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ORIGINAL ARTICLE

Impact of the Outpatient Prescription Incentive Program on Reduction of Pharmaceutical Costs of Clinics in South Korea

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Background: South Korea has experienced problems with excessive pharmaceutical expenditures. In 2010, the South Korean government introduced an outpatient prescription incentive program to effectively manage pharmaceutical expenditures. Therefore, we examined the relationship between the outpatient prescription incentive program and pharmaceutical expenditures.
Methods: We used data from the Korean National Health Insurance claims database, which included medical claims filed for 22,732 clinics from 2011–2014 to evaluate associated pharmaceutical expenditures. We performed multiple regression analysis and Poisson regression analysis using generalized estimating equation models to examine the associations between outpatient prescription incentives and the outcome variables.
Results: The data used in this study consisted of 123,392 cases from 22,372 clinics (average 5.4 periods follow-up). Clinics that had received outpatient prescription incentives in the last period had better cost saving and Outpatient Prescribing Costliness Index (OPCI) (received: proportion of cost saving, $\beta = 6.8179$; p-value < 0.0001; OPCI, $\beta = -0.0227$; p-value < 0.0001; reference = non-received). Moreover, these clinics had higher risk in the provision of outpatient prescription incentive (relative risk, 2.772; 95% confidence interval, 2.720 to 2.824). The associations were higher in clinics that had separate prescribing and dispensing programs, or had professional staff.
Conclusion: The introduction of an outpatient prescription incentive program for clinics effectively managed problems with rapid increases of pharmaceutical expenditures in South Korea. However, the pharmaceutical expenditures still increased in spite of the positive impact of the outpatient prescription incentive program. Therefore, healthcare professionals and health policy makers should develop more effective alternatives (i.e., for clinics without separate prescribing and dispensing programs) based on our results.

Keywords: Pharmaceutical expenditures; Financial incentives; Health services research; Separation of prescribing and dispensing

INTRODUCTION

In 2000, the South Korean government introduced program reform of the prescribing and dispensing of pharmaceuticals to reduce misuse of drugs and to contain drug expenditures. In contrast to government expectations, healthcare costs gradually increased in South Korea [1-3]. According to the Organization for Economic Cooperation and Development (OECD), the annual average growth rate of health expenditures in South Korea was second highest among OECD countries (South Korea, 9.3% growth per year; OECD average, 4.1% growth per year from 2000 to 2009) [4]. Specifically, the growth rate of pharmaceutical costs exceeded the growth rate of total healthcare expenditures in South Korea (South Korea, 9.8% growth per year; OECD average, 3.5% growth

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per year from 2000 to 2009) [4]. To reduce the rapid increases in healthcare expenditures, health policy makers and decision makers in South Korea realized the importance of controlling pharmaceutical costs; since 2006, they have made an effort to better manage increasing healthcare expenditures. However, most strategies, such as management of replicated prescriptions or high cost medications, ultimately failed to control pharmaceutical costs [5]. The main reason for this failure was that doctors' prescribing behavior was more affected by patient needs rather than pharmaceutical costs [6,7]. Therefore, doctors should be better informed of the importance of management of pharmaceutical expenditures.

In 2010, the South Korean government introduced a financial incentive program for clinics to effectively manage pharmaceutical expenditures [8]. This program provided financial incentives to clinics based on evaluation of pharmaceutical costs. The evaluation criteria were pharmaceutical cost savings and the Outpatient Prescribing Costliness Index (OPCI). Based on these two indicators, the South Korean government provided financial incentives for each clinic at the 20% to 40% level of cost savings [9]. Thus, this incentive plan was expected to contribute to slowing the growth of pharmaceutical expenditures.

Data from previous studies showed that many other countries had introduced similar financial incentive programs to change the behavior of healthcare providers. The provision of financial incentives had many positive effects in controlling medical costs [10-13]. However, although the outpatient prescription incentive program had been in place in South Korea since 2010, there had been few studies about effect of this program on cutting costs. Given that this program was gradually expanded in South Korea (February 2012, expanded to outpatient services at hospitals; September 2014, expanded to inpatient care in clinics and hospitals), there was a need to evaluate the impact of the program since its inception. Therefore, we examined the relationship between the outpatient prescription incentive program and pharmaceutical expenditures. The results of this study should inform evidence-based pharmaceutical policies in South Korea.

METHODS

1. Study population

The data used in this study were from the National Health Insurance Claims database of South Korea. The data were collected by the Health Insurance Review and Assessment Service to evaluate pharmaceutical expenditures. From 2010 to 2014, 29,267 clinics participated in the outpatient prescription incentive program. In this program, each clinic was evaluated based on pharmaceutical expenditures every 6 months. Therefore, the data consisted of 6-month units (from first half of 2011 to first half of 2014). We excluded data that did not include variables such as representative doctor's sex, age, major treatment area, region, separate drug prescribing and dispensing program, presence of expensive medical equipment (magnetic resonance imaging [MRI], computed tomography [CT], or positron emission tomography [PET]), presence of inpatient beds, number of patients, pharmaceutical cost per patient, types of medication, number of doctors, number of nurses, proportion of outpatient prescriptions, proportion of specialists, and proportion of registered nurses. Data included were used to analyze the relationship between the outpatient prescription incentive program and pharmaceutical expenditures in the clinic. In addition, to examine the impact of the outpatient prescription incentive on pharmaceutical expenditures, we excluded the baseline period of each clinic to identify clinics that received incentives in the last period. Finally, the data used in this study were collected from 22,732 clinics between the last half of 2011 to the first half of 2014. The unit of analysis was at the clinic level rather than the outpatient level.

2. Variables

The outcome variables in this study were proportion of cost savings, OPCI, and receipt of outpatient prescription incentives. The pharmaceutical cost saving was calculated as the difference between expected pharmaceutical cost and actual pharmaceutical cost during each period. The expected expenditures were calculated based on results of pharmaceutical expenditures in the past period. To determine relative differences between clinics, we calculated the proportion of cost savings compared to the actual pharmaceutical cost. The OPCI reflected the relative level of pharmaceutical cost compared to other clinics. The OPCI, which indicated relative evaluation, was calculated as follows:

$$OPCI_h = \Sigma_i(C_{hi} \times N_{hi}) \div \Sigma_i(C_i \times N_{hi})$$

h: clinics of evaluation

i: categories of diseases

C_i: pharmaceutical cost per patient in same disease category

C_{hi}: pharmaceutical cost per patient in same disease category of clinics of evaluation

N_{hi}: the number of patients in clinics of evaluation

Therefore, the OPCI could reflect the relative level of pharmaceutical cost compared to other clinics [14]. If a specific clinic had low cost savings or high OPCI, it meant that this clinic could not manage pharmaceutical expenditures effectively. Based on these indicators, the South Korean government provided financial incentives to the clinics. If a specific clinic received the incentive, then the clinic had optimally managed its pharmaceutical expenditures.

The primary variable of interest in this study was whether a clinic received the financial incentive based on results of pharmaceutical expenditures during the previous period. We assumed that a financial incentive would have a positive effect on each clinic's pharmaceutical expenditures, and clinics that received the incentive would continuously improve prescription behavior. Therefore, we considered this variable as the most interesting variable in this study. We also included other independent variables to examine the relationship between outcome variable and outpatient prescription incentive as follows: representative doctor's sex, age, major treatment area, region, separate drug prescribing and dispensing program, presence of expensive medical equipment (MRI, CT, or PET) [15], presence of inpatient beds, number of patients, pharmaceutical cost per patient, types of medications, number of doctors, number of nurses, proportion of outpatient prescriptions, proportion of specialists, and proportion of registered nurses. Age was categorized as less than 39 years, 40–49 years, 50–59 years, and more than 60 years. Major treatment areas were internal medicine, surgery, and others. The regions where the clinics were located were Kangwon, Gyeonggi, Gyeongsang, Gwangju, Daegu, Daejeon, Busan, Seoul, Ulsan, Incheon, Jeolla, and Chungcheong. In South Korea, a program for the separation of drug prescribing and dispensing was introduced nationwide, but the South Korean government designated some regions as exceptions to reduce the inconvenience for individuals residing in regions with shortages of health care resources. According to a previous study, the pharmaceutical behavior in these regions had some difference with other regions [16]. To reflect such differences, we included the separate drug prescribing and dispensing program in this study. Finally, to reflect the variation in pharmaceutical behaviors in each clinic, we also included the pharmaceutical cost per patient, types of medication, and proportion of outpatient prescriptions in this study.

3. Statistical analysis

We first examined the frequencies and percentages of each categorical variable and the mean and standard deviation of each continuous variable at the baseline of each clinic. Next, to compare the average values and standard deviations of the proportion of cost savings and OPCI, we performed a *t*-test or analysis of variance according to each independent variable during the study period. In addition, we performed chi-square tests for the distribution of clinics according to receipt of outpatient prescription incentives during the study period. Finally, we performed multiple regression analysis and Poisson regression analysis using generalized estimating equation models to examine the associations between the outpatient prescription incentive and the outcome variables [17,18]. Moreover, subgroup analyses were performed according to the separate drug prescribing and dispensing program, presence of specialists, and presence of registered nurses. All statistical analyses were performed using SAS statistical software ver. 9.2. (SAS Institute Inc., Cary, NC, USA).

RESULTS

The data used in this study consisted of 123,392 cases from 22,372 clinics (average 5.4 periods of follow-up). Table 1 shows the characteristics of each clinic at study baseline. At baseline, 29.7% clinics had received the outpatient prescription incentive in the last half of the year. According to representative doctor's characteristics, 87.3% and 47.3% clinics were operated by male doctors between the ages of 40 to 49 years, respectively. The major areas of treatment in these clinics were internal medicine or surgery. According to separate drug prescribing and dispensing programs, about 0.3% of clinics were exempt from among the total number of clinics (because of their location in areas with few healthcare resources). Regarding characteristics that reflected the size of each clinic, such as the presence of expensive medical equipment or inpatients beds, 1.5% and 24.1% of clinics had expensive medical equipment, such as CT, MRI, or PET, and inpatient beds, respectively. Among all clinics, the average number of patients was 4,012.2 and the average pharmaceutical costs per patient was 26,340.4 Korean won. Within the clinics, the average numbers of doctors and nurses were 1.2 and 2.7, respectively.

Table 2 shows the associations between outcome variables and each independent variable. The average values for the proportion of cost savings and OPCI among all clinics were -3.23 and 0.96, re-

Table 1. General characteristics of clinics which were applied to outpatient prescribing incentive at baseline

Characteristic	Value
Outpatient prescribing incentive in last period	
Provided	6,743 (29.7)
Non-provided	15,989 (70.3)
Sex of representative doctor	
Male	19,835 (87.3)
Female	2,897 (12.7)
Age of representative doctor (yr)	
≤ 39	2,281 (10.0)
40–49	10,747 (47.3)
50–59	6,917 (30.4)
≥ 60	2,787 (12.3)
Major treatment area	
Internal medicine	8,236 (36.2)
Surgical medicine	8,167 (35.9)
Others	6,329 (27.8)
Region	
Kangwon	596 (2.6)
Gyeonggi	4,832 (21.3)
Gyeongsang	2,541 (11.2)
Gwangju	667 (2.9)
Daegu	1,315 (5.8)
Daejeon	814 (3.6)
Busan	1,672 (7.4)
Seoul	5,564 (24.5)
Ulsan	452 (2.0)
Incheon	1,150 (5.1)
Jeolla	1,607 (7.1)
Chungcheong	1,522 (6.7)
Applicability of separation for drug prescribing and dispensing	
Exception	64 (0.3)
Application	22,668 (99.7)
Presence of expensive medical equipment	
Presence	346 (1.5)
Absence	22,386 (98.5)
Presence of inpatient bed	
Presence	5,471 (24.1)
Absence	17,261 (75.9)
Follow-up period (half of the year)	5.4 ± 1.3
No. of patients	4,012.2 ± 3,024.3
Pharmaceutical cost per patient (Korean won)	26,340 ± 22,995
Kinds of prescribing medicine	34,372.8 ± 31,123.6
Proportion of outpatient prescription (%)	92.8 ± 16.7
Total doctors	1.2 ± 0.9
Proportion of specialist	93.0 ± 24.5
Total nurses	2.7 ± 2.5
Proportion of registered nurses	15.0 ± 29.0
Total	22,732 (100.0)

Values are presented as mean ± standard deviation or number (%).

spectively. Clinics that received outpatient prescription incentives in the last period had low pharmaceutical costs and low OPCI (according to cost saving: received, 2.64; non-received, -5.22; p-value < 0.0001; according to OPCI: received, 0.89; non-received, 0.98; p-value < 0.0005). With respect to clinic characteristics, the clinics with internal medicine doctors or larger size (e.g., had expensive medical equipment or inpatient beds) were associated with higher OPCI than others. In addition, clinics with separate drug prescribing and dispensing programs had higher OPCI. Clinics that had received incentives in the last period were more frequently associated with outpatient prescribing incentives (received, 46.3%; non-received, 16.1%; p-value < 0.0001). However, there were no significant associations between outcome variables and separate drug prescribing and dispensing programs or presence of expensive medical equipment.

Table 3 shows the results of multiple linear regression analysis and Poisson regression analysis to examine the associations with outcome variables considering independent variables including whether clinics had received the outpatient prescribing incentive in the last period. According to outpatient prescribing incentive, clinics that had received the outpatient prescribing incentive in the last period had better results in proportion of cost savings and OPCI (received: proportion of cost savings, $\beta = 6.8179$; p-value < 0.0001; OPCI, $\beta = -0.0227$; p-value < 0.0001; reference = non-received). In addition, these clinics had a higher risk in the provision of outpatient prescribing incentive (relative risk, 2.772; 95% confidence interval, 2.720 to 2.824). According to major treatment area, internal medicine clinics had better results for OPCI and provision of outpatient prescribing incentives than other treatment areas or specialties. Clinics with higher costs per patients or types of medication had lower cost savings or higher OPCI. These clinics also had a lower risk for outpatient prescribing incentive. According to the results of separate drug prescribing and dispensing programs, clinics without these programs had a lower risk of outpatient prescribing incentive than clinics that had these programs. In addition, clinics that had more doctors or a greater proportion of registered nurses were positively associated with the outpatient prescribing incentive.

We performed sub-group analysis for the multiple linear regression analysis and Poisson regression analysis to examine the differences in association between outcome variables and clinic reception of incentives in the last period. Clinics that had received incentives in the last period were associated with a higher proportion of cost saving, lower OPCI, and were at high risk for provision of outpatient prescribing incentive in clinics with separate drug prescribing and dispensing programs than those without. In addition, according to outpatient prescribing incentive programs in

Table 2. The association with cost saving, OPCI, outpatient prescribing incentive as outcome variables by characteristics of clinics

Variable	Proportion of cost saving		OPCI		Outpatient prescribing incentive		*p*-value
	Mean ± SD	*p*-value	Mean ± SD	*p*-value	Provided	Non-provided	
Outpatient prescribing incentive in last period							
Provided	2.64 ± 17.13	< 0.0001	0.89 ± 0.38	< 0.0001	14,473 (46.3)	16,819 (53.7)	< 0.0001
Non-provided	-5.22 ± 30.95		0.98 ± 0.41		14,795 (16.1)	77,305 (83.9)	
Sex of representative doctor							
Male	-3.30 ± 29.60	0.0219	0.96 ± 0.41	< 0.0001	25,353 (23.4)	82,876 (76.6)	< 0.0001
Female	-2.73 ± 16.27		0.94 ± 0.37		3,915 (25.8)	11,248 (74.2)	
Age of representative doctor (yr)							
≤ 39	-3.72 ± 14.62	0.2334	1.05 ± 0.41	< 0.0001	1,685 (21.8)	6,061 (78.2)	< 0.0001
40–49	-3.10 ± 17.45		0.99 ± 0.39		13,261 (24.6)	40,545 (75.4)	
50–59	-3.34 ± 13.61		0.93 ± 0.39		10,193 (23.4)	33,354 (76.6)	
≥ 60	-3.13 ± 63.05		0.86 ± 0.43		4,129 (22.6)	14,164 (77.4)	
Major treatment area							
Internal medicine	-3.54 ± 9.99	< 0.0001	0.97 ± 0.36	< 0.0001	10,607 (23.5)	34,573 (76.5)	< 0.0001
Surgical medicine	-3.42 ± 13.70		0.94 ± 0.42		11,293 (24.8)	34,213 (75.2)	
Others	-2.52 ± 51.21		0.95 ± 0.44		7,368 (22.5)	25,338 (77.5)	
Region							
Kangwon	-3.48 ± 15.40	0.0006	1.01 ± 0.41	< 0.0001	768 (23.5)	2,496 (76.5)	< 0.0001
Gyeonggi	-2.84 ± 54.46		0.97 ± 0.40		6,372 (24.3)	19,874 (75.7)	
Gyeongsang	-3.41 ± 12.00		0.96 ± 0.39		3,362 (24.1)	10,606 (75.9)	
Gwangju	-3.32 ± 16.51		0.96 ± 0.39		804 (22.1)	2,836 (77.9)	
Daegu	-3.53 ± 13.19		0.97 ± 0.42		1,668 (23.0)	5,570 (77.0)	
Daejeon	-3.05 ± 13.86		0.92 ± 0.39		1,112 (24.9)	3,349 (75.1)	
Busan	-3.34 ± 13.76		0.90 ± 0.37		2,116 (23.4)	6,940 (76.6)	
Seoul	-2.95 ± 15.93		0.95 ± 0.44		7,130 (24.0)	22,529 (76.0)	
Ulsan	-1.80 ± 14.56		0.93 ± 0.36		687 (28.0)	1,768 (72.0)	
Incheon	-3.61 ± 11.19		0.98 ± 0.37		1,415 (22.9)	4,752 (77.1)	
Jeolla	-4.35 ± 15.49		0.97 ± 0.39		1,857 (20.8)	7,087 (79.2)	
Chungcheong	-3.64 ± 16.99		0.95 ± 0.40		1,977 (23.8)	6,317 (76.2)	
Applicability of separation for drug prescribing and dispensing							
Exception	-1.28 ± 28.12	0.2773	0.68 ± 0.42	< 0.0001	57 (23.0)	191 (77.0)	0.7851
Application	-3.23 ± 28.30		0.96 ± 0.40		29,211 (23.7)	93,933 (76.3)	
Presence of expensive medical equipment							
Presence	0.22 ± 35.81	< 0.0001	1.01 ± 0.60	< 0.0001	457 (24.5)	1,405 (75.5)	0.3996
Absence	-3.28 ± 28.17		0.95 ± 0.40		28,811 (23.7)	92,719 (76.3)	
Presence of inpatient bed							
Presence	-3.00 ± 51.67	0.1049	0.98 ± 0.44	< 0.0001	7,363 (24.6)	22,520 (75.4)	< 0.0001
Absence	-3.30 ± 14.27		0.95 ± 0.39		21,905 (23.4)	71,604 (76.6)	
Total	-3.23 ± 28.30		0.96 ± 0.40		29,268 (23.7)	94,124 (76.3)	

Values are presented as mean ± standard deviation or number (%).

the last period these positive results were more associated with clinics that had specialists or registered nurses (Figure 1 and Appendices 1, 2).

DISCUSSION

Because of increasing pharmaceutical costs after introducing separate drug prescribing and dispensing programs, the South Korean government made an effort to manage pharmaceutical expenditures as part of reducing healthcare expenditures. However, most strategies had failed to control pharmaceutical costs. A breakthrough came in 2010 when an outpatient prescribing incentive program was introduced. This program was gradually expanded within South Korea; therefore, it was necessary to evaluate the impact of this program [9]. Thus, we investigated the relationship between the outpatient prescribing incentive program and outcomes related to pharmaceutical expenditures.

Our findings suggested that clinics that received the outpatient prescribing incentive based on pharmaceutical expenditures in last period had high cost savings, low OPCI, and were at high risk for provision of the outpatient prescribing incentive. Therefore, the introduction of the outpatient prescribing incentive program had

Table 3. The results of multiple linear regression analysis and Poisson regression analysis for the associations with outcome variables

Variable	Proportion of cost saving		OPCI		Outpatient prescribing incentive	
	β	*p*-value	β	*p*-value	Relative risk (95% confidence interval)	*p*-value
Outpatient prescribing incentive in last period						
Provided	6.8179	<0.0001	-0.0227	<0.0001	2.772 (2.720–2.824)	<0.0001
Non-provided	Ref	-	Ref	-	1.000	-
Sex of representative doctor						
Male	0.1110	0.5481	-0.073	<0.0001	0.964 (0.938–0.990)	0.0079
Female	Ref	-	Ref	-	1.000	-
Age of representative doctor (yr)						-
≤39	Ref	-	Ref	-	1.000	0.0255
40–49	0.3650	0.0862	-0.0193	<0.0001	1.049 (1.006–1.094)	0.339
50–59	0.2247	0.2817	-0.0344	<0.0001	1.021 (0.978–1.066)	0.3595
≥60	0.2022	0.7317	-0.0471	<0.0001	0.978 (0.932–1.026)	
Major treatment area						
Internal medicine	-0.2298	0.373	-0.1935	<0.0001	1.111 (1.081–1.141)	<0.0001
Surgical medicine	-1.9704	0.0008	0.141	<0.0001	1.015 (0.987–1.044)	0.3005
Others	Ref	-	Ref	-	1.000	-
Region						
Kangwon	0.1725	0.6421	0.0296	0.0886	0.985 (0.920–1.053)	0.6522
Gyeonggi	0.5171	0.2406	0.0493	<0.0001	0.992 (0.953–1.033)	0.6974
Gyeongsang	-0.0586	0.8146	0.0285	0.0066	0.986 (0.944–1.031)	0.5366
Gwangju	0.0631	0.8734	0.0146	0.3349	0.909 (0.851–0.972)	0.0049
Daegu	-0.1599	0.5841	0.0197	0.1096	0.934 (0.887–0.984)	0.0108
Daejeon	0.0105	0.9745	0.0109	0.4076	0.982 (0.927–1.040)	0.5294
Busan	-0.1550	0.5971	-0.0025	0.8266	0.945 (0.899–0.993)	0.0242
Seoul	0.1627	0.5202	0.0398	<0.0001	0.954 (0.916–0.993)	0.0208
Ulsan	1.1291	0.0072	0.0512	0.0029	1.088 (1.016–1.164)	0.0152
Incheon	-0.0354	0.8957	0.0353	0.0045	0.963 (0.912–1.017)	0.1789
Jeolla	-0.4276	0.1687	-0.0272	0.0150	0.906 (0.861–0.954)	0.0002
Chungcheong	Ref	-	Ref	-	1.000	-
Applicability of separation for drug prescribing and dispensing						
Exception	0.1184	0.9557	-0.0133	0.5821	0.792 (0.637–0.985)	0.0362
Application	Ref	-	Ref	-	1.000	-
Presence of expensive medical equipment						
Presence	3.2132	0.0049	0.0166	0.3787	1.005 (0.926–1.091)	0.9002
Absence	Ref	-	Ref	-	1.000	-
Presence of inpatient bed						
Presence	0.5054	0.3019	0.0126	0.0677	1.021 (0.996–1.046)	0.1053
Absence	Ref	-	Ref	-	1.000	-
Study period (half of the year)	-0.0064	0.9343	0.0025	<0.0001	0.953 (0.947–0.958)	<0.0001
Number of patients	-0.0002	0.4871	-0.0003	<0.0001	1.000 (1.000–1.000)	0.1745
Pharmaceutical cost per patient (Korean won)	-0.0689	<0.0001	0.0155	<0.0001	0.993 (0.993–0.994)	<0.0001
Kinds of prescribing medicine	-0.0251	<0.0001	0.0049	<0.0001	0.998 (0.997–0.999)	<0.0001
Proportion of outpatient prescription	-0.1724	0.0053	0.0114	0.0628	0.972 (0.967–0.978)	<0.0001
Total doctors	0.2209	0.0599	0.0047	0.0435	1.032 (1.017–1.047)	<0.0001
Proportion of specialist	0.1070	0.0075	0.0004	0.7292	0.999 (0.995–1.004)	0.6644
Total nurses	-0.0665	0.0386	0.0008	0.3322	0.998 (0.993–1.002)	0.3342
Proportion of registered nurses	0.0445	0.0641	-0.0026	0.0089	1.006 (1.002–1.009)	0.0008

OPCI, Outpatient Prescribing Costliness Index; Ref, reference.

a positive effect on reducing pharmaceutical expenditures in South Korea. There have been similar results of financial incentives in reducing unnecessary expenditures in many previous studies. The provision of financial motivation, such as incentives for healthcare providers, could change providers' healthcare behavior positively [12,19]. In many other countries or in other policies of the South Korean government, strategies that induced improvement by providing financial incentives have been introduced and shown as effective. However, health policies to control pharmaceutical expenditures in South Korea are needed to reduce

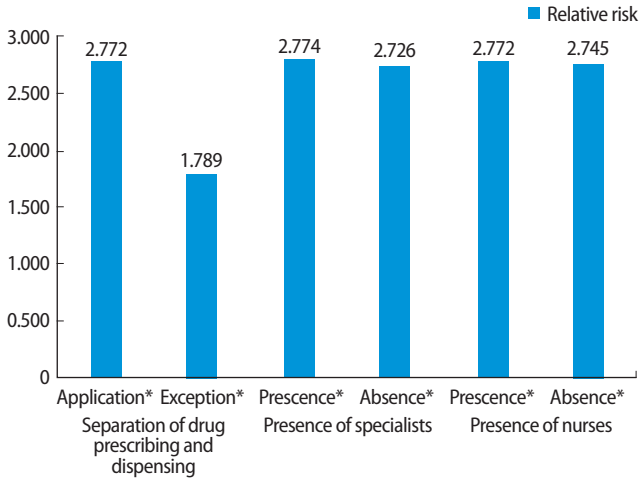

Figure 1. The results of sub-group analyses for the provision of outpatient prescription incentive. Results of sub-group analyses for clinics that received the outpatient prescription incentive according to the provision of outpatient prescription incentive in the last period. The results were calculated by multiple Poisson regression analysis to examine the relationship between outcome variables and receipt of outpatient prescription incentive in the last period. *The results were statistically significant and the reference was clinics that had not received the incentive.

pharmaceutical expenditures to levels seen with other countries. This was because pharmaceutical expenditures continued to increase even after the outpatient prescribing incentive had positive outcomes [4,20]. In our results, the average pharmaceutical cost savings were still record deficits compared to expected expenditures. Thus, healthcare professionals and health policy makers must develop alternatives to the present program that are more effective. In particular, present incentive program had less motivating for providers, because the profit by the cost saving was not relatively larger than existing profit without cost saving. Thus, there are needed to suggest the more attractive methods for providers. In addition, healthcare professionals and policymakers should positively consider other exquisite methods to predict and estimate expected pharmaceutical expenditures more effectively. Through such efforts, we look forward to specific solutions to problems related to increasing pharmaceutical expenditures in South Korea.

Our study showed some interesting findings. The positive impact of provision of outpatient prescribing incentives had differences according to separate drug prescribing and dispensing programs. For these programs to reduce the inconvenience for populations residing in regions with shortages of health care resources, the South Korean government designated these regions as exceptions for the separate prescribing and dispensing rule. According to previous studies, these regions had different pharmaceutical behaviors than other regions [16,21]. In this study, we observed lower cost savings and less risk of provision of incentives. In addition, the clinics in exception regions had relatively less of a positive impact associated with outpatient prescribing incentives programs in the last period. Hence, we thought that different policies for these regions to reduce the pharmaceutical expenditures as effectively were needed because there were no optimal monitoring system and management strategies despite adverse effects by exception. Furthermore, the clinics with more professional staffing had better behaviors in controlling pharmaceutical expenditures based on our results. Thus, it is necessary to evaluate the positive impact of special staffing with specialists or registered nurses to better manage healthcare expenditures in clinics [22].

Our study has some strengths and limitations compared to previous studies. First, the data used in this study included information for pharmaceutical expenditures of all clinics in South Korea. In South Korea, after National Health Insurance was introduced in 1989, insurance claims data were collected by the Health Insurance Review and Assessment Service (HIRA) [23]. Based on these data, HIRA evaluated each medical institution and provided the incentives or penalties. By using one of the claims databases in this study, we could investigate the overall pharmaceutical expenditures in clinics, which could be helpful in establishing evidence-based policy. Second, to our best knowledge, this is first study to investigate positive impacts of introducing an outpatient prescribing incentive program. After introducing this program in 2010, there were few studies about the relationship between this program and pharmaceutical expenditures in South Korea. Regarding this program and similar programs to mitigate the rapid increase in pharmaceutical expenditures, which were gradually expanded (February 2012, expanded to outpatient of hospitals; September 2014, expanded to inpatient care in clinics and hospitals), our results provided effective evidence for such expansion. Third, in this study, we considered the characteristics of doctor, region, clinic, and prescribing behavior to minimize the limitations of using secondary data. However, the data used in this study were collected in 6-month units, because the outpatient prescribing incentive program was applied based on the evaluation by half of the year. Therefore, we could not reflect the detailed period effect in monthly or daily units. In addition, the data consisted of aggregate data at the clinic-level rather than the patient-level. Hence, the re-

sults of this study could not reflect the patient mix in each clinic and also could not include the patients' socio-economic status [24]. To reduce such limitations, we included variables such as pharmaceutical cost per patient in this study.

In conclusion, clinics that received the outpatient prescribing incentive in the last period had better pharmaceutical behaviors than clinics that had not received the prescribing incentive. Thus, outpatient prescribing incentive programs for clinics was somewhat effective to manage rapid increases of pharmaceutical expenditures. However, the pharmaceutical expenditures still increased even after the positive impact of the outpatient prescribing incentive program. Therefore, healthcare professionals and health policy makers should develop more effective alternatives (i.e., for clinics without separation of prescribing and dispensing programs) based on our results.

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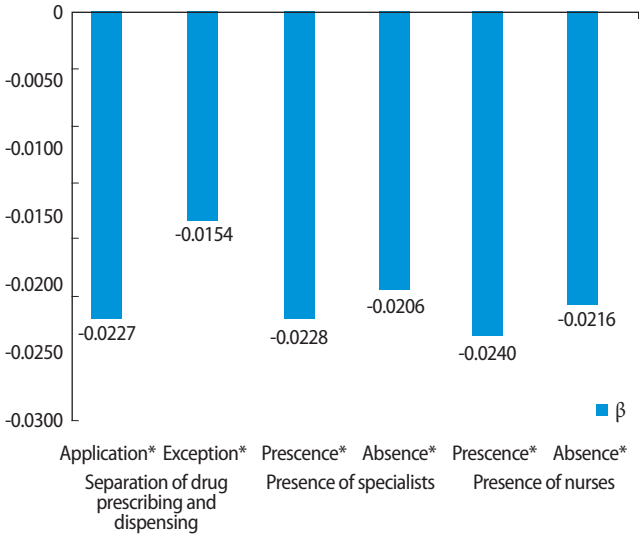
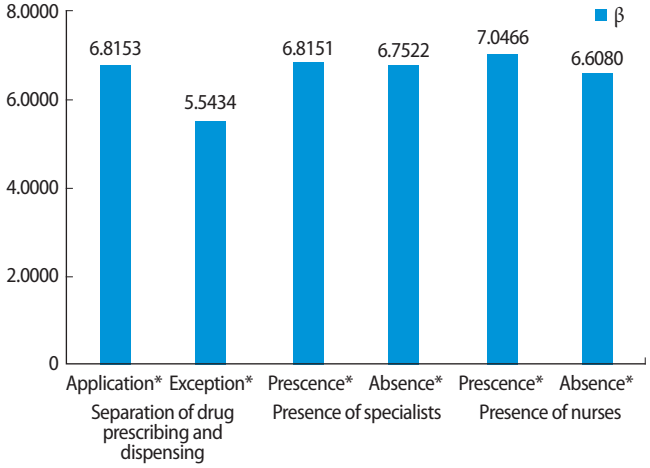


Appendix 1. The results of sub-group analyses for proportion of the pharmaceutical cost saving. Results of sub-group analyses for proportion of pharmaceutical cost savings according to provision of outpatient prescription incentive in the last period. The results were calculated by multiple linear regression analysis to examine the relationship between outcome variables and receipt of outpatient prescription incentive in the last period.



Appendix 2. The results of sub-gqoup analyses for the OPCI. Results of sub-group analyses for OPCI according to provision of outpatient prescription incentive in the last period. The results were calculated by multiple linear regression analysis to examine the relationship between outcome variables and receipt of outpatient prescription incentive in the last period. OPCI, Outpatient Prescribing Costliness Index.