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Impact of improved price transparency on patients' demand of healthcare services

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ABSTRACT

Evidence is limited and mixed as to how improved price transparency affects patients' demand for healthcare. Price transparency usually affects both the supply and the demand side of healthcare. However, in Japan—where healthcare providers cannot compete on prices—we can examine an independent impact of price transparency on patients' demand for healthcare.

The aim of this study is to investigate the impact of improved price transparency on patients' demand for healthcare. We conducted an experiment by presenting patients with the “price list” of individual healthcare services. We provided the price list for a limited time and compared the healthcare spending and utilization of care between these patients who were provided the price list (patients who visited between the first and third week of January in 2016) versus those who were not (patients who visited during the same period in 2015 or 2017), adjusting for potential confounders. A total of 1053 patients were analyzed (27.5% were provided the price list).

We found that improved price transparency was associated with a higher total cost per patient (adjusted difference, +16.1%; 95%CI, +0.6% to +34.0%; p = 0.04). We also found that improved price transparency was associated with higher costs related to laboratory tests and imaging studies, and a larger total number of items of blood tests and urine tests. By conducting an experiment in a real-world setting, we found that improved price transparency paradoxically increased the utilization of healthcare services in Japan. These findings suggest that when prices are relatively low, as is the case in Japan, reduced uncertainty about the prices of healthcare service may make patients comfortable requesting more healthcare services.

1. Introduction

Evidence is limited as to how improved price transparency affects patients' demand for healthcare (Christense and Maffett, 2013; Castellucci and Livingston, 2019). The lack of price transparency in healthcare has been seen as one of the fundamental issues of healthcare, leading to information asymmetry between providers and patients and precluding patients from making rational choices about healthcare by weighing the costs and benefit of care they receive. Proponents of price transparency argue that improved transparency may allow patients to “shop” for a better price, promoting more competition between healthcare providers and consequently reduce healthcare expenditure (Volpp, 2016). However, others have argued that price transparency leads to lower healthcare spending only when their willingness-to-pay is lower than actual prices and therefore, when prices are relatively low, improved price transparency may actually lead to overutilization of healthcare services (Wong et al., 2010). Also, research indicates that only a small proportion of people who were provided the price transparency tool actually use the tool, suggesting that the improved price transparency may actually have little or no impact on patients' behavior (Gourevitch et al., 2017; Sinaiko et al., 2016). Given that many countries are seeking effective strategies for reducing healthcare expenditure without compromising the quality of care, empirical evidence about the real-world impact of improved price transparency on patients' demand of care is immensely helpful for policymakers to design health policies.

The evidence is limited and mixed as to how improved price

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transparency affects patients' demand for care (Sinaiko et al., 2016; Whaley et al., 2014; Desai et al., 2017; Sinaiko and Rosenthal, 2016). Literature suggests that many price transparency tools may be ineffective in lowering the cost of care, at least among the general population (Desai et al., 2017). On the contrary, previous studies that allowed participants to voluntarily decide whether or not to acquire access to the price transparency tools have shown to be effective in reducing spending (Desai et al., 2017). This contradicting evidence suggests that improved price transparency may lead to lower healthcare spending only among those individuals who are conscious about healthcare spending and willing to shop for a better price.

The price transparency impacts both the supply and demand of healthcare. For the supply side, price transparency makes healthcare providers compete on prices with the aim of attracting more patients. For the demand side, it affects patients' behavior, as patients may demand more or fewer healthcare services by knowing about their prices. If the actual price of care is lower than patients' willingness-to-pay, they may demand more care; whereas, if known prices are higher than patients' willingness-to-pay, their demand may decrease (Feldstein, 2012). In addition, reduced uncertainty (through improved information) about the prices may make patients more comfortable requesting healthcare services among the risk-averse patients (i.e., patients may refrain from requesting healthcare services due to concerns about potentially high prices when little information about prices is available). Therefore, whether or not improved price transparency leads to lower healthcare spending ultimately depends on the balance between the supply- and demand-side responses. However, previous studies—largely conducted in the United States—could not disentangle these two factors because improved price transparency inevitably led to higher competition between providers (Desai et al., 2017). In Japan, however, prices of healthcare services are set centrally by the government (and listed in the price list known as “national fee schedule”), and providers cannot compete based on price; therefore, the supply-side factors are unaffected by the improved price transparency. By exploiting this uniformly-set unit prices of healthcare services in Japan, we had a unique opportunity to investigate an isolated impact of improved information about prices on patients' demand for care.

The aim of this study to investigate an independent impact of improved price transparency on patients' demand of care at an outpatient clinic in Japan, by providing patients with information about the prices of healthcare services for a limited time, and examine the changes in the quantity of care consumed.

2. Methods

The institutional review board of St. Luke's International Hospital approved this study (approval number: 15-J021 and 18-R051). We conducted an experiment by presenting patients with information about prices of healthcare services at the outpatient clinic of a large, teaching hospital in Tokyo, Japan. All patients who visited the outpatient clinic were seen by general internists or primary care physicians between the first and third week of January in 2016. Patients were informed of prices of individual healthcare services using a price list (patients could choose not to read the list if they were not interested). The patients' demand of care was compared between patients who were informed about the prices of individual services and those who were not (comparable patients who visited the same clinic during the same time of the year in 2015 and 2017).

2.1. Intervention

Patients in the intervention group consisted of all patients who were treated for new-onset symptoms by a general internist or primary care physician at the outpatient clinic. All patients in the intervention group received written price information about individual healthcare service at the time of registration. Although all patients who visited during the intervention period received the price lists, they were allowed to ignore the list if they wished. The price information included both prices of individual healthcare services patients typically receive during the office visit and expected patient's out-of-pocket spending amount under a different level of co-insurance. These prices are set uniformly by the “Central Social Insurance Medical Council,” organized by the government of Japan; therefore, the unit price is exactly same for the same healthcare services, regardless of where patients seek care. In addition, we conducted anonymous surveys of the participants asking about the socioeconomic status, knowledge about price transparency for healthcare services, and their willingness to receive healthcare services after presenting price information (see online appendix for additional details).

The control group was comprised of all patients who were treated for new-onset symptoms at the outpatient clinic during the same time of the year (i.e., between the first and third week of January) in 2015 and 2017. Patients in the control group received usual care without information about the prices. Those who came to the outpatient clinic for the follow-up visits were excluded from both intervention and control groups.

2.2. Outcomes

Our primary outcomes were the patients' demand for care. The patients' demand for care was measured as individual costs of care for healthcare service and the quantity of care received by patients. Costs of care were defined as the total payment amount (the sum of out-of-pocket spending and the payment from the health insurance to the hospital) within one month from their initial visits, including both initial and the follow-up visits (if patients were seen by a physician multiple times for the same condition). Costs of care included only the cost of outpatient care even though a small proportion of patients consequently were admitted to the hospital after examination at the outpatient clinic. We conducted sub-analyses that focused separately on laboratory tests (blood and urine tests) and imaging studies (X-ray, CT, and MRI). Although changes were made to the national fee schedule in 2017, the prices of healthcare services studied were largely unaffected, except for prices of CT and MRI scans, which prices were reduced by approximately $1.80.

The utilization of care was measured as the quantity of healthcare services consumed by patients. The healthcare services included blood tests, urine tests, physiological tests (electrocardiogram and pulmonary function test), endoscopy (esophagogastroduodenoscopy and colonoscopy), bacterial culture tests (blood, urine, and sputum) and imaging studies (X-ray, CT, and MRI). We also conducted an analysis focusing on the total number of items of blood and urine tests for individual patients.

2.3. Adjustment variables

Adjustment variables included patient demographics, primary symptoms/diagnosis for the outpatient clinic visit, comorbidities, and patient's co-insurance level. Patient demographics included age at the time of visit and gender. Primary symptoms/diagnosis were categorized based on clinical classifications software for ICD-10-CM/PCS, developed by Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (H-CUP) (Project HCaU, 2018). Comorbidities were included as indicator variables for 27 comorbidities in the Elixhauser comorbidity index (Elixhauser et al., 1998). Patient co-insurance level was either 0%, 10%, 20%, 30% or 100%, based on their insurance coverage (determined largely by their age).

2.4. Statistical analysis

First, we compared patient baseline characteristics and level of co-insurance between intervention period (2016) and the control period

(2015 and 2017). Then, we compared the patients' demand for care between the treatment and control groups, after adjusting for potential confounders. We used multivariate generalized linear models with a negative binomial distribution and log-link function to account for a skewed distribution of costs and utilization data. We adjusted for the adjustment variables described above.

Finally, we examined the impact of price transparency on (A) the costs of care paid by the insurer, and (B) the costs of care by patients separately (i.e., out-of-pocket spending), after adjusting for potential confounders. All analyses were performed in 2018 by Stata 14.0 (Stata Corp, TX, USA).

3. Results

3.1. Participant's characteristics

A total of 1053 patients were included in our study; 290 (27.5%) presented to the outpatient clinic of the division in intervention period and 763 (72.5%) presented in control periods (376 in 2015 and 387 in 2017). Mean (standard deviation) age of total patients was 54.1 (20.0) years, and 404 (38.4%) were male. Patient baseline characteristics are shown in Table 1. Patients who presented in the intervention period were significantly older than those in control periods and had more valvular disease. Other characteristics, including gender, level of patient co-insurance, and Elixhauser comorbidities index (except for valvular disease), were similar between two groups.

Table 2 presents the comparison of primary symptoms/diagnosis between patients in the intervention versus control groups. Patients in the intervention group were more likely to have a diagnosis of the nervous system and sense organs, and a diagnosis of the musculoskeletal system and connective tissue, but less likely to have a diagnosis of the respiratory system, compared to those in the control group.

3.2. Improved price transparency and the costs/utilization of care

After adjusting for potential confounders, total costs of care in the intervention group was significantly higher than that of the control group (adjusted costs per patient, $91.20 for the intervention group vs. $78.60 for the control group; adjusted percentage difference, +16.1%; 95%CI, +0.6% to +34.0%; $p = 0.04$) (Table 3). We also found significantly higher costs of laboratory tests (adjusted percentage difference, +28.8%; 95%CI, +11.1% to +49.4%; $p < 0.01$) and costs of imaging studies (adjusted percentage difference, +38.4%; 95%CI, +17.8% to +62.6%; $p < 0.01$).

As for the utilization of care, patients in the intervention group received a larger total number of blood tests (adjusted percentage difference, +52.8%; 95%CI, +30.5% to +78.8%; $p < 0.01$), and a larger total number of items of urine test (adjusted percentage difference, +46.9%; 95%CI, +7.6% to +100.5%; $p = 0.02$), compared to patients in the control group. We found no evidence that the intervention group and the control group differ for other types of utilization.

3.3. Costs/utilization of care incurred by the insurers versus patients

We found a significantly higher total cost of care incurred by the insurers (adjusted percentage difference, +18.0%, 95%CI, +2.1% to +36.3%; $p = 0.03$) in the intervention group compared to the control group (Table 4). On the other hand, we found no evidence that out-of-pocket spending differed between the intervention and control groups (adjusted percentage difference, +9.5%, 95%CI, −5.4% to +26.9%; $p = 0.23$).

3.4. Anonymous survey results

Among patients in the intervention group, 23% responded to an anonymous survey about the knowledge and attitude with regard to the cost of healthcare services. More than 80% reported that they had little or no knowledge about the cost of healthcare services. Common factors affecting patient's demands of care were physician's recommendation (92%), followed by the recommendation by their relative or friend (79%), and price of healthcare services (56%). After exposed to the price list, 23% reported that they were willing to receive more healthcare services, while 16% reported that they were willing to decline some healthcare services.

Table 1
Baseline patient characteristics between the intervention and control groups.

	Intervention group (n = 290)	Control group (n = 763)	p value
Age, year (SD)	56.3 (19.5)	53.2 (20.2)	**0.02**
Male, n (%)	112 (38.6)	292 (38.3)	0.92
Patients' co-insurance level, n (%)			0.23
0%	7 (2.4)	31 (4.1)	
10%	48 (16.6)	95 (12.5)	
20%	3 (1.0)	11 (1.4)	
30%	219 (75.5)	578 (75.8)	
100%	13 (4.5)	48 (6.3)	
Elixhauser comorbidities index, n (%)			
Congestive cardiac failure	5 (1.7)	10 (1.3)	0.57
Cardiac arrhythmia	17 (5.9)	49 (6.4)	0.89
Valvular disease	11 (3.8)	12 (1.6)	**0.03**
Pulmonary circulation disease	4 (1.4)	4 (0.5)	0.23
Peripheral vascular disease	16 (5.5)	33 (4.3)	0.42
Arterial hypertension	64 (22.1)	138 (18.1)	0.16
Arterial hypertension with complications	4 (1.4)	6 (0.8)	0.48
Paralysis	0 (0.0)	1 (0.1)	1.00
Other neurological disease	73 (25.2)	224 (29.4)	0.19
Chronic pulmonary disease	3 (1.0)	8 (1.1)	1.00
Hypothyroidism	8 (2.8)	30 (3.9)	0.46
Kidney failure	10 (3.5)	19 (2.5)	0.40
AIDS	0 (0.0)	0 (0.0)	1.00
Lymphoma	1 (0.3)	3 (0.4)	1.00
Cancer with metastasis	5 (1.7)	5 (0.7)	0.15
Tumor	96 (33.1)	259 (33.9)	0.83
Rheumatic diseases	5 (1.7)	13 (1.7)	1.00
Coagulopathies	1 (0.3)	3 (0.4)	1.00
Obesity	3 (1.0)	7 (0.9)	1.00
Weight loss	0 (0.0)	1 (0.1)	1.00
Hydro electrolytic imbalance	0 (0.0)	0 (0.0)	1.00
Iron-deficiency anemia	24 (8.3)	74 (9.7)	0.55
Alcohol abuse	2 (0.7)	3 (0.4)	0.62
Drug abuse	0 (0.0)	2 (0.3)	1.00
Psychosis	21 (7.2)	45 (5.9)	0.48
Depression	24 (8.3)	59 (7.7)	0.80
Diabetes	26 (9.0)	78 (10.2)	0.64
Diabetes with complications	7 (2.4)	16 (2.1)	0.81
Liver disease	3 (1.0)	19 (2.5)	0.23
Peptic ulcer without bleeding	66 (22.8)	177 (23.2)	0.94
Anemia due to bleeding	0 (0.0)	0 (0.0)	1.00

The p values were calculated between intervention group and control group.

4. Discussion

By conducting an experiment in a real-world setting, we found that the costs and utilization of care, including the utilization of the numbers of laboratory tests, paradoxically increased when price transparency of healthcare services improved. Although healthcare providers in Japan, in theory, can still compete on other margins of healthcare (e.g., on the quality of care), patients were unlikely to select the provider based on other relevant characteristics (e.g., previous experience with the provider, distance to the provider), because we provided the information on prices to patients after they visited hospitals and prices do not vary between providers in Japan. Therefore, observed changes in patients'

Table 2
Clinical classification of diseases between the intervention and control groups.

	Intervention (n = 290)	Control (n = 763)	p value
Disease classification based on ICD-10, n (%)			
Infectious and parasitic diseases	10 (3.5)	18 (2.4)	0.39
Neoplasms	4 (1.4)	6 (0.8)	0.48
Endocrine; nutritional; and metabolic diseases and immunity disorders	15 (5.2)	54 (7.1)	0.33
Diseases of the blood and blood-forming organs	2 (0.7)	8 (1.1)	0.74
Diseases of the nervous system and sense organs	33 (11.4)	56 (7.3)	< **0.05**
Diseases of the circulatory system	25 (8.6)	56 (7.3)	0.52
Diseases of the respiratory system	74 (25.5)	259 (33.9)	< **0.01**
Diseases of the digestive system	69 (23.8)	171 (22.4)	0.62
Diseases of the genitourinary system	7 (2.4)	16 (2.1)	0.81
Complications of pregnancy; childbirth; and the puerperium	0 (0.0)	0 (0.0)	1.00
Diseases of the skin and subcutaneous tissue	5 (1.7)	9 (1.2)	0.55
Diseases of the musculoskeletal system and connective tissue	26 (9.0)	39 (5.1)	**0.03**
Congenital anomalies	0 (0.0)	1 (0.1)	1.00
Certain conditions originating in the perinatal period	1 (0.3)	0 (0.0)	0.28
Injury and poisoning	0 (0.0)	2 (0.3)	1.00
Symptoms; signs; and ill-defined conditions and factors influencing health status	13 (4.5)	35 (4.6)	1.00
Residual codes; unclassified; all E codes [259. and 260.]	4 (1.4)	21 (2.8)	0.26
Mental Illness	3 (1.0)	12 (1.6)	0.77

utilization of care arguably are explained primarily by the patients' demand-side changes due to improved price transparency. These findings indicate that when the unit price of healthcare services is relatively low, as is the case in Japan, reduced uncertainty about the prices of healthcare services may make patients (especially those who are risk-averse) more comfortable requesting additional tests and imaging studies, resulting in higher healthcare expenditure. These findings highlight the importance of understanding how improved price transparency influences patient behavior, indicating the possibility that the utilization of care may actually increase for relatively low-price services when hospitals are required to post their prices publicly.

There are several potential reasons why our findings were different from previous studies that showed modest reductions in the use of imaging studies and laboratory tests among patients who actively used the transparency tools (Sinaiko et al., 2016; Whaley et al., 2014; Desai et al., 2017). First, in the U.S. market, these price reductions can stem both from the demand- and supply-side of healthcare. Patients who were given information about prices might switch to low-priced providers (i.e., informed patients might "shop" for a better price) (Victoor et al., 2012). While providers under price competition in the market, may lower their prices with the aim of attracting more patients (van der Geest and Varkevisser, 2016). However, in Japan, the unit prices of healthcare services are centrally set by the government using the "national fee schedule," under which patients have no incentive to shop for healthcare providers for lower prices (prices are the same regardless of the healthcare providers) (Matsuda, 2019). These findings suggest that an independent impact of price transparency on patients' demand may be different from a combined impact of price transparency on both the supply and demand sides.

Second, the impact of the price transparency may be different from patients who opt-in (enrolled to learn about the prices of healthcare services) and patients who opt-out. Patients were allowed to opt-out in this study, if they prefer not to know about the prices of healthcare services. In previous studies, however, patients decided to opt-in when they were interested to know about the prices (Sinaiko et al., 2016; Whaley et al., 2014; Desai et al., 2017). It is possible that patients who opted-in and actually used the price transparency tools may be more price-conscious than the general population who were provided of price transparency regardless of their interest (and allowed to opt-out if they chose not to know the prices)—who were the target population of our study (Gourevitch et al., 2017; Bentley et al., 2008). Moreover, it is also possible that by presenting the price list to patients, they became aware

Table 3
The impact of improved price transparency on the costs of care, the utilization of healthcare services.

	Adjusted values (95%CI)			
	Intervention group	Control group	Adjusted percentage difference (95%CI)	p-value
Costs of care				
Total costs of care[a]	$91.2 ($79.8 to $102.7)	$78.6 ($72.5 to $84.7)	+16.1% (+0.6% to +34.0%)	0.04
Cost of care[a] for laboratory tests	$42.2 ($36.5 to $47.9)	$32.7 ($29.9 to $35.6)	+28.8% (+11.1% to +49.4%)	< 0.01
Cost of care[a] for imaging services	$34.1 ($27.8 to $40.4)	$24.3 ($20.8 to $27.8)	+38.4% (+17.8% to +62.6%)	< 0.01
Utilizations of healthcare services				
Laboratory tests				
Blood test	47.0% (36.8%–57.1%)	38.2% (32.9%–43.5%)	+23.2% (−4.9% to +59.5%)	0.12
Total number of items of blood test	7.9 items (6.8 items to 9.0 items)	5.2 items (4.7 items to 5.7 items)	+52.8% (+30.5% to +78.8%)	< 0.01
Urine test	17.1% (11.4%–22.8%)	12.8% (9.9%–15.8%)	+33.4% (−11.2% to +100.4%)	0.17
Total number of items of urine test	0.4 items (0.3 items to 0.5 items)	0.3 items (0.2 items to 0.3 items)	+46.9% (+7.6% to +100.5%)	0.02
Bacterial culture test	2.7% (0.7%–4.7%)	4.7% (2.6%–6.9%)	−42.9% (−76.5% to +38.7%)	0.22
Imaging services				
X-ray	26.0% (19.0%–33.0%)	23.1% (19.1%–27.0%)	+12.8% (−18.2% to +55.6%)	0.46
CT scan	6.2% (2.6%–9.8%)	3.9% (2.4%–5.4%)	+59.4% (−22.1% to +226.4%)	0.20
MRI	1.2% (−0.3%–2.7%)	1.3% (0.1%–2.4%)	−7.7% (−83.9% to +428.1%)	0.93
Physiological test	12.1% (7.3%–16.8%)	9.5% (6.9%–12.0%)	+27.9% (−20.9% to +107.0%)	0.32

Adjusted for age, gender, primary symptoms/diagnosis, 27 comorbidities (Elixhauser comorbidity index), and patients' co-insurance level.

[a] The costs of care were defined as the total payment amount (the sum of out-of-pocket spending and the payment from the health insurance to the hospital) within one month from their first visits.

Table 4
The impact of improved price transparency on the costs of care, by costs incurred by the insurers and by the patients (out-of-pocket).

	Out-of-pocket spending		Payment from the health insurance	
	Adjusted percentage difference (95%CI)	p-value	Adjusted percentage difference (95%CI)	p-value
Costs of care				
Total costs of care[a]	+9.5% (−5.4% to +26.9%)	0.23	+18.0% (+2.1% to +36.3%)	**0.03**
Cost of care[a] for laboratory tests	+25.8% (+7.7% to +46.9%)	< 0.01	+28.6% (+10.8% to +49.4%)	**< 0.01**
Cost of care[a] for imaging services	+50.5% (+26.1% to +79.6%)	< 0.01	+26.1% (+7.2% to +48.4%)	**< 0.01**

Adjusted for age, gender, primary symptoms/diagnosis, 27 comorbidities (Elixhauser comorbidity index), and patients' co-insurance level.
[a] The costs of care were defined as the total payment amount within one month from their first visits.

of many options of healthcare services that have not come to their mind otherwise. For example, a patient with a headache may come and see a physician not knowing exactly what kinds of examinations are necessary to identify the cause of a headache. However, by seeing CT and MRI on the list and being aware that those imaging studies are available at relatively affordable prices, this patient may request these imaging studies to reduce concerns about critical conditions such as intracranial bleeding and brain tumor. Patients may also feel more empowered to ask for specific tests and imaging studies once they learn about their prices.

Third, these findings may also be explained by the fact that the presented prices of services were lower than the anticipated prices (Lieber, 2017), which is plausible given relatively low unit prices of healthcare services in Japan. For instance, the price of blood test and urine test in Japan is $9-$45 and $2, respectively, which are significantly lower than average prices of these services in the U.S. (The Blue Cross and Blue Shield Association, 2009). For imaging studies, it costs $180-$270 for CT and $230-$360 for MRI (without contrast), which again is substantially lower than those in the U.S. (International Federation of Health Plans, 2015) In addition, the co-insurance rate is either 30% (for non-elderly adults) or 10% (e.g., for the elderly) for most people in Japan; therefore, patients pay only a small portion of the already affordable price of healthcare services, suggesting that the actual out-of-pocket spending for patients may be well under their willingness-to-pay for many healthcare services in Japan. Furthermore, risk-averse patients concerned with high medical costs, may avoid requesting tests and imaging studies. However, by knowing that prices are relatively affordable, these patients may demand larger and more sophisticated care (e.g., demand a CT scan instead of an X-ray). Although there are individuals who overestimate the prices of healthcare services and those who underestimate them, the number of people who overestimate may be larger than those who underestimate prices. In fact, the anonymous survey collected from the individuals included in the intervention group as part of our study showed that 23% reported having demanded more healthcare services after learning about individual healthcare prices whereas only 16% reported demanding less after knowing the prices. A conventional economic theory may explain this phenomenon in which risk-averse people will gain more utility if they are able to estimate their healthcare spending with high certainty. The literature suggests that Japanese people may be more risk-averse than people in other countries (in both gain and loss domains) (Rieger et al., 2014). Furthermore, our study sample included a large number of female elderly, who are known to be more risk-averse than male and the young (Agnew et al., 2008; Dohmen et al., 2011). These factors may explain why our findings were different from previous studies. This can also be explained by a behavioral economics theory, where decision makers derive utility from changes in wealth relative to some reference value (here, the reference value is patients' "prior" or anticipated prices of services before knowing the data) known as the "reference price effect" (Tversky and Kahneman, 1991). It is probable that the presented prices of healthcare services were lower than their "prior" (expectation) about prices. Although the overall price elasticity of demand in healthcare services is reported to be relatively low (e.g. −0.2 in the RAND Health Insurance Experiment (Newhouse and Insurance Experiment Group, 1993), previous study in Japan found that outpatient care, including laboratory test and diagnostic imaging in the outpatient setting, have higher price elasticity of demand than those services provided in the inpatient setting, explaining why learning about healthcare prices led to an increased demand of care in our study (Fukushima et al., 2016).

Our study had some limitations. First, the historical control (i.e., patients who visited the hospital in the same weeks in the prior year and the year after the intervention) may not serve as an appropriate counterfactual of the intervention group (Papageorgiou et al., 2017). However, we adjusted a comprehensive set of factors that can potentially influence the demand for care in our regression models. In addition, the results of our analyses showed relatively similar baseline characteristics between patients included the intervention versus control groups, suggesting that the bias due to the use of inappropriate historical control, if any, is small. Second, we were unable to study whether the observed change in patients' demand of care is due to the actual prices being lower than their willingness-to-pay or reduced uncertainty about prices made them more comfortable to request more care. Third, not all patients were affected by the improved price transparency, even if they visited the hospital during the intervention period, because patients were allowed to ignore the price list if they did not like to know about the prices. However, this would bias our estimates towards null, i.e., if all patients who were exposed to the price list actually learned about prices, the impact of the improved price transparency would be larger than what we observed. Fourth, although patients with considerable previous experience with the healthcare services may respond differently than those who had little or no experience, we could not examine this hypothesis due to the lack of patients' previous experience data. It is unlikely, however, that patients who visited the hospital in 2016 (the treatment group) are systematically more or less experienced with those healthcare services than patients visited in 2015 or 2017 (the control group); thus, we believe that this does not introduce biases in our estimates. Finally, given that this study was conducted in Japan, our findings may not be generalizable to improved price transparency in other counties with different health systems.

In summary, by conducting an experiment in the real-world setting, we found that improving price transparency in the outpatient setting may paradoxically increase the costs and utilization of care healthcare services consumed by patients, including the laboratory tests and imaging studies. Our findings suggest that when the unit prices are relatively low and when patients are not required to ration their care due to costs—as is the case in Japan—improved transparency may lead to higher demand of care and higher healthcare expenditure.

Contributors

All authors contributed to the design and conduct of the study, data collection and management, interpretation of the data; and preparation, review, and approval of the manuscript. DK had full access to the data and conducted the statistical analysis.

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None.

Conflicts of interest

All authors have completed the ICMJE uniform disclosure form at (available on request from the corresponding author) and declare no competing interest.

Data sharing

No additional data available.

Transparency statement

The corresponding author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies are disclosed.

Conflicts of interest

All authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2019.112390.

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