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Rapid Increase of Health Care Utilization and Cost due to Benign Prostatic Hyperplasia in Korean Men: Retrospective Population-based Analysis Using the Health Insurance Review and Assessment Service Data

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Using the Korean public health insurance database, we analyzed patients diagnosed as benign prostatic hyperplasia (BPH) from 2004 to 2008. Age and year-specific amount and seasonal variation of hospital visits (HV), duration of treatment (DT), the total and per capita amount of insurance payment (TAIP, PCIP) were evaluated. A total of 12,088,995 HV were studied. Total HV increased 1.7 times and DT almost doubled in 2008 compared to those in 2004. HV, DT, and TAIP showed linearly increasing patterns year by year. In a time series analysis, HV increased in winter and demonstrated seasonality in a 12-month cycle. In a Poisson regression analysis, the annual variations of HV, DT, TAIP, and PCIP were different by age groups. In patients older than 40 yr, HV significantly increased 1.10-1.16 times compared to that of the previous year. DT markedly increased in their 60s and 80s patients. The rate of increase in PCIP was steeper in patients 50 yr and older than in the others.Health care utilization due to BPH was rapidly increasing in Korea and it was remarkable in the elderly population. Seasonal variation of HV demonstrated that health care utilization increased in winter.

Keywords: Prostatic Hyperplasia; Epidemiology; Insurance Claim Review

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a highly prevalent disease affecting middle aged and elderly men (1). In the United States, BPH is the most common benign tumor in men and is the most typically the disorder that reduces the quality of life (QOL) in men, causing lower urinary tract symptoms (LUTS) (2). BPH could be accepted as one of the processes of aging, rather than a life threatening disease, however, and as Korea is rapidly becoming an aging society, the QOL becomes a major issue among Koreans. It seems certain that, before long, BPH will emerge as one of the main priorities of concern for health care service authorities, as well as the government.

According to the report in the United States, approximately 4.5 million visits were made to physicians' offices for a primary diagnosis of BPH, and almost 8 million visits were made with a primary or secondary diagnosis of BPH in the year 2000 (3). The direct cost of BPH treatment was estimated to be 1.1 billion USD, excluding outpatient pharmaceuticals and nutritional supplements or herbal medications. There have been some population surveys on the prevalence of BPH in Korea (4-6), but the scale of those studies was small, and the issue of cost for BPH treatment was not investigated. Therefore, in the present study, the authors aimed to estimate the amount of health care utilization due to BPH by surveying the records of patients who visited the designated medical institutions by the Health Insurance Review and Assessment service (HIRA) of Korea. The HIRA monitors and analyzes reimbursement records from the Korean National Health Insurance (NHI) and Medical Aid. Because almost the entire nation is required to join the NHI (approximately 96.6% of the population) and Medi-

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cal Aid (approximately 3.4%), HIRA records cover all citizens (approximately 49 million people) in Korea. We also aimed to find any seasonal or regional variation in the cost of health care utilization due to BPH, as well as to examine economic burdens on the health insurance system and the pattern of practice in the management of BPH. Lastly, this nationwide, large-scale survey was conducted to offer the most reliable and objective epidemiological data in order to provide fundamental information for authorities formulating health care policy to improve the national health-related QOL.

MATERIALS AND METHODS

We evaluated data from the HIRA from a span of 5 yr (2004 to 2008). Data consisted of the patient's age, residence at diagnosis, treatment cost for BPH (medical and surgical), time to surgery from medication, emergency visits, etc. The HIRA is a nonprofit governmental organization established to review medical fees and to evaluate the appropriateness of health care benefits that beneficiaries receive. The HIRA database contains reimbursement records from all medical facilities (~5-6 million inpatient-visits per year in about 1,100 hospitals and 25,000 private clinics) in Korea (7). The criteria to divide the residence at diagnosis into rural and urban depended on the locations of the clinics or hospitals which were visited by patients. In HIRA database, small and medium sized cities and farm villages are equivalent to the rural area, while large cities more than megalopolis correspond to the urban area (8).

We used all claims records of outpatient visits or hospital admissions of patients aged 20 yr or older, diagnosed with BPH (International Classification of Diseases [ICD]-10 diagnostic code: N40) as the primary diagnosis. We then assessed the seasonal and annualpatterns of hospital visits and duration of treatment due to BPH, as well as the changes in the amount of insurance payment for the diagnosis and treatment of BPH, during the research period. Hospital visit (HV) meant the number of days that the patients visited the hospital due to BPH and duration of treatment (DT) indicated the period of prescription if the patients received medications due to BPH. Total amount of insurance payment (TAIP) gave the information of the total cost of national insurance payment for BPH within one year, and per capitainsurance payment (PCIP) signified calculated values using this total amount of insurance payment and national population data (9, 10).

Age-specific number of HV and DT were presented, and differences over the years were analyzed with a Poisson analysis and the relative risk (RR) was estimated. RR was the calculated specific value which indicated the age-specific relative difference of HV, DT, and PCIP based on the value of 1. A time series analysis was performed to explore the seasonal and annual variation of the amount of HV, DT, TAIP, and PCIP. The Durbin-Watson test was used to evaluate self-correlations of error. To remove the self-correlations of error, a stepwise autoregressive process was performed using the Yule-Walker method. A Poisson regression analysis was done to estimate the RR of annual variation, age difference, number of HV, and DT for the PCIP. Age-specific PCIP was analyzed after age-standardization using data from the 2005 Census (9, 10), obtained from the Korean National Statistical Office. All hypotheses were evaluated in a 2-sided manner, and P value of < 0.05 was considered significant.

Ethics statement

This study was exempted from review and evaluation by the institutional review board of the Boramae Medical Center, Seoul.

RESULTS

The total number of HV from 2004 to 2008 was 12,088,995. The number of visits increased with time and reached the almost 1.7 fold in 2008 compared to 2004 (Table 1). HV showed linearly increasing patterns from year to year (Fig. 1A). After a logarithmic transformation to remove an increasing tendency of the range of fluctuation, the linear pattern persisted. The total DT almost doubled from 3,463,520 days in 2004 to 6,598,787 days in 2008 (Table 1). DT demonstrated linearly increasing patterns from year to year (Fig. 1B). TAIP per year also showed a continuously growing pattern (Fig. 1C).

In the time series analysis using the stepwise autoregressive process, the amount of HVincreased every winter which demonstrated seasonality, repetition of a variation of patterns in a 12-month cycle (Fig. 2A, $P = 0.005$). The DT (Fig 2B, $P = 0.058$) and TAIP (Fig. 2C, $P = 0.544$) also showed seasonality, but it was not statistically significant.

The annual variation of HV count was different across age groups (Fig. 3). Patients in the 20s showed a decrease in HV from year to year, those in the 30s showed an increase until 2006 and then a decrease, those in the 40s showed an increase throughout the study period. After a Poisson regression analysis, we found that HV were different depending on the age groups, years, and type of visit (inpatient or outpatient) ($P < 0.001$). The interaction between age groups and years was significant ($P < 0.001$), which meant that the variation of HV by year was significantly different depending on the age groups. Estimated RR is presented in Table 2. For patients in the 20s and 30s, HV significantly decreased 0.78 and 0.96 times, respectively, compared with that of the previous year. On the other hand, in patients in the 40s and above, HV significantly increased 1.10, 1.13, 1.17, and 1.16 times compared to the previous year. There was 11.45 times more outpatient HV than inpatient HV in the same age group and year.DT markedly increased in patients in the 60s and 80s (Fig. 3). The variation of DT by years was significantly different ac-

Table 1. Hospital visits and duration of treatment by age groups and by years

Age (yr)	Hospital visit by year (No.)										
	2004		2005		2006		2007		2008		Subtotal
	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	
20s	72	1,960	43	1,662	26	1,767	52	856	36	684	7,158
30s	924	19,474	1,099	20,207	1,299	20,311	1,247	17,225	760	16,837	99,383
40s	5,649	110,862	7,502	118,759	7,366	141,098	6,336	150,749	7,037	160,455	715,813
50s	21,263	341,120	24,517	382,598	29,495	464,709	29,654	504,770	26,379	553,075	2,377,580
60s	56,007	639,286	68,017	701,119	74,345	818,942	76,642	921,221	78,455	1,043,364	4,477,398
70s	44,946	444,778	52,426	510,746	68,036	616,242	82,399	716,297	83,302	833,513	3,452,685
> 80s	15,582	124,806	16,101	142,189	23,133	166,459	28,483	189,011	32,525	220,689	958,978
Subtotal	144,443	1,682,286	169,705	1,877,280	203,700	2,229,528	224,813	2,500,129	2,288,494	2,828,617	
Total	1,826,729		2,046,985		2,433,228		2,724,942		3,057,111		12,088,995
Age (yr)	Duration of treatment by year (days)										
	2004		2005		2006		2007		2008		Subtotal
	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	
20s	111	2,414	123	1,925	86	1,855	86	927	57	844	8,428
30s	1,426	24,316	1,574	24,736	1,871	24,090	2,013	20,486	1,695	20,564	122,771
40s	7,761	136,217	10,142	143,254	10,533	175,727	9,925	189,279	11,550	206,786	901,174
50s	32,435	713,919	36,367	829,935	45,680	956,906	45,912	990,598	46,198	1,017,950	4,715,900
60s	92,490	1,017,676	105,926	1,256,252	119,984	1,624,750	126,144	2,047,781	134,570	2,597,312	9,122,976
70s	75,740	1,148,624	85,228	1,286,461	109,966	1,488,953	128,577	1,636,818	136,303	1,907,998	8,004,668
> 80s	26,885	183,415	26,936	220,867	35,950	278,786	41,908	343,601	47,988	428,972	1,675,308
Subtotal	236,848	3,226,672	266,296	3,763,430	324,070	4,551,067	354,565	5,229,490	378,361	6,220,426	
Total	3,463,520		4,029,726		4,875,137		5,584,055		6,598,787		24,551,225

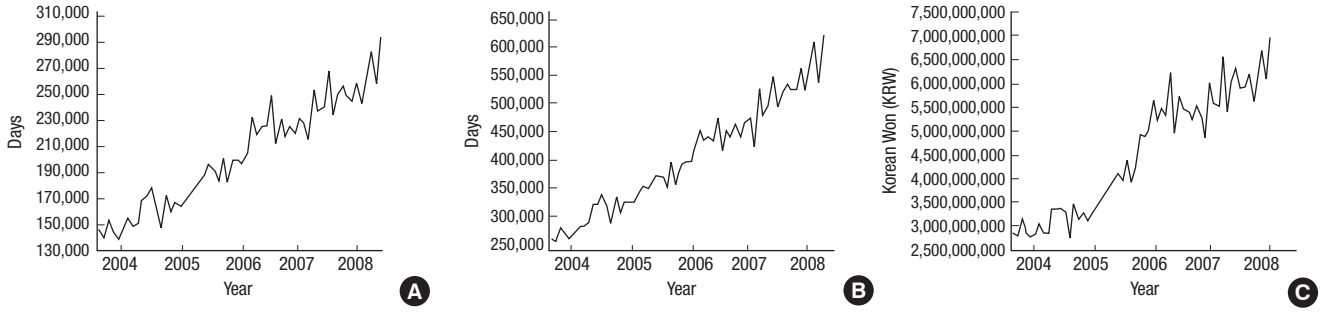

Fig. 1. The linearly increasing pattern of BPH health utilizationfrom year to year. (**A**) Hospital visits (days) per month, (**B**) Duration of treatment (days) per month, and (**C**) Total amount of insurance payment (Korean won [KRW]) per month.

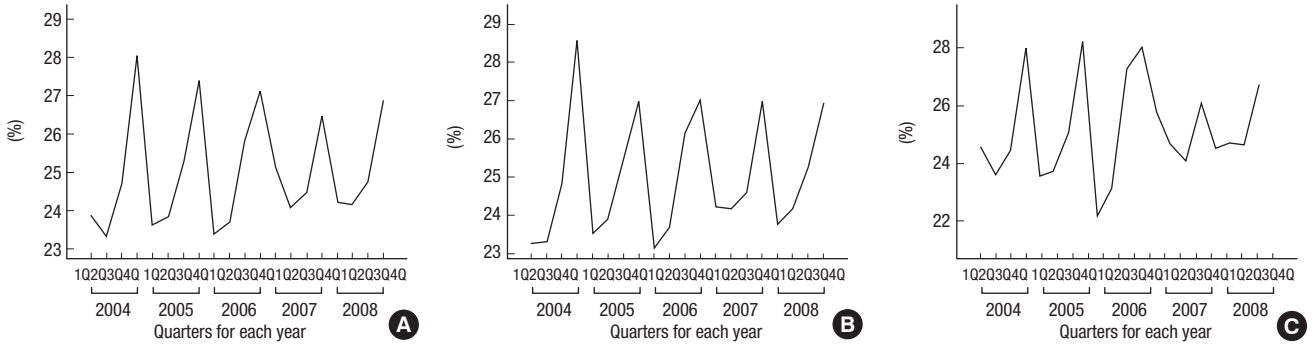

Fig. 2. The seasonality of BPH health utilization in the time series analysis. Quarterly amount of: (**A**) Hospital visits per month. (**B**) Duration of treatment per month. (**C**) Total amount of insurance payment per month show seasonality. The unit of Y axis indicates percent ratio of quarter amount of hospital visits, duration of treatment and total amount of insurance payment for each year, respectively.

cording to the age groups.

Per capita insurance payment (PCIP) increased with increasing age and with times (Table 3 and Fig. 3). The rate of increase was steeper in the age groups older than the 50s compared to the other age groups. In a significance test for the regression coefficient, we found that the PCIP were different depending on

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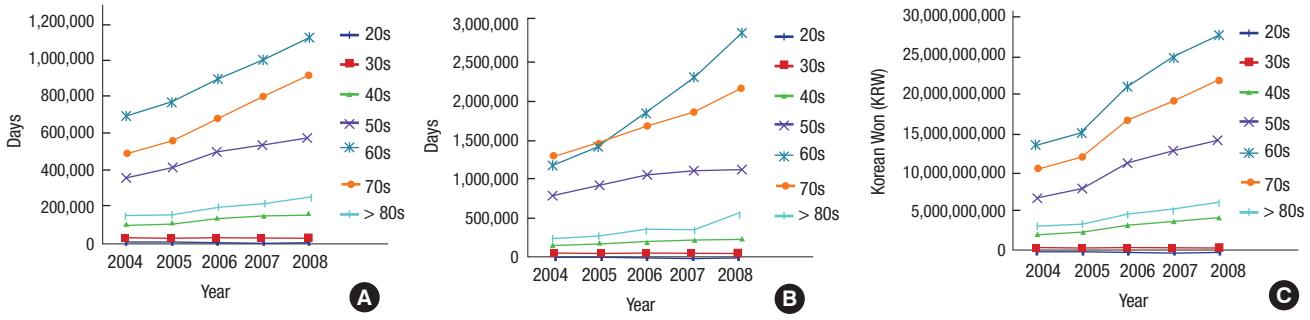

Fig. 3. The annual variation of BPH health utilization across age groups. (**A**) Hospital visits (days) per year by age groups. (**B**) Duration of treatment (days) per year by age groups. (**C**) Per capita amount of insurance payment (Korean won) per year by age group.

Table 2. Relative risk (RR) estimated by Poisson regression analysis

	Age groups	RR	Lower 95% CI	Upper 95% CI
Hospital visits	20s	0.78	0.769	0.796
	30s	0.96	0.954	0.963
	40s	1.10	1.095	1.100
	50s	1.13	1.124	1.129
	60s	1.13	1.127	1.132
	70s	1.17	1.170	1.176
	> 80s	1.16	1.159	1.165
	Outpatient	11.45	11.423	11.473
Duration of treatment	20s	0.77	0.758	0.782
	30s	0.96	0.898	1.020
	40s	1.11	1.046	1.188
	50s	1.09	1.022	1.161
	60s	1.26	1.178	1.337
	70s	1.14	1.067	1.211
	> 80s	1.26	1.180	1.340
	Outpatient	14.74	14.713	14.759
Per capita insurance payment	20s	0.84	0.837	0.838
	30s	1.05	1.046	1.047
	40s	1.20	1.204	1.205
	50s	1.21	1.207	1.208
	60s	1.21	1.209	1.209
	70s	1.21	1.207	1.207
	> 80s	1.20	1.204	1.205
	Outpatient	2.93	2.932	2.932

Table 3. Per capita insurance payment by age groups and years (Korean Won [KRW])

Age groups	2004	2005	2006	2007	2008
20s	8	7	8	5	3
30s	86	91	103	97	104
40s	498	557	790	913	1,012
50s	2,632	3,062	4,426	4,950	5,514
60s	8,086	9,059	12,695	14,861	16,636
70s	13,482	15,181	21,101	24,490	27,710
> 80s	15,263	16,964	23,089	26,757	31,134

Average exchange rate in 2008 was 1 USD = 1,103.36 KRW.

the age groups and years ($P < 0.001$). The interaction between age groups and years was significant ($P < 0.001$), which implied that the variation of PCIP by years was significantly different across the age groups. Estimated RR from the Poisson regression analysis is presented in the Table 3.

In patients in the 20s, PCIP significantly decreased 0.84 times compared with the previous year. On the other hand, in patients in the 30s or older, PCIP significantly increased 1.05, 1.20, 1.21, 1.21, and 1.20 times compared with the previous year. There was 2.93 times more outpatient PCIP than inpatient PCIP in the same age group and year. There was no regional difference between urban and rural areas in terms of HV count, DT, and TAIP due to BPH.

DISCUSSION

There is not a single developed country in which the importance of care due to BPH is not growing. The main contributors of the rising prevalence of BPH in Korea are suspected to be the elevated standard of living, westernized diet with increased consumption of animal fat, and aging population (11). Although the fact that the prevalence of BPH increases with age is widely accepted and presumed to apply to the Korean society, the rate of increase in this study is noteworthy and greater than expected. In the US, the total rate of BPH procedures increased significantly after 2002 and was driven by a marked increase of new minimally invasive surgical technologies (MIST) (12, 13). Our data also shows a remarkable elevation in medical costs over a relatively short period of time, which is suspected to be due to not only a sharp upsurge of disease prevalence but also an increase in physicians' interests, along with the expanded release of new BPH drugs and the increase in patients' treatment-seeking behaviors (13).

In this study, we demonstrated that the demand for BPH treatment nearly doubled throughout the 5 yr of study period. The DT was 3462273 days in 2004 and increased by 1.9-fold, to 6598787 days, in 2008. The HV was 1827996 days in 2004 and increased by 1.7-fold, to 3057111 days, in 2008. This rapid growth happened irrespective of regional differences such as whether the area is urban or rural, and regardless of practice patterns by urologists or non-urologists, whether inpatient or outpatient.

Our results showed the significant increase of BPH patients in the elderly. That was the reason why potentially BPH patients in the elderly were more diagnosed and treated after recent large-scale public advertisements and medical education about

BPH. In other words, in the past, elderly patients suffering from voiding problem due to BPH did not know the cause of the problem and the solving methods. But these days, awareness of BPH was wide spread and people could easily access the medical knowledge, elderly BPH patients had more chance to receive the proper medical care (14).

By analyzing the hospital visits, we found that the frequency of hospital visits started to increase in the autumn and peaked in December in a similar pattern every year from 2004 to 2008. From February to April, when the temperature was warmer, the number of hospital visits was fewer. The difference between the number of hospital visits in the colder season and the warmer season reached 1.2 fold. In Korea, the annual mean temperature ranges from 10 to 16 degrees Celsius except in the high mountain areas and islands. The warmest month is August, whereas January is the coldest one. The monthly mean temperature ranges from 23 to 27 in August and from -6 to +7 degrees Celsius in January (15). A majority of urologists have experienced the seasonal variation and rising tendency of BPH incidence in the winter, and such a phenomenon has been confirmed with solid evidence based on a large population data (16, 17). It is presumed that our body is too slow to adapt to the sudden change in temperature in the winter (18, 19). In addition, alcohol consumption rapidly increases at the end of the year in Korea, deteriorating LUTS in BPH patients and occasionally leading to the most serious complication of BPH: acute urinary retention (AUR) (20). Higher rates of cold medicine intake could be another explanation for worsening BPH symptoms in the winter. Alpha-adrenergic agonists, which are a common component of over-the-counter cold medicines, may precipitate urinary retention by enhancing bladder outlet resistance (21, 22). Hormonal variation could be another answer for this matter. Testosterone is considered to play a permissive role in BPH (23). The reports are inconsistent and controversy persists on the seasonal variation of testosterone, but in the largest cross-sectional study, that analyzed archival data from 4,462 US veterans aged 32-44 yr, there was a report of a seasonal peak of total testosterone in December (24).

The amount of HVincreased every winter which demonstrated statically significant seasonality, but the DT and TAIP were not showed significant pattern.The reasons were suggested that HV was directly influenced and changed by seasonality, but DT and TAIP were not. For example, even though a patient visited hospital due to aggravating voiding symptoms in winter, the diagnostic procedures or medications were not changed because of season of winter, rather influenced by physician or medical costs.

Until recently, studies on the health care costs of BPH were reported mostly in Western societies (25, 26). In the pharmacy and medical claims data obtained from 61 US healthcare plans, 77,040 patients aged over 45 yr were examined, and the overall average annual cost of diagnosis and management for BPH was 31.4 million USD. Based on US Census estimates (July 2003), the direct cost estimate was approximately 3 billion USD for the year after BPH diagnosis. Through this study, we figured out that Korean TAIP in 2008 was 66 million USD (1 USD = 1,103.36 Korean Won [KRW] in 2008) which were relatively small expenditure of BPH costs compared to the United States. However, it is not possible to describe briefly the gap between the two countries, because the medical system of Korea and the United States was totally different. To explain the discrepancy of medical costs between Korea and other countries would be an interesting subject in future research.

The present study has several limitations that require consideration because of the methodological modality using the insurance claim data, as was the case for several studies reported in similar manner (4, 5, 26, 27). Not all patients with BPH have access to hospitals. The insurance claims records might have underestimated the entire BPH population if many patients with BPH were not diagnosed or treated in health care institutions. Misclassifications of disease or coding errors for diagnosis could have occurred. Additionally, only a single claim with a BPH diagnosis was used to identify patients with the condition, so the incidence of this condition might be overestimated in the database because a single patient may have visited clinics several times a year. This study reflects data only for the 5 yr from 2004 to 2005, which is a relatively short period of time. In addition, we did not have detailed clinical information for each patient, including symptom severity, duration, prostate size, and other medical or surgical history. Using the HIRA data, we did not demonstrated cost of each treatment modalities. However, as was shown in the US (12), MIST has gained enormous attention from the urologists and the number of MIST performed is also increasing in Korea. Additional researches are warranted.

Despite these limitations, however, this study has important implications. This is the first nation-wide, population-based study demonstrating not only seasonal and age-specific variation in the incidence of BPH, but also the amount of the economic costs for BPH patients in Korea. Therefore, our large-scale data could provide the most reliable information about the incidence of BPH and its cost for researchers and authorities formulating health care policy. Health care utilization due to BPH is rapidly increasing in Korea and is more remarkable in the elderly population. Seasonal variations in HV demonstrated that there was an increase in the winter. Our study is the largest scale population study, as well as the most objective clinical data in Korea, so it could provide fundamental epidemiological information on BPH.

DISCLOSURE

The authors have no relevant financial relationships to disclose

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or conflicts of interest to report.

AUTHOR CONTRIBUTION

Conceived and designed the experiments: Son H, Lee KS. Performed the experiments: Son H, Lee KS, Park J, Song SS. Analyzed the data: Son H, Song SS. Contributed reagents/materials/analysis tools: Kang JY, Hong SK, Lee HM. Wrote the first draft of the manuscript: Son H, Song SS, Lee KS. Wrote the paper: Son H, Song SS, Park J. ICMJE criteria for authorship read and met: Kim SH, Park BJ, Lee HL. Agree with manuscript results and conclusions: Son H, Lee KS. Enrolled patients: Son H, Kang JY, Hong SK, Lee HM, Kim SH, Lee HL, Lee KS.

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