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ORIGINAL ARTICLE

Status and prospect of workforce requirement for surgery in republic of Korea

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Purpose: In order to prepare long-term alternatives to surgical residency training and workforce policies in Korea, objective data are needed; in addition, determination of the status of surgical procedures being performed is also needed. **Methods:** Cases of surgeries performed by board-certified Korean surgeons for 1 year, from July 2009 to June 2010 were reviewed and analyzed. Variation of the last five years was also investigated against the number of surgery cases of the same item and for data on status of population, medical institutions, and surgeons. **Results:** Difficulty in distribution of a given surgery varied according to the classification of medical institution types, and performance of highly difficult surgeries occurred more in tertiary hospitals. The number of surgeries has increased over the last 5 years (28.1%). The number of surgeries among elderly patients (41.5%), high difficulty (41.8%), and tertiary hospitals (34.9%) has especially increased. There has been no increase in the number of diagnosis related group claim cases for the last 5 years (-0.8%). 43.3% of surgeons working at private clinics in Korea did not present surgery as an indicating item of their clinics. **Conclusion:** While the demand for surgeons in high risk and highly difficult surgeries is continuously increasing, stagnation is expected in the traditional area. Considering the proportion and current status of surgeons working at private clinics, the need for a realistic reduction in the quota of surgical residents and reconsideration of personnel policies is raised.

Key Words: Quota, Resident, Surgeon

INTRODUCTION

The direction of improvement of the residency program has emerged as the most important issue in the Korean medical society. According to the results of the recent survey of Korean doctors, 84% of all think that the training system needs to be improved [1]. The Korean Academy of Medical Sciences has proposed abolishment of the current intern system and it is known that at least 4 among 26 medical societies are conducting reviews for reduction of the

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training period [2]. In addition, activation of the fellow training system and introduction of a medical subspecialty system are being promoted [3]. The purpose of these trials for training system changes is to achieve fundamental improvement of its quality. In the same context, resident work hour restriction and childbirth and infant care support measures for residents are also being discussed [2]. At the present time, when the entire medical community presents a new vision, this study was performed in order to present the specific direction of training policy in surgery of Korea, where the rate of resident applications has shown a marked reduction in recent years [4].

Work hours of Korean surgical residents are estimated to far exceed 80 hours per week; the Special Committee on Health System Development of Korea is currently reviewing the possibility of limiting the number of work hours per week [2]. In particular, it was determined that 74% of first year residents are working over 18 hours per day in Korea [5]. This phenomenon may reflect the characteristics of surgical specialty, in which there are a large number of serious patients who require 24-hour surveillance and emergency situations occur frequently. However, the guidelines of residency program directors of Korean Academy of Medical Sciences published in December 2010 suggested that too much work should not be imposed on residents and that if the amount of work and work strength of residents are excessive, measures such as work sharing and supporting staff supplementation should be taken [6]. Considering 1) the influence that the negative image has on application for surgery due to excessive work, 2) prevention of accidents that can be caused by overwork of residents, and 3) time allocation for teaching and learning, introduction of a resident working hour limitation, which has already been established as a global trend, is expected to be addressed seriously in surgical resident training policy of Korea [7-10].

However, it is impossible to produce a new policy by the existing frame setting quota of surgical residents as a means of coping with the workload of a hospital. Surgical residents are the targets of education in training of surgeons and training policies should be prepared by consideration for social demand for surgeons. However, conversion of social demand for surgeons into figures is a difficult task. Unless a reasonable basis for demand for surgeons is presented, there will be difficulties in establishment of new resident training policies as well as proper quota and foundation construction of all policies to present the future of surgery. Under the assumption that the most basic indicator representing the social role of surgeon is the number of surgeries performed by surgeons, this study analyzed the number of surgeries performed by surgeons in Korea from various angles and attempted to present the policy direction and demand for surgeons based on this.

METHODS

In Korea, starting from July 2, 2009, if a board-certified surgeon performs 7,652 codes of 321 items corresponding to asterisks in the health insurance code reference, the National Health Insurance Corporation pays a 30% increased fee by separate placement in the form of entering a 1 in the first digit of the calculation code. Among surgeries inspected for 1 year, from July 2009 to June 2010, items performed by board-certified surgeons and on which extra points are granted were analyzed first. The figure of diagnosis related group (DRG) was excluded from this data. For analysis of the number of cases performed strictly by board-certified surgeons for the past year, the items on which extra points are granted. Also, in order to determine the long-term trend change, the number of surgeries performed over a period of 5 years, from 2005 to 2009, was investigated on the same item based on health insurance electronic media screening decisions for the last 5 years, However, in this data, whether the item was performed by a board-certified surgeon or not was not presented directly, and DRG items were included without distinction.

The authors analyzed the variables, including types of medical institutions, whether patients were hospitalized, difficulty of surgeries, ages of patients, areas, performing at night and on holidays, with the help of the Health Insurance Review and Assessment Service. For analysis of the distribution according to difficulty of surgeries, difficulty of surgeries was classified into four groups based on

the relative value score presented in the health insurance code reference in January 2010. 1) The item that generally does not require a trained assistant and a surgery that can be performed in the outpatient clinic with local anesthesia, that is the item corresponding to less than 951, relative value score of sclerotherapy of varicose vein, was classified as level of difficulty 1 (e.g., benign skin tumor excision), 2) The surgery that generally requires a trained assistant and does not necessarily require general anesthesia, that is, the item of less than 3,437, the score of simple appendectomy, was classified as level of difficulty 2 (e.g., hemorrhoidectomy and excision of benign breast tumor), 3) The surgery that may need more than 2 trained assistants because dangerous complications could occur during surgery or there is a significant possibility of expanding to larger surgery than expected, that is, the item of less than 6,549, score of cholecystectomy, was classified as level of difficulty 3 (e.g., thyroidectomy, primary closure of gastric/duodenal ulcer perforation, inguinal hernia repair, etc.), 4) The surgery that specifically requires good results after surgery since it is related to long-term survival rate of patients and requires constant research and training, that is, all items higher than the score of cholecystectomy, was classified as level of difficulty 4 (e.g., various cancer surgery for digestive system and transplantation surgery). Sixteen Korean cities and provinces presented for status analysis by area are based on location of medical institutions. For data on population, medical institutions, and medical specialist status, data of the Statistics Korea and the health insurance Review and Assessment Service were cited. For annual production status of surgical residents and medical specialists, data of the Korean Hospital Association and the Korean Surgical Society was cited.

All statistical analyses were performed using the SAS ver. 9.1 (SAS Institute Inc., Cary, NC, USA). For surgeon distribution by type of medical institution, surgeon distribution by region, distribution of medical institutions, distribution of surgical cases, distribution of surgical cases for the last 5 years, chi-squared test of goodness of fit was performed for determination of whether the distribution rate is the same. For all statistical analyses, P-values of less than $\alpha = 0.05$ were considered statistically significant.

RESULTS

Status of surgeons by medical institution

According to the data of the Health Insurance Policy Research Institute, the number of domestic board-certified medical specialists is 61,708 as of 3/4 quarter in 2010, and, among these, 5,078 (8.2%) are surgeons, the professional subject with the third largest number of medical specialists, followed by internal medicine (10,858 people, 17.6%) and obstetrics and gynecology (5,182 people, 8.4%). Examining the number of domestic medical institutions by type, the number of tertiary hospitals is 44, general hospitals 273, hospitals 1,287, and private clinics (based on the presented indicating item) 1,048. Examining the medical institutions where surgeons work according to type, 712 surgeons work in tertiary hospitals (14.0%), 919 in general hospitals (18.1%), 606 in hospitals (11.9%), 291 in medical treatment hospitals (5.7%), 2,485 in private clinics (48.9%), 19 in county hospitals, 22 in public health centers, 24 in public health branches (Table 1). Regarding the average number of surgeons per medical institution, 16.2 surgeons work in tertiary hospitals, 3.4 in general hospitals, 0.5 in

Table 1. Distribution of medical specialist by type of medical institution

Indicating item	Total	Tertiary hospital	General hospital	Hospital	Private clinic	Others
Total	61,708	9,133 (14.8)	10,947 (17.7)	8,129 (13.2)	30,611 (49.6)	2,854 (4.6)
Internal medicine	10,858	2,254 (20.8)	2,246 (20.7)	1,083 (10.0)	4,840 (44.6)	433 (4.0)
Obstetrics and gynecology	5,182	405 (7.8)	649 (12.5)	800 (15.4)	3,114 (60.1)	214 (4.1)
Surgery	5,078	712 (14.0)	919 (18.1)	606 (11.9)	2,485 (48.9)	356 (7.0)

Values are presented as number or number (%).
Based on 3/4 quarter in 2010.

hospitals, and 2.4 in clinics ($P < 0.001$).

Distribution of medical institutions and surgeons per region

Reflecting demographic characteristics showing that 42.7% of the total domestic population is concentrated in the Seoul (23.2%) and Gyeonggi-do (capital area, 22.0%), working area of surgeons is also concentrated in Seoul (23.2%) and Gyeonggi-do (18.3%) ($P < 0.001$). Comparing the number of surgeons per 100,000 people, it can be seen that working area of surgeons is generally distributed in proportion to the population (Table 2). The number of medical institutions is generally distributed in proportion to the regional population; however, in the case of tertiary hospitals, 17 (38.6%) of a total of 44 institutions are concentrated in Seoul area ($P < 0.001$).

Table 2. Distribution of surgeons and medical institutions by area

Area	Population[a]	Surgeons	No. of surgeons per 100,000	Tertiary hospitals	General hospitals	Hospitals	Private clinics
Seoul	9,762,546 (20.8)	1,176 (23.2)	12.0	17 (38.6)	42 (15.4)	166 (12.9)	205 (19.6)
Busan	3,512,547 (7.5)	430 (8.5)	12.2	4 (9.1)	24 (8.8)	102 (7.9)	91 (8.7)
Daegu	2,456,016 (5.2)	312 (6.1)	12.7	4 (9.1)	7 (2.6)	100 (7.8)	79 (7.5)
Incheon	2,517,680 (5.4)	235 (4.6)	9.3	2 (4.5)	12 (4.4)	53 (4.1)	55 (5.2)
Gwangju	1,413,644 (3.0)	165 (3.2)	11.7	2 (4.5)	19 (7.0)	50 (3.9)	33 (3.1)
Daejeon	1,438,551 (3.1)	147 (2.9)	10.2	2 (4.5)	6 (2.2)	35 (2.7)	33 (3.1)
Ulsan	1,044,934 (2.2)	81 (1.6)	7.8	0 (0.0)	4 (1.5)	38 (3.0)	18 (1.7)
Gyeonggi-do	10,341,006 (22.0)	927 (18.3)	9.0	5 (11.4)	48 (17.6)	250 (19.4)	170 (16.2)
Gangwon-do	1,460,770 (3.1)	160 (3.2)	11.0	2 (4.5)	13 (4.8)	44 (3.4)	29 (2.8)
Chungcheongbuk-do	1,453,872 (3.1)	137 (2.7)	9.4	1 (2.3)	9 (3.3)	39 (3.0)	36 (3.4)
Chungcheongnam-do	1,879,417 (4.0)	215 (4.2)	11.4	2 (4.5)	9 (3.3)	54 (4.2)	65 (6.2)
Jeollabuk-do	1,778,879 (3.8)	210 (4.1)	11.8	2 (4.5)	12 (4.4)	66 (5.1)	53 (5.1)
Jeollanam-do	1,815,174 (3.9)	224 (4.4)	12.3	0 (0.0)	20 (7.3)	71 (5.5)	40 (3.8)
Gyeongsangbuk-do	2,594,719 (5.5)	293 (5.8)	11.3	0 (0.0)	18 (6.6)	75 (5.8)	75 (7.2)
Gyeongsangnam-do	3,040,993 (6.5)	313 (6.2)	10.3	1 (2.3)	24 (8.8)	139 (10.8)	56 (5.3)
Jeju-do	530,686 (1.1)	53 (1.0)	10.0	0 (0.0)	6 (2.2)	5 (0.4)	10 (1.0)
Total	47,041,434 (100)	5,078 (100)	–	44 (100)	273 (100)	1,287 (100)	1,048 (100)

Values are presented as number (%) or number.
[a]The Statistics Korea, Census data in 2005.

Table 3. Distribution of number of surgeries per year by patient age

Age	Total population[a] (n = 47,274,722)	No. of surgeries (n = 523,299)	Level of difficulty			
			1 (n = 96,328)	2 (n = 186,845)	3 (n = 173,868)	4 (n = 66,258)
0-4	2,382,350 (5.0)	12,282 (2.3)	1,776 (1.8)	8,045 (4.3)	1,791 (1.0)	670 (1.0)
5-14	6,603,778 (14.0)	22,760 (4.3)	3,549 (3.7)	15,995 (8.6)	3,025 (1.7)	191 (0.3)
15-24	6,762,646 (14.3)	35,382 (6.8)	8,267 (8.6)	20,189 (10.8)	6,454 (3.7)	472 (0.7)
25-34	7,768,129 (16.4)	61,542 (11.8)	13,928 (14.5)	28,976 (15.5)	16,595 (9.5)	2,043 (3.1)
35-44	8,235,826 (17.4)	93,128 (17.8)	19,043 (19.8)	36,817 (19.7)	29,590 (17.0)	7,678 (11.6)
45-54	6,756,196 (14.3)	117,466 (22.4)	22,486 (23.3)	37,584 (20.1)	41,258 (23.7)	16,138 (24.4)
55-64	4,167,291 (8.8)	85,799 (16.4)	14,213 (14.8)	21,004 (11.2)	34,013 (19.6)	16,569 (25.0)
65-74	2,932,801 (6.2)	67,990 (13.0)	9,434 (9.8)	13,402 (7.2)	28,587 (16.4)	16,567 (25.0)
75+	1,665,705 (3.5)	26,950 (5.2)	3,632 (3.8)	4,833 (2.6)	12,555 (7.2)	5,930 (8.9)

Values are presented as number (%).
Based on July 2009-June 2010, diagnosis related group is not included.
[a]The Statistics Korea, Census data in 2005.

Number of cases

Of the number of surgeries reviewed for 1 year, from July 2009 to June 2010, cases in which surgery was performed by board-certified surgeons and on which extra points were given were 523,299 and DRG cases were not included in the extra point calculation. Among these, 388,582 cases (74.3%) were inpatient surgeries, 134,717 (25.7%) were outpatient surgeries; 26,068 cases were night surgeries (5.0%), and 9,938 (1.9%) were holiday surgeries. Looking at the distribution by level of difficulty set based on the relative value score presented in the health insurance code reference, 96,328 cases (18.4%) were difficulty 1, 186,845 (35.7%) difficulty 2, 173,868 (33.2%) difficulty 3, and 66,258 (12.7%) difficulty 4. Examining age distribution, 35,042 surgeries were performed on children under 15 years (6.7%), 393,317 cases (75.2%) on adults older than 15 years to under 65 years, 94,940 (18.1%) on adults 65 years and older, and it was shown that more surgeries were performed on elderly patients than on the general population distribution (infants, 19.0%; adults, 71.3%; elderly people, 9.7%) ($P < 0.001$). In particular, this trend was more pronounced in more difficult surgeries, and, although the general population over age 45 is 32.8%, 83.3% of surgeries with difficulty 4 were performed on patients older than 45 ($P < 0.001$, Table 3).

Analysis of the number of surgeries according to the regional location of the medical institution found that 302,462 cases (57.8%) were performed in metropolitan areas, such as Seoul and metropolitan cities (Table 4). In order to correct for the effects of population distribution and the number of surgeons, the number of surgeries per surgeon and the number of surgeries per 100,000 people were presented (Table 5). It turned out that, in general, a surgeon performed more surgeries in metropolitan areas than in other areas (118.8 cases in metropolitan cities, 87.2 cases in other areas) ($P = 0.028$). In particular, in cases of surgeries of difficulty 4, including various cancer surgeries and transplant surgeries, the difference between Seoul and other regions was significant and surgeries per surgeon in Seoul were 28.9 cases per year, and, in areas other than Seoul, 8.3 cases ($P = 0.001$). When considering the population distribution, these patterns appeared again, and, in general, relatively more surgeries were performed in metropolitan areas (1,366 cases per 100,000 in Seoul and metropolitan cities, 887 cases in other areas) ($P < 0.001$) and surgeries of difficulty 4 showed a pattern concentrating to Seoul (348 cases per 100,000 people in Seoul, 86 cases outside Seoul, $P < 0.001$).

Table 4. Distribution of number of annual surgeries by area where medical institutions are located

Area	No. of surgeries	Inpatient surgeries	Outpatient surgeries	Level of difficulty			
				1	2	3	4
Seoul	159,486	130,668	28,818	20,699	47,294	57,472	34,021
Busan	42,320	28,544	13,776	8,595	15,545	13,528	4,652
Daegu	24,347	18,972	5,375	4,220	9,264	8,570	2,293
Incheon	31,209	24,543	6,666	4,588	9,807	12,497	4,317
Gwangju	19,106	14,458	4,648	3,199	8,984	6,148	775
Daejeon	15,886	12,040	3,846	2,305	6,379	5,405	1,797
Ulsan	10,108	6,732	3,376	2,435	4,055	2,806	812
Gyeonggi-do	100,349	73,434	26,915	19,535	36,362	34,528	9,924
Gangwon-do	12,827	8,316	4,511	3,808	4,635	3,503	881
Chungcheongbuk-do	10,389	6,838	3,551	2,376	4,279	3,142	592
Chungcheongnam-do	12,033	7,445	4,588	3,373	5,376	2,598	686
Jeollabuk-do	17,489	11,969	5,520	3,885	5,891	6,127	1,586
Jeollanam-do	18,971	13,418	5,553	4,276	7,516	5,278	1,901
Gyeongsangbuk-do	15,207	8,704	6,503	4,747	6,699	3,437	324
Gyeongsangnam-do	30,196	20,428	9,768	7,400	13,671	7,644	1,481
Jeju-do	3,376	2,073	1,303	887	1,088	1,185	216
Total	523,299	388,582	134,717	96,328	186,845	173,868	66,258

Based on July 2009-June 2010, diagnosis related group is not included.

Table 5. Distribution of annual number of surgeries according to population and number of surgeons by area

	No. of surgeries per surgeon					No. of surgeries per 100,000 population[a]				
	Total	Level of difficulty				Total	Level of difficulty			
		1	2	3	4		1	2	3	4
Seoul	135.6	17.6	40.2	48.9	28.9	1,634	212	484	589	348
Busan	98.4	20.0	36.2	31.5	10.8	1,205	245	443	385	132
Daegu	78.0	13.5	29.7	27.5	7.3	991	172	377	349	93
Incheon	132.8	19.5	41.7	53.2	18.4	1,240	182	390	496	171
Gwangju	115.8	19.4	54.4	37.3	4.7	1,352	226	636	435	55
Daejon	108.1	15.7	43.4	36.8	12.2	1,104	160	443	376	125
Ulsan	124.8	30.1	50.1	34.6	10.0	967	233	388	269	78
Gyeonggi-do	108.3	21.1	39.2	37.2	10.7	970	189	352	334	96
Gangwon-do	80.2	23.8	29.0	21.9	5.5	878	261	317	240	60
Chungcheongbuk-do	75.8	17.3	31.2	22.9	4.3	715	163	294	216	41
Chungcheongnam-do	56.0	15.7	25.0	12.1	3.2	640	179	286	138	37
Jeollabuk-do	83.3	18.5	28.1	29.2	7.6	983	218	331	344	89
Jeollanam-do	84.7	19.1	33.6	23.6	8.5	1,045	236	414	291	105
Gyeongsangbuk-do	51.9	16.2	22.9	11.7	1.1	586	183	258	132	12
Gyeongsangnam-do	96.5	23.6	43.7	24.4	4.7	993	243	450	251	49
Jeju-do	63.7	16.7	20.5	22.4	4.1	636	167	205	223	41
P-value	<0.001	0.632	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

P-value by chi-square goodness-of-fit test for equal proportion.
Based on July 2009-June 2010, diagnosis related group is not included.
[a]The Statistics Korea, Census data in 2005.

Table 6. Annual number of surgeries by type of medical institution

Medical institution	Total	Inpatient	Outpatient	Level of difficulty			
				1	2	3	4
Tertiary hospital	167,824	161,181	6,643	4,294	43,210	73,536	46,784
General hospital	179,837	150,995	28,842	19,409	76,960	65,966	17,502
Hospital	65,015	43,623	21,392	15,606	35,858	11,795	1,756
Private clinic[a]	110,615	32,782	77,833	57,017	30,812	22,570	216
Public health center	8	1	7	2	5	1	-
Total	523,299	388,582	134,717	96,328	186,845	173,868	66,258

Based on July 2009-June 2010, diagnosis related group cases are not included.
[a]Based on indicating item.

Analysis according to type of medical institution found that the total number of surgeries in tertiary hospitals was 167,824 cases (32.1%), general hospitals 179,837 (34.4%), hospitals 65,015 (12.4%), and private clinics 110,615 (21.1%, Table 6). Outpatient surgeries were shown to account for the highest proportion (77,833 cases, 70.4%) in private clinics, compared with other medical institutions ($P < 0.001$). Depending on the results of analysis by difficulty of surgery, in the order of tertiary hospitals, general hospitals, hospitals, and private clinics, 4,294, 19,409, 15,606, and 57,017 surgeries (4.5, 20.1, 16.2, and 59.2%) of level of difficulty 1 were performed and 43,210, 76,960, 35,858, and 30,812 surgeries (23.1, 41.2, 19.2, and 16.5%) of level of difficulty 2, 73,536, 65,966, 11,795, and 22,570 surgeries (42.3, 37.9, 6.8, and 13.0%) of level of difficulty 3, and 46,784, 17,502, 1,756, and 216 surgeries (70.6, 26.4, 2.7, and 0.3%) of level of difficulty 4. The contrastive aspect showed that more surgeries of level of difficulty 1 were performed in private clinics (57,017 cases) than in tertiary hospitals (4,294 cases) ($P < 0.001$) and more surgeries of

Table 7. Number of surgeries per surgeon and per type of medical institution

Medical institution	No. of surgeries per 1 medical institution					No. of surgeries per surgeon				
	Total	Level of difficulty				Total	Level of difficulty			
		1	2	3	4		1	2	3	4
Tertiary hospital	3,814.2	97.6	982.0	1,671.3	1,063.3	226.4	6.0	60.7	103.3	65.7
General hospital	658.7	71.1	281.9	241.6	64.1	164.3	21.1	83.7	71.8	19.0
Hospital	50.5	12.1	27.9	9.2	1.4	72.0	25.8	59.2	19.5	2.9
Private clinic	105.5	54.4	29.4	21.5	0.2	13.2	22.9	12.4	9.1	0.1
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001

Based on July 2009-June 2010, diagnosis related group cases are not included.
P-value by chi-square goodness-of-fit test for equal proportions.

Table 8. Changes in the number of diagnosis related group claims by disease classification for the last 5 years

	2005	2006	2007	2008	2009	P-value	Increase rate for 5 years (%)
Anal surgery	237,086	248,226	246,500	246,829	248,600	<0.001	4.6
Inguinal hernia repair	10,806	10,387	10,207	9,118	8,638	<0.001	-25.1
Appendectomy	37,664	34,231	34,390	29,475	26,133	<0.001	-44.1
Total	285,556	292,844	291,097	285,422	283,371	<0.001	-0.8

level of difficulty 4 were performed in tertiary hospitals (46,784 cases) than in private clinics (216 cases, $P < 0.001$). Comparing the number of surgeries per medical institution, 3,814.2 cases were performed per tertiary hospital and 658.7 cases per general hospital, 50.5 cases per hospital, and 105.5 cases per private clinic ($P < 0.001$, Table 7). A trend toward performance of more difficult surgeries in tertiary hospitals was clear and surgeries of level of difficulty 3 and level of difficulty 4 were performed 6.9 times more (1,671.3 cases vs. 241.6 cases, $P < 0.001$) and 16.6 times more (1,063.3 cases vs. 64.1 cases, $P < 0.001$) in tertiary hospitals than in general hospitals, respectively. The number of surgeries per surgeon also showed a similar pattern and surgeons working in tertiary hospitals performed 226.4 cases per surgeon, exceeding the number of surgeries per surgeon of other medical institutions (164.3 cases in general hospitals, 72.0 cases in hospitals, and 13.2 cases in clinics, $P < 0.001$) and this difference was more pronounced in surgeries of level of difficulty 4 (65.7 cases in tertiary hospitals, 19.0 in general hospitals, 2.9 cases in hospitals, and 0.1 case in private clinics; $P < 0.001$). On the other hand, analysis of the number of DRG claim cases in 2008 found that a total of 283,371 were claimed and 128 were claimed in tertiary hospitals, 28,695 cases in general hospitals, 62,703 in hospitals, 193,838 cases in clinics, and claims in private clinics accounted for the most ($P < 0.001$), and, in particular, most of the surgeries claimed in the private clinics (185,194 cases, 95.5%) were anal surgeries (Table 8).

Changes in the number of surgeries for the last 5 years

To determine the trend in the number of surgeries over a long period of time, the number of surgeries from 2005 to 2009 was compared and analyzed and the DRG item is included in this figure (Table 9). In general, the number of surgeries has increased by 28.1% over a period of 5 years ($P < 0.001$) and this increasing trend was shown in both inpatient surgeries (31.7%, $P < 0.001$) and outpatient surgeries (24.5%, $P < 0.001$). Examining patients by age, the number of surgeries showed an increase in all age groups, and, in particular, the phenomenon that the number of surgeries of patients older than 75 years is increasing (41.5%) was distinguished. When analyzing rate of in-

Table 9. Change in number of surgeries for the last 5 years[a)]

	2005	2006	2007	2008	2009	P-value	Increase rate for 5 years (%)
	666,377	710,083	752,030	858,938	926,355	<0.001	28.1
Medical form							
Inpatient	315,240	339,431	364,821	426,875	461,427	<0.001	31.7
Outpatient	351,137	370,652	387,209	432,063	464,928	<0.001	24.5
Patient age							
0-4	19,400	19,268	20,263	21,184	20,279	<0.001	4.3
5-14	40,058	40,642	40,542	41,087	43,076	<0.001	7.0
15-24	63,894	65,861	65,160	68,622	72,705	<0.001	12.1
25-34	102,504	107,731	110,002	118,961	123,375	<0.001	16.9
35-44	131,568	137,550	142,138	161,126	171,845	<0.001	23.4
45-54	124,742	141,823	154,350	187,302	204,135	<0.001	38.9
55-64	93,099	98,539	106,143	125,839	141,166	<0.001	34.0
65-74	66,826	71,979	82,264	98,460	108,239	<0.001	38.3
75+	24,286	26,690	31,168	36,357	41,535	<0.001	41.5
Level of difficulty							
1	293,561	310,891	326,138	368,413	398,609	<0.001	26.4
2	224,579	237,592	246,644	257,474	268,347	<0.001	16.3
3	110,250	120,114	134,604	174,107	194,148	<0.001	43.2
4	37,987	41,486	44,644	58,944	65,251	<0.001	41.8
Tertiary hospital-level of difficulty							
Subtotal	135,750	148,567	161,038	185,597	208,497	<0.001	34.9
1	12,253	14,469	16,257	17,678	19,318	<0.001	36.6
2	49,882	53,295	55,976	59,426	63,909	<0.001	21.9
3	49,359	53,489	59,680	69,069	80,146	<0.001	38.4
4	24,256	27,314	29,125	39,424	45,124	<0.001	46.2
General hospital-level of difficulty							
Subtotal	159,238	176,065	192,953	216,194	224,581	<0.001	29.1
1	27,306	30,123	31,690	37,649	40,040	<0.001	31.8
2	72,535	81,039	87,566	92,140	94,203	<0.001	23.0
3	47,150	52,217	59,951	68,886	72,360	<0.001	34.8
4	12,247	12,686	13,746	17,519	17,978	<0.001	31.9
Hospital-level of difficulty							
Subtotal	78,917	84,115	85,623	97,566	105,499	<0.001	25.2
1	25,953	28,165	29,740	34,259	36,768	<0.001	29.4
2	41,120	43,828	43,374	46,715	50,474	<0.001	18.5
3	10,449	10,770	10,922	14,815	16,325	<0.001	36.0
4	1,395	1,352	1,587	1,777	1,932	<0.001	27.8
Private clinic-level of difficulty							
Subtotal	292,199	301,082	312,189	359,420	387,550	<0.001	24.6
1	227,899	237,963	248,302	278,718	302,343	<0.001	24.6
2	60,938	59,356	59,659	59,149	59,686	<0.001	-2.1
3	3,274	3,629	4,042	21,329	25,304	<0.001	87.1
4	88	134	186	224	217	<0.001	59.4
Public health center-level of difficulty							
Subtotal	273	254	227	161	228	<0.001	-19.7
1	150	171	149	109	140	0.007	-7.1
2	104	74	69	44	75	<0.001	-38.7
3	18	9	9	8	13	0.194	-38.5
4	1	-	-	-	-	-	-

P-value by chi-square goodness-of-fit test for equal proportions.
[a)]Diagnosis related group cases are also included.

crease for 5 years by level of difficulty, increase of surgeries of a high level of difficulty was more pronounced (level of difficulty 1, 26.4%; level of difficulty 2, 16.3%; level of difficulty 3, 43.2%; level of difficulty 4, 41.8%); by type of medical institution, rateof increase was 34.9% in tertiary hospitals, 29.1% in gene ral hospitals, 25.2% in hospitals, 24.6% in private clinics, and rate of increase of tertiary hospitals was shown to be somewhat higher, and, in cases of surgeries of level of difficulty 4, increase of surgery in tertiary hospitals was more pronounced (46.2%). Despite relatively fewer numbers, the phenomenon that increase in surgeries of level of difficulty 3 (87.1%) and level of difficulty 4 (59.4%) was distinguished in private clinics could be seen. However, there has been no increase in the number of DRG claims for the last 5 years (-0.8%, Table 8).

DISCUSSION

Quantitative presentation of the current status and forecasting of medical demand is not easy. The Korean Ministry of Health and Welfare have provided compensation in the form of paying additional benefits to surgeons since 2009 by raising funds in the form of adding extra points to fees of surgery. To calculate these extra points, the Health Insurance Review and Assessment Service has performed computational processing on the number of surgeries performed by board-certified surgeons against 321 items since July 2, 2009 [11]. This study assumed these items to be the most surgeries performed and estimated and analyzed the number of surgeries performed by board-certified surgeons in Korea; the following information could be identified with regard to the current status of domestic surgeries.

According to data provided by the National Health Insurance Corporation, as of 2009, the total number of surgery (no distinction whether they were performed by board-certified surgeons) was 926,355 cases. There were several months of time difference; however, since the number of same item of surgeries to which extra points are given for surgeries performed by board-certified surgeons was 523,299 cases from July 2009 to June 2010, and the number of DRG item claims in 2009 was 283,371 cases, the percentage of surgeries performed by surgeons among items in which surgeons' expertise is recognized is estimated to be approximately 87.1%. In general, the number of surgeries has increased by 28.1% for 5 years; examining patients by age, the phenomenon that the number of surgeries of patients older than 75 years increased (41.5%) was particularly pronounced. Given the aging trend of the total domestic population, this is considered to imply that the number of surgeries will not decrease for the time being. However, since surgeries vary from simple cosmetic procedures to complex transplant surgeries, it is difficult to present demand simply by the number of surgeries. Therefore, based on the relative value scores presented in health insurance codes, difficulties of surgeries were classified into 4 groups and presented. When analyzing rate of increase for 5 years by level of difficulty, increase of highly difficult surgeries and surgeries in tertiary hospitals was more distinct. However, in contrast to the general increase in the number of surgeries, there has been no increase in the number of DRG claims for the last 5 years (Table 8).

The total number of surgeons working in Korea is 5,078, and it was determined that it is the item with the third largest number of medical specialists, followed by internal medicine and obstetrics and gynecology. In particular, the percentage of surgeons working at private clinics (48.9%) was higher than that of internal medical doctors working at private clinics (44.6%); therefore, special review is required for the situation of hospital opening doctors. Looking at the current status of the number of clinics by indicating item disclosed by the Health Insurance Review and Assessment Service, 43.3% of surgeons working at private clinics (1,049 people/2,485 people) do not put up surgery as an indicating item and many of these are estimated to perform medical activities not related to surgical training courses. According to a survey, only 2.5% of surgeons working at private clinics responded that they do not regret their selection of surgery [12].

The current number of surgeries is not considered insufficient for training of surgeons. According to the curriculum of the Korean Surgical Society, which has been applied since 2004, surgical trainees should participate in over 300 surgeries and perform over 90 surgeries during

Table 10. Number of successful applicants for surgical residency per year and figure change of medical specialist exam passers

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Board-certification passers	171	180	159	214	178	191	186	179	217	212	214	191	(162)	(172)	(160)	(183)
Resident passers	-	-	-	237	239	251	257	240	198	209	171	183	-	-	-	-
Quota of surgical resident	-	-	-	257	256	270	273	308	315	322	317	304	-	-	-	-

Source: The Korean Surgical Society, Korean Medical Association.
The figure after 2012 is presented as the number of applicants for surgical residency conducted in October 2010 and the number of those who passed.

the resident training period [13]. In the case of tertiary hospitals, 3,814 surgeries are performed annually per institution, and this number of surgeries can provide training for 39 surgeons, even if only 1 resident participates in one surgery. Estimating only by the number of surgeries, 429 surgeons can be produced per year in only 44 tertiary hospitals. The quota of surgical residents increased from 257 in 2003 to 304 in 2011; however, there has been no significant change in the number of surgeons produced over the last 10 years (Table 10). In addition, things to consider include the fact that the tasks surgical residents take charge of are broad, including writing medical records, writing consents, emergency patient treatment, inpatient prescription, conferences, wound care, in addition to participating in operation [4], and excessive work burden can lead to a secondary accident due to fatigue of residents [14]. Meanwhile, a criticism has been raised that too many residents are selected for treatment of hospital work, not for the need of society [2,15]. For example, it is known that there are 5,078 surgeons in Korea and 16,662 surgeons in the U.S. Calculating the number of surgeons per 100,000 people, there are 10.8 surgeons per 100,000 in Korea and 5.7 in the U.S, and for surgeons per capita, there are more surgeons in Korea. In addition, based on 2009, board-certified surgeons produced per year are 212 in Korea and 909 in the U.S, and, converting it to surgeons produced annually per 100,000, 0.45 in Korea and 0.30 in the U.S; considering population, more surgeons are being produced in Korea [16-19].

Simple comparison of these figures might be unreasonable, due to the fact that conditions in Korea differ from those of foreign countries [17]. While the number of surgeries is not predicted to decrease for a while (the aspect that the number of surgeries has increased for the last 5 years, aging of the population, the relatively older age of surgical patients, increase of early diagnosis of various cancers, attraction of overseas patients), an environment that is relatively less dependent on residents is being prepared (introduction of robot surgeries and wider use of laparoscopic surgeries, review of introduction of medical assistants, new residency training system, etc.). This study confirmed the fact that there are significant differences in number and types of surgeries performed by surgeons according to types of medical institutions. The fact that there is a major difference between diseases emphasized during training and diseases encountered after acquisition of board-certification has already been presented [4]. This is the part that should be considered in the resident training system improvement process, along with introduction of a detailed resident system and fellow system [3]. In addition, the fact that number and types of surgeries differ significantly depending on areas and medical institutions makes analyses difficult and it should be considered along with policy alternatives of the overall medical situation.

Though difficult, social demand for calculation of the proper number of surgeons is the basis of policies of Korean Surgical Society and it should not be put off as a task for the future because the domestic health care environment is changing rapidly. It is determined that the results of analysis of the number of surgeries performed in Korea will be basic data for use in multilateral review on demand for surgeons needed in Korean society. Based on this, government policy will also be presented through in-depth research of The Korean Surgical Society. It is

known that in the case of doctor workforce, the social cost incurred in the adjustment process is larger at the time of supply excess rather than supply shortfall. In particular, the social cost needed for training of good surgeons will be difficult to convert into an amount of money. We have shown that while the demand for surgeons in high risk, highly difficult surgeries is continuously increasing, stagnation is expected in the traditional area. Considering the proportion and current status of surgeons working at private clinics, the need for a realistic reduction in the quota of surgical residents and reconsideration of personnel policies is raised

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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