The impact of revision for coinsurance rate for elderly on healthcare resource utilization: a pilot study using interrupted time series analysis of employee health insurance claims data

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Impact of revising the coinsurance rate for elderly people on health-care resource utilization: a pilot study using interrupted time-series analysis of employee health insurance claims data

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Abstract

Cost sharing, including copayment and coinsurance, is often used as a means of containing medical expenditure by reducing unnecessary or excessive use of health-care resources. Previous studies have reported the effects of reducing the coinsurance rate in Japan from 30% to 10% on demand for medical care among people aged 70 years. However, the coinsurance rate in Japan for individuals aged 70–74 years old has recently been increased from 10% to 20%. This study aimed to estimate the economic impact of coinsurance rate revision on health-care resource utilization using interrupted time-series analysis of employee health insurance claims data. I classified those who were born in FY 1944 and whose coinsurance rates decreased to 20% into the 10%-reduction group. It was found that the 10%-reduction group showed a lower increase of health-care utilization than the 20%-reduction group. However, no significant differences were observed in the overall and inpatient settings. The results of this study suggest that increasing the coinsurance rate among elderly people would reduce outpatient health-care resource utilization; however, it would not necessarily reduce overall health-care resource utilization.

Running title: Impact of coinsurance reduction in elderly

JEL classification: I13; I18

Keywords: Coinsurance; Health-care resource utilization; Elderly

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Introduction

Like other developed countries, Japan has a rapidly aging population: in 2016, 34.61 million people (27.3% of the total population) were aged 65 years or older (Ministry of Internal Affairs and Communications, 2016). According to one estimate, the number of such older people will increase to 36.57 million in FY 2025 ; social security expenditure in Japan will rapidly increase from approximately 110.7 trillion yen in fiscal year (FY) 2013 to about 148.9 trillion yen in FY 2025 (National Institute of Population and Social Security Research, 2014).

Higher patient cost sharing is often used to contain medical expenditure by reducing unnecessary or excessive use of health-care resources. The Japanese government has implemented several cost-sharing reforms. First, copayments (inpatients, 300 yen/day; outpatients, 400 yen/day) for elderly people aged 65 years or older were introduced in February 1983; however, such individuals did not have to pay out-of-pocket expenses from January 1973 until that time. Subsequently, 10% coinsurance was introduced with the reform of Japan's health insurance system in January 2002. Owing to the rapid increase in medical expenditure for older people, the government implemented an independent health insurance system for individuals aged 75 years or older (Medical Care System for Elderly in the Latter Stage of Life) in 2008. Accordingly, the coinsurance rate for people in Japan aged 70–74 years increased from 10% to 20% by amending the Health Insurance Act and National Health Insurance Act (Ministry of Health, Labour and Welfare, 1922; Ministry of Health, Labour and Welfare, 1958). To mitigate the impact of rapid change, the coinsurance rate was frozen at 10% by budgetary provision after 2008. However, to reduce inequity across generations, the 20% coinsurance rate was enforced for people who reached the age of 70 after April 2014.

Recently, several studies have reported the effects of reducing the coinsurance rate from 30% to 10% for medical care on demand among Japanese aged 70 years and older

(Shigeoka, 2014; Fukushima et al., 2016). However, that situation is unclear following the coinsurance rate revision in 2014. Thus, determining the effects of the coinsurance rate revision by comparison with the previous coinsurance rate would have important policy implications in health-care economics.

Accordingly, the present study aimed to estimate the economic impacts of the coinsurance rate revision on health-care resource utilization. It did so by conducting an interrupted time-series analysis of employee health insurance claims data.

Materials and methods

2-1. Data sources

The data of health insurance beneficiaries aged 70 years in FY 2013 or 2014 and their claims data were obtained from the claims database of the Fukuoka branch of the Japanese Health Insurance Association. Individuals who obtained or lost quantification for health insurance the year before or after their birthday were excluded. Finally, 11,367 beneficiaries were selected as the study subjects.

2-2. Study variables

I categorized subjects who were born in FY 1943 and whose coinsurance rates were to decrease to 10% the following month upon reaching the age of 70 years into the 20%-(coinsurance rates) reduction group; I classified those who were born in FY 1944 and whose coinsurance rates decreased to 20% into the 10%-reduction group. I employed medical expenditure and the number of outpatient visits or the length of inpatient stay as the main outcome variables. Those variables were also separately measured according to inpatient and outpatient settings. I used the exchange rate in 2010 (US$1 = 87.75 yen) for easy comparison with the study results reported by Fukushima et al (Fukushima et al., 2016).

2-3. Econometric framework and estimation strategy

I assigned the 10%-reduction group as the control group (reference) and the 20%-reduction group as the assigned treatment group. I employed an interrupted time-series analysis (ITSA) for multiple groups to compare trends for health-care resource utilization before and after the intervention (coinsurance rate reduction at 70 years). The visual depiction of multiple group ITSA was shown in Figure 1.

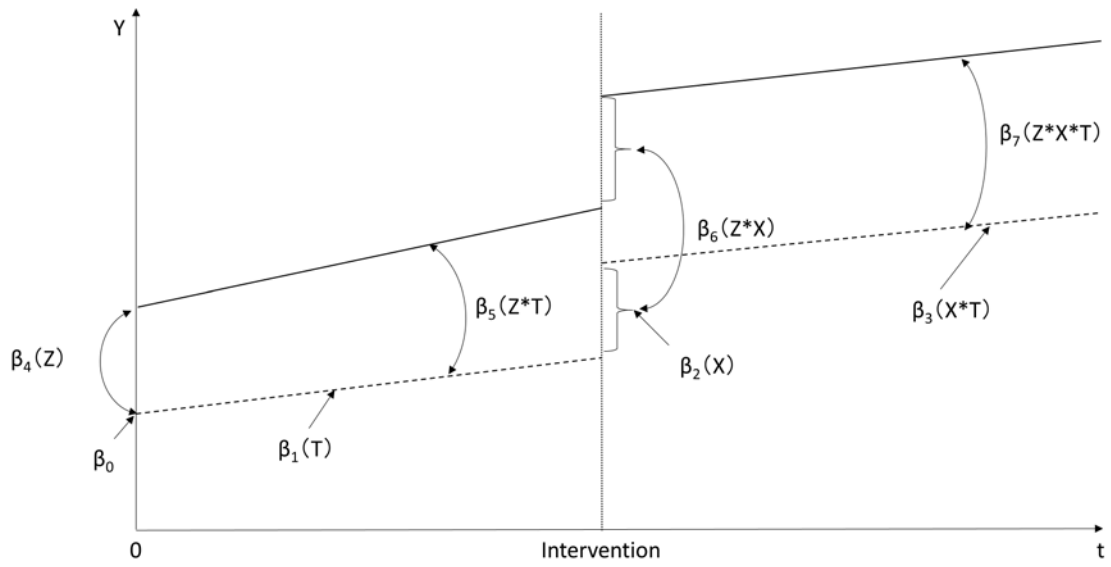

Figure 1. Visual depiction of multiple group ITSA

The ITSA model used the following equation (Linden and Adams, 2011):

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \beta_4 Z + \beta_5 Z T_t + \beta_6 Z X_t + \beta_7 Z X_t T_t + \varepsilon_t$$

where Y_t is the outcome measure along time t; T_t is a time variable from the point when the study began; X_t is a dummy variable indicated as 0 before and 1 after the intervention; Z is a dummy variable for assignment to 0, the control, or 1, the treatment group. β_0 to β_3

represent trends in the control group as follows: β_0, intercept; β_1, slope before the intervention; β_2, change in the trend caused by the intervention; β_3, coefficient of the interaction between X_t and T_t, the slope after the intervention. β_4 to β_7 represent differences between the control and treatment groups as follows: β_4, difference in the intercepts; β_5, difference in the slopes before the intervention; β_6, difference in the changes caused by the intervention; β_7, difference in the slopes after the intervention (Linden and Adams, 2011). After the individual data were summarized, I generated the ITSA dataset by aggregating individual data by month.

I performed all statistical analyses using Stata for Windows, version 15.1 (Stata Corp, College Station, TX, USA). I used the *itsa* command (Linden and Arbor, 2015).

2-4. Ethical considerations

According to the Ethical Guidelines for Medical and Health Research Involving Human Subjects in Japan, the need to obtain informed consent for this study was waived; that was because the study used a retrospective cohort, and the analyzed data were anonymized (Ministry of Education, Culture, Sports, Science and Technology, and Ministry of Health, Labour and Welfare, 2014). This study was approved by the Kyushu University Institutional Review Board for Clinical Research (No. 28-84).

Results

3-1. Descriptive statistics

Descriptive statistics of the study subjects appear in Table 1. The gender proportions and average standard monthly income were similar in the two groups. The 20%-reduction group had higher medical expenditure during the 2-year study period (approximately $176) than the 10% group. This difference was largely due to outpatient expenditure (approximately $167). Similarly, there was a difference in the number of outpatient visits and the length of

inpatient stays (approximately 4 days).

3-2. Estimation by ITSA models

Table 2 presents the results obtained with the ITSA. The intervention led to a significant increase in overall and outpatient medical expenditure: the coefficient representing the change in the trend caused by the intervention in the control group (β_2) was 34.282 overall and 19.150 for outpatients (P = 0.013, P <0.001, respectively). Conversely, there were no significant differences with the inpatient setting. Further, significant differences in the change caused by the intervention were evident in outpatient medical expenditure: β_6 was 16.445 (P = 0.042). An increased trend after the intervention was observed in the overall and inpatient settings: β_7 was –6.445 overall (P = 0.042) and –6.832 for inpatients (P = 0.023).

As shown in Table 3, there was a significant increase in overall number of treatment days and physician visits: β_2 overall, 0.104, P = 0.002; for outpatients, 0.087, P = 0.003, respectively. The 20%-reduction group had more frequent physician visits after the intervention than the 10%-reduction group: β_6 overall, 0.194, P = 0.001; for outpatients, 0.185, P <0.001, respectively. The 20%-reduction group showed a significantly sharper upper trend after the intervention than the 10% group for outpatients (β_7 for outpatients, –0.010, P = 0.019); however, there were no significant differences overall and for number of inpatient days.

Figures 2–4 present the observed and predicted values according to the treatment setting. The solid lines and filled circles indicate the 20%-reduction group; the dotted lines and open circles show the 10%-reduction group.

Table 1. Descriptive statistics of study subjects

	Coinsurance rate reduction					
	20% reduction (n =5,488)			10% reduction (n =5,877)		
Sex, n (%)						
Male	2,497	(45.5%)		2,680	(45.6%)	
Female	2,991	(54.5%)		3,197	(54.4%)	
Standard monthly income, mean (SD), $	3,087.4	(2,380.6)		3,123.0	(2,460.1)	
Medical expenditure, mean (SD),$						
Overall	9,409.4	(16,544.1)		9,233.2	(16,968.6)	
Inpatients	3,462.5	(12,433.7)		3,453.6	(12,904.0)	
Outpatients	5,946.8	(8,561.2)		5,779.5	(8,783.8)	
No. of outpatient visits/length of inpatient stay, mean (SD)						
Overall	50.7	(61.6)		47.6	(60.9)	
Inpatients	6.5	(31.1)		6.7	(35.2)	
Outpatients	44.3	(50.9)		40.9	(47.8)	

SD, standard deviation.

Table 2. Results for medical expenditure by ITSA

	Overall			Inpatients			Outpatients		
	Coeff.	SE	*P* value	Coeff.	SE	*P* value	Coeff.	SE	*P* value
β_0	351.583	5.894	<0.001	141.706	7.370	<0.001	209.877	2.273	<0.001
β_1	-0.253	1.056	0.812	-2.151	1.109	0.060	1.899	0.339	<0.001
β_2	34.282	13.233	0.013	15.131	10.761	0.167	19.150	4.235	<0.001
β_3	6.872	1.526	<0.001	7.043	1.423	<0.001	-0.172	0.602	0.777
β_4	-13.631	9.866	0.175	-20.307	9.719	0.043	6.675	3.501	0.064
β_5	2.409	1.623	0.146	3.184	1.495	0.039	-0.775	0.672	0.256
β_6	22.246	23.529	0.350	5.800	19.273	0.765	16.445	7.835	0.042
β_7	-6.445	3.069	0.042	-6.832	2.896	0.023	0.387	0.892	0.667

SE, standard error.

Table 3. Results for physician visits by ITSA

	Overall			Inpatients			Outpatients		
	Coeff.	SE	*P* value	Coeff.	SE	*P* value	Coeff.	SE	*P* value
β_0	1.821	0.014	<0.001	0.262	0.008	<0.001	1.558	0.020	<0.001
β_1	0.009	0.002	<0.001	-0.001	0.001	0.228	0.010	0.003	0.001
β_2	0.104	0.031	0.002	0.017	0.011	0.137	0.087	0.028	0.003
β_3	0.003	0.003	0.354	0.009	0.002	<0.001	-0.006	0.003	0.079
β_4	0.096	0.029	0.002	-0.040	0.009	<0.001	0.136	0.033	<0.001
β_5	-0.004	0.004	0.349	0.005	0.002	0.006	-0.009	0.005	0.092
β_6	0.194	0.055	0.001	0.009	0.026	0.715	0.185	0.047	<0.001
β_7	-0.005	0.006	0.413	-0.010	0.004	0.019	0.005	0.006	0.368

SE, standard error.

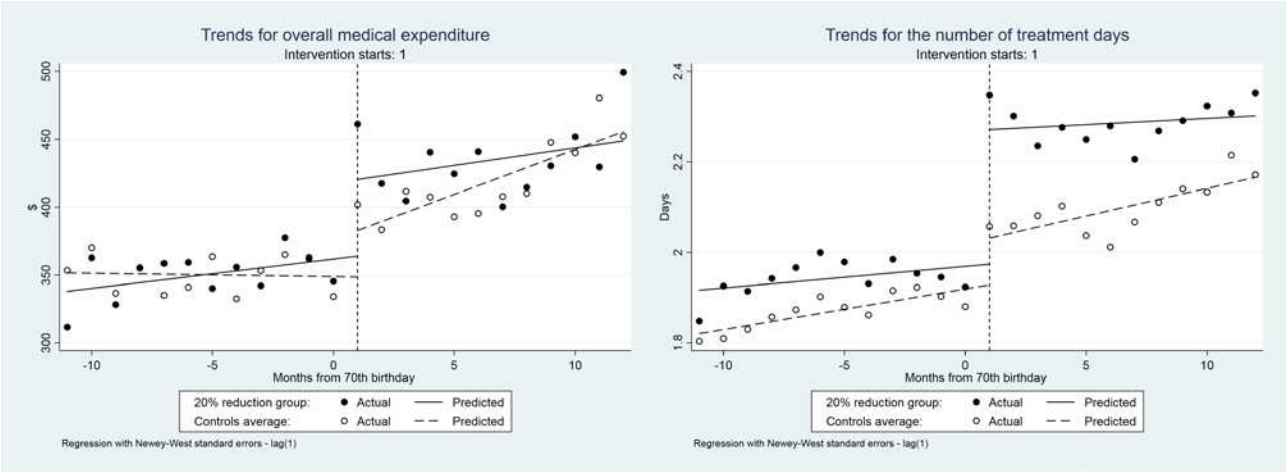

Figure 2. Trends for overall medical expenditure and number of treatment days before and after the month reaching the age of 70 years (per month, per person, unit: US dollars, days).

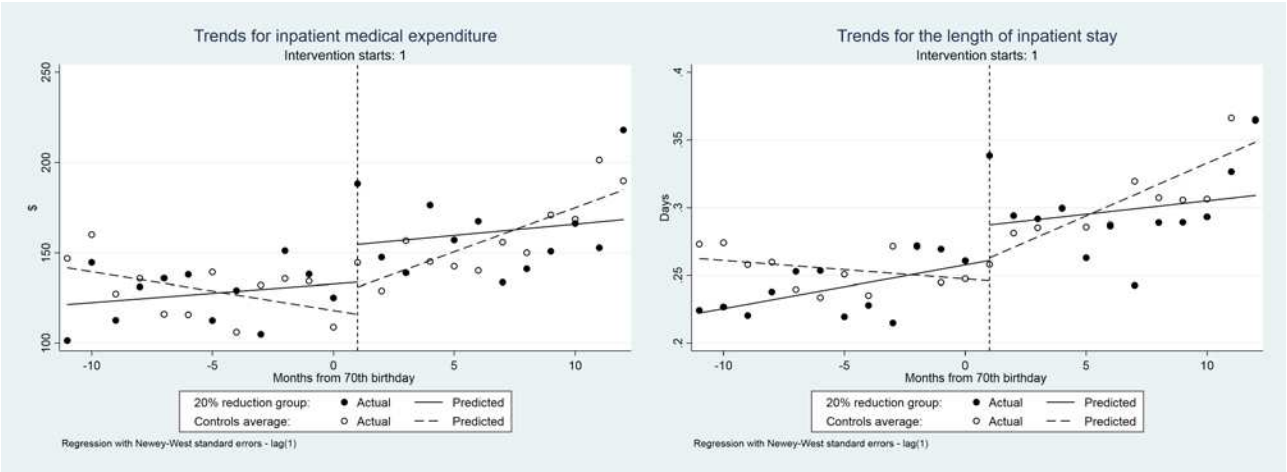

Figure 3. Trends for inpatient medical expenditure and length of inpatient stay before and after the month reaching the age of 70 years (per month, per person, unit: US dollars, days).

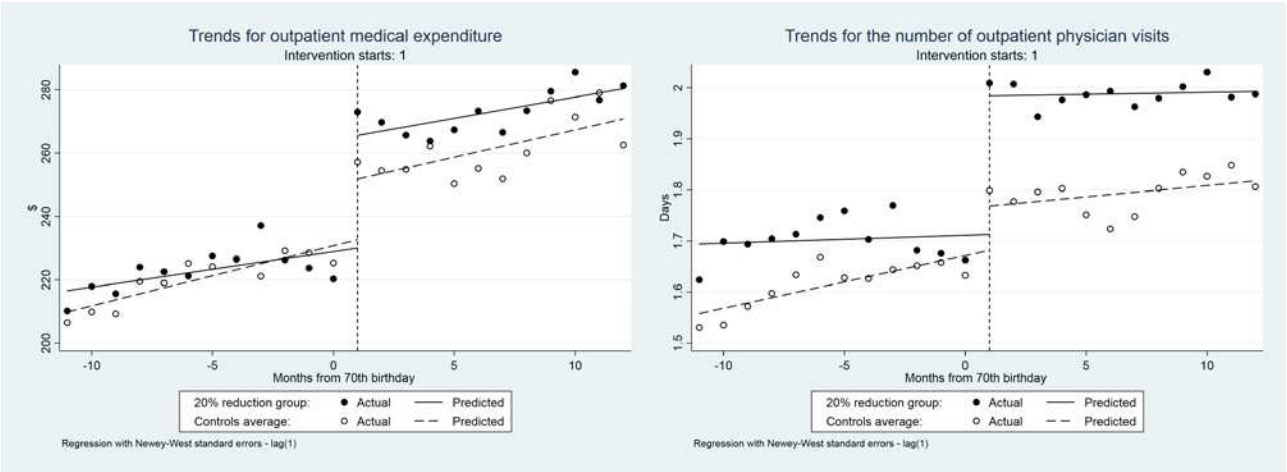

Figure 4. Trends for outpatient medical expenditure and number of physician visits before and after the month reaching the age of 70 years (per month, per person, unit: US dollars, days).

Discussion

4-1. Main study findings

Previous studies have reported the effect in Japan of coinsurance reduction from 30% to 10% at the age of 70 years on medical expenditure (Shigeoka, 2014; Fukushima et al., 2016). In the present study, I found that the coinsurance reduction from 30% to 20% also had an impact on utilization of overall and outpatient health-care resources. Further, I observed that the impact was smaller than with the 20% reduction.

4-2. Comparison with previous studies

Unlike previous investigations, the present study evaluated not just the effects of decreased coinsurance at age 70 on health-care resource utilization under the revised coinsurance rate; it also examined the differences in the period before and after coinsurance rate revision. Substantial differences were evident in overall medical expenditure immediately after reaching the age of 70; however, they gradually diminished along with increased inpatient medical expenditure. The conditions that demand inpatient care are severe or critical; thus, the effects of decreased coinsurance on inpatient health-care resource utilization should be weaker than with outpatient care. Further, health insurance beneficiaries can receive catastrophic coverage as shown in table 4.

Table 4. The amounts of catastrophic coverage

	Catastrophic coverage: maximum out-of-pocket expenditure per month (yen)	
	Outpatient	Inpatient
High income	44,000	80,100 + (medical expenditure − 267,000)×1%
Regular income	12,000	44,000
Low income II	8,000	24,600
Low income I (beneficiaries exempt from resident tax)		15,000

Since such inpatient medical expenditure would likely be expensive, inpatient health-care resource utilization would be affected by out-of-pocket caps associated with catastrophic coverage.

4-3. Limitations and future challenges

This study has several limitations. First, the study subjects did not include beneficiaries of National Health Insurance, which is the most popular insurer for people aged 65–74 years in Japan. Second, the observation periods in this study were shorter than with previous investigations. Thus, further research should be implemented to reveal the effects of coinsurance rates decreasing to 10% at age 75 years. Third, the sample size of this study was smaller than with previous reports; thus, sub-analyses, such as analyses by clinical departments, could not be performed.

However, the present investigation using claims data has several advantages, including applicability for generations other than those examined in this study, applicability to health-care system reform and fee schedule revisions, and changes in detailed treatment patterns. As an example of investigation in other generations, one study in Japan has examined the effects of reduced cost sharing on children's health using data from the Comprehensive Survey of Living Conditions (Takaku, 2016). However, a study using claims data of public subsidiaries would allow an analysis of the effect of the increased coinsurance rate on health demand among pre-school-aged children upon reaching the age of 6 years. Further, the claims data approach could be used with public health promotion: one example would be analyzing changes in the number of pneumonia-related hospitalizations and expenditure every 5 years following mandatory pneumococcal vaccination for people aged 65 years or older. From the perspective of pharmaco-economics, the claims data approach would allow investigation of certain aspects of patient behavior, such as switching from a generic to a brand-name drug in

accordance with coinsurance reduction.

4-4.Conclusion

In conclusion, I clarified that increasing the coinsurance rate among the elderly in Japan would reduce outpatient health-care resource utilization; however, it would not necessarily reduce overall health-care resource utilization.

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