Hospital location	
Urban	208 (91.2)
Rural	20 (8.8)
Teaching	
Yes	121 (53.1)
No	107 (46.9)

Table 3. Average length of stay

Variable	2012. 7.– 2013. 6.		2013. 7.–2014. 6.	
	Mean ± SD	*p*-value	Mean ± SD	*p*-value
Type of hospital		0.0247		0.6685
Advanced general	5.24 ± 4.86		3.93 ± 2.49	
General	5.46 ± 4.22		3.91 ± 1.99	
No. of beds		<0.0001		<0.0001
>500	5.05 ± 4.18		3.76 ± 2.11	
>300	5.65 ± 4.55		3.83 ± 1.98	
≤300	6.01 ± 4.43		4.42 ± 2.15	
Hospital location		0.6395		0.7392
Urban	5.41 ± 4.36		3.92 ± 2.11	
Rural	5.48 ± 4.33		3.89 ± 1.94	
Teaching		<0.0001		<0.0001
Yes	5.24 ± 4.31		3.85 ± 2.15	
No	5.63 ± 4.40		4.00 ± 2.04	
Length of stay before introducing DRG		<0.0001		<0.0001
Short	4.21 ± 2.45		3.53 ± 2.01	
Long	7.03 ± 5.64		4.45 ± 2.11	
Gender		<0.0001		0.0001
Male	5.28 ± 4.23		3.86 ± 2.12	
Female	5.65 ± 4.55		4.01 ± 2.06	
Age (yr)		<0.0001		<0.0001
20–39	5.09 ± 3.99		3.79 ± 2.15	
40–64	5.49 ± 4.40		3.99 ± 2.09	
≥65	5.98 ± 5.03		3.97 ± 1.96	
Patient clinical complexity level		<0.0001		<0.0001
≥1	7.84 ± 6.87		5.95 ± 4.15	
0	4.86 ± 3.30		3.86 ± 1.98	
DRG*		<0.0001		<0.0001
G102	6.75 ± 6.17		4.57 ± 2.77	
G104	4.86 ± 3.97		3.32 ± 1.96	
G105	5.70 ± 4.71		3.97 ± 1.78	
G106	5.42 ± 4.22		4.05 ± 2.13	
Total†	5.41 ± 4.35		3.92 ± 2.10	

SD, standard deviation; DRG, diagnosis-related groups.
*G102: multi-anal surgery, G104: other anal surgery, G105: circular stapled hemorrhoidectomy, G106: main anal surgery. †Difference of mean length of stay between before and after introducing DRGs was statistically significant.

tively longer than advanced general hospital's average LOS, 5.24 days. Hospitals having small number of beds showed longer LOS,

Table 4. Association between characteristics of hospital and LOS

Variable	β ± standard error	*p*-value
Type of hospital		
Advanced general	0.0179 ± 0.2024	0.9296
General	Ref	-
No. of beds		
>500	–0.1340 ± 0.2131	0.5296
>300	–0.0929 ± 0.1678	0.5798
≤300	Ref	-
Hospital location		
Urban	–0.1536 ± 0.2175	0.48
Rural	Ref	-
Teaching		
Yes	0.2679 ± 0.1852	0.1482
No	Ref	-
LOS before introducing DRG		
Short	–1.7855 ± 0.0595	<0.0001
Long	Ref	-
Doctors per 100 beds	–0.0078 ± 0.0075	0.3012
No. of cases of operation	–0.0019 ± 0.0009	0.0474
Gender		
Male	–0.2264 ± 0.0403	<0.0001
Female	Ref	-
Age (yr)		
20–39	–0.1810 ± 0.0671	0.007
40–64	–0.0481 ± 0.0633	0.4478
≥65	Ref	-
Patient clinical complexity level		
≥1	2.9366 ± 0.0662	<0.0001
0	Ref	-
DRG*		
G102	0.6488 ± 0.1009	<0.0001
G104	–0.7927 ± 0.0533	<0.0001
G105	–0.0038 ± 0.0687	0.9565
G106	Ref	-
Year		
2013. 7.–2014. 6.	–1.0063 ± 0.0399	<0.0001
2012. 7.–2013. 6.	Ref	-

LOS, length of stay; Ref, reference; DRG, diagnosis-related groups.
*G102: multi-anal surgery, G104: other anal surgery, G105: circular stapled hemorrhoidectomy, G106: main anal surgery.

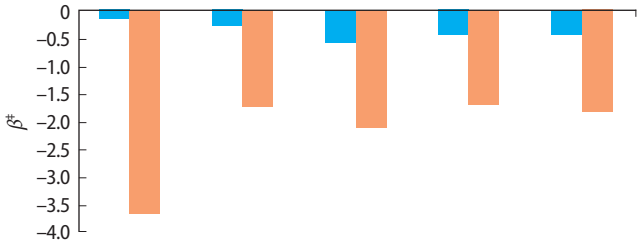
and rural-located hospitals showed longer LOS. Teaching hospitals indicated longer LOS than non-teaching hospitals. From July 2013 to June 2014, the average LOS was 1.49 days shorter than baseline (3.92 days). In all categories of hospital and patient characteristics, shorter LOS was observed than baseline.

Table 4 shows the difference of average LOS by the characteristics of hospital and patient. Hospitals having above 300 beds indicated shorter LOS compared with the hospitals which had lower than 300 beds, but it was not statistically significant (above 500 beds, β = –0.3721; above 300 to 500 beds, β = –0.0266). Teaching hospital had statistically longer LOS than which did not (β = 0.5310, p = 0.0368). The number of doctors per 100 beds (β = –0.0253, p = 0.0114) was

Table 5. Association between characteristics of hospital and length of stay by relative LOS

Variable	LOS of hospital before DRGs			
	Short		Long	
	β ± SE	*p*-value	β ± SE	*p*-value
Type of hospital				
Advanced general	0.1677 ± 0.1973	0.3954	0.2155 ± 0.3215	0.5026
General	Ref	-	Ref	-
No. of beds				
>500	−0.0284 ± 0.2016	0.888	−0.4994 ± 0.2968	0.0925
>300	0.0426 ± 0.1578	0.7873	−0.2184 ± 0.2274	0.3369
≤300	Ref	-	Ref	-
Hospital location				
Urban	0.0201 ± 0.2101	0.9239	−0.1783 ± 0.3106	0.566
Rural	Ref	-	Ref	-
Teaching				
Yes	−0.1212 ± 0.1841	0.5105	0.6919 ± 0.2448	0.0047
No				
Doctors per 100 beds	0.0032 ± 0.0073	0.6599	−0.0151 ± 0.0105	0.149
No. of cases of operation	−0.0004 ± 0.0009	0.6583	−0.0033 ± 0.0014	0.019
Gender				
Male	−0.1331 ± 0.0360	0.0002	−0.3637 ± 0.0790	<0.0001
Female	Ref	-	Ref	-
Age (yr)				
20–39	−0.1764 ± 0.0594	0.003	−0.1519 ± 0.1328	0.2525
40–64	−0.0770 ± 0.0561	0.1696	0.0385 ± 0.1253	0.7588
≥65	Ref	-	Ref	-
PCCL				
≥1	1.5422 ± 0.0606	<0.0001	4.9818 ± 0.1371	<0.0001
0	Ref	-	Ref	-
DRG*				
G102	0.0065 ± 0.0934	0.9445	1.2993 ± 0.2135	<0.0001
G104	−0.6973 ± 0.0510	<0.0001	−0.9218 ± 0.1131	<0.0001
G105	−0.0872 ± 0.0621	0.1604	0.0060 ± 0.1468	0.9675
G106	Ref	-	Ref	-
Year				
2013. 7.–2014. 6.	−0.4282 ± 0.0358	<0.0001	−1.8280 ± 0.0783	<0.0001
2012. 7.–2013. 6.	Ref	-	Ref	-

LOS, length of stay; DRG, diagnosis-related groups; SE, standard error; Ref, reference.
*G102: multi-anal surgery, G104: other anal surgery, G105: circular stapled hemorrhoidectomy, G106: main anal surgery.



	G102	G104	G105	G106	Total
Short	−0.1352	−0.2836	−0.5720	−0.4522	−0.4282
Long	−3.6746	−1.7377	−2.1283	−1.7091	−1.8280

Figure 1. Association between years and LOS by DRGs* and relative LOS†. LOS, length of stay; DRG, diagnosis-related groups. *G102: multi-anal surgery, G104: other anal surgery, G105: circular stapled hemorrhoidectomy, G106: main anal surgery. †Relative LOS was divided into < mean and ≥ mean by the average LOS of equivalent type hospitals. ‡Reference of estimations was baseline year (2012. 7.–2013. 6.).

plenty and the number of cases of operation ($\beta = -0.0031$, $p = 0.0195$) was a lot, the LOS was significantly shorter. Compared with after DRG introducing, before DRG LOS was longer and it was statistically significant ($\beta = -1.0450$, $p < 0.0001$). Intraclass correlation coefficient (ICC) was 133,937.2.

Table 5 shows the association between characteristics of hospital and LOS by relative LOS. Among hospitals which had short LOS (shorter than mean of LOS) before introducing DRGs, effect of introducing DRGs was smaller ($\beta = -0.4282$, $p < 0.0001$). On contrary, among hospitals which had long LOS (longer than mean of LOS) before introducing DRGs, effect of introducing DRGs was bigger ($\beta = -1.8280$, $p < 0.0001$). ICC was 65,631.9 for hospitals with longer LOS, 61,911.0 for hospitals with shorter LOS.

Figure 1 shows the estimation of length of hospital stay in year of after introducing DRG-based payments compared with the baseline year by sub-groups: relative LOS hospitals and DRG. After introducing DRG, hospitals, which demonstrated relatively longer LOS at baseline, had shorter LOS than baseline in all DRG and it was statistically significant (multi-anal surgery, $\beta = -3.6746$; other anal surgery, $\beta = -1.7377$; circular stapled hemorrhoidectomy, $\beta = -2.1283$; main anal surgery, $\beta = -1.7091$; and total DRG, $\beta = -1.8280$). Hospitals, which demonstrated relatively shorter LOS at baseline, also had shorter LOS than baseline and all the results were statistically significant except multi-anal surgery, but the degree was tender than previous hospital group, which had relatively longer LOS at baseline (multi-anal surgery, $\beta = -0.1352$; other anal surgery, $\beta = -0.2836$; circular stapled hemorrhoidectomy, $\beta = -0.5720$; main anal surgery, $\beta = -0.4522$; and total DRG, $\beta = -0.4282$).

DISCUSSION

This study aimed to analyze the changes of LOS and the factors had an effect on the changes of LOS after adopted DRG in FFS used hospitals. As the result, we found LOS were reduced when DRG was adopted in general and advanced general hospitals, which used to using FFS. In addition, the hospitals, which had relatively longer LOS at the baseline, had bigger reducing of LOS.

Length of hospital stay was the most important index, which

well indicated the status of hospitals [1]. First of all, LOS could be an index of measuring the quality of care [18]. Well-planned medical care permit offers effective treatment and minimizes the LOS in the process of performances [19-21]. Second, LOS could be an index for measuring the management condition of hospital, and it was not independent with quality of care [21]. The hospitals, which examined a lot of patients, can attract high quality physicians using the revenue, and can achieve excellent results under obtained learning effect over the process of examine [22]. On the other hand, patients are tended to converge on the hospitals, which achieved excellent results, that is the reason of the relation between the number of operation and the quality of care [22]. Provided that it is expected to admit new patients, who are known for create much higher daily cost, hospitals put effort into reducing existing patients' unnecessary LOS [23]. Therefore, LOS could be important index to access hospital's medical quality and effectiveness of management [23].

According to previous study, payment system strongly impact on LOS [24]. Under FFS, hospitals could receive all performances they offered, so they tend to offer medical performance as many as possible [25,26]. Increasing medical costs which were followed on FFS became a global issue, and DRG was suggested as a solution [1]. DRG arranged a mechanism that hospitals to minimize offering medical performances through preserving fixed price for a disease, so reducing net proceeds when they offering unnecessary performances or LOS [27]. In practice, we could identify substantially shorter LOS among the cases which were claimed as DRG than the cases which were claimed as FFS in our study.

According to previous study, above payment system, the average length of hospital stay were well documented that closely connected with patient's severities and some characteristics of hospitals [28]. As a result of our study, we could identify similar appearance among general and advanced general hospital with clinic and hospital. Male and 20s to 30s showed shorter LOS than others. We assumed that it's because male or 20s to 30s populations are comparatively healthier than other population so they could quickly recover, or they usually carry on works or studies so they could want to discharge quickly. In addition, patients who had high PCCL, which indicates disease' severities, spend long hospitalization period as previous studies.

Among characteristics of hospital, a large number of doctors and plenty of operation cases were related in LOS. We assumed that those variables reduced LOS by improved quality of care and efficiency of management as we mentioned above [29]. A large number of beds and doctors increase medical supply and intensify the competition between hospitals [29,30]. In addition, under DRG, hospitals desire to preserve revenue as increasing the cases of operation because the cost per operation is fixed [26]. In this process, for achieving high number of operation, high turnover rate is needed and followed by reduced LOS [29].

Teaching hospitals had long LOS as previous study [28]. We assumed that this result caused by Korean teaching hospital's structural characteristics that residents primarily take care of patients and specialist coach and supervise the residents' performances [28,31]. However, reduced LOS had not only advantages. Especially, under DRG, the payment which fixed the cost per disease, "spill-over effect" and "blood discharge" became adverse effects [9,10].

In previous research, anal surgery was known as a disease has big deviation of LOS between hospitals [17]. According to previous study, anal surgery had high rates of patients who had remarkably shorter LOS than average LOS [17]. Nevertheless, as a result of our study, average LOS of anal surgery which claimed as FFS was longer than average LOS, which was suggested by Health Insurance Review & Assessment Service. In our study, we identified significantly reduced LOS after introducing DRG.

We additionally analyzed to identify whether reduced LOS in anal surgery was a positive effect that was reducing of unnecessary LOS caused by efficiency of hospital, or a negative effect that was excessively reducing basically appropriated LOS. In our study results, the hospital, which had relatively long LOS at FFS, reduced relatively long LOS, and the hospitals, which had relatively short LOS at FFS, reduced relatively short LOS. Therefore, we speculated the reduced LOS was unnecessarily long LOS, and deviations between hospitals were reduced.

There are some limitations in our research. First, our study results were confined in anal surgery and targeted general and advanced general hospitals. However, it because we wanted to focus on the objective which was highly necessary to study or rarely studied for filling up unstudied blank in previous studies. Second, our study objects were hospitals, which did not choose DRG when the system was not an obligation duty. That kind of hospital could have own characteristics but we did not reflect in our study. However, all of advanced general hospitals and most of general hospitals did not participated in DRG before it became a obligation duty, so it could not be a barrier for representative of our study.

Third, we found more reduced LOS in hospitals which had long LOS at FFS, but could not proof that there was no spill-over of blood discharge caused by reduced LOS. In addition, whether the effect of LOS reducing caused by improved hospitals' management efficiency and quality of care during introducing DRG or not could not be certainly proved. Further studies about those will be necessary. Fourth, there was no control groups which did not participated in DRG, we could not certainly identify the effect of LOS reducing was only because of DRG. However, the reduced LOS at FFS every year was not as reduced LOS in this study, so it could be confined as an effect of DRG.

Despite of some limitations, our study had strong advantages. First, we filled up black of previous study about the effects of DRG, as analyzing general and advanced general hospitals. Second, we used all data of anal surgery claimed by hospitals, which newly participated in DRG, so it well represented national information. Third, we adjusted our study results with most of hospital characteristics that well known for impacting on LOS by previous studies. Fourth, as suggesting the main source of reduced LOS was the hospitals which had relatively long LOS in FFS, we implied the possibility of hospital efficiency according to DRG.

In conclusion, introducing DRGs was more effective to hospitals which had long LOS before introducing DRGs. It could have possibility of reducing unnecessary LOS among hospitals which had long LOS [1]. However, there are concerns of adverse effect [10]. Further studies are needed to ensure the positive and negative effect of introducing DRGs. We expected that our study results could help decision makers of health policy, who consider effective payment systems in the world, by offering information of practical effectiveness of DRG.

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