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Reference Pricing, Consumer Cost-Sharing, and Insurer Spending for Advanced Imaging Tests

James C. Robinson, PhD, Christopher Whaley, PhD, and Timothy T. Brown, PhD

Background: Fees charged for similar imaging tests often vary dramatically within the same market, leading to wide variation in insurer spending and consumer cost-sharing. Reference pricing is an insurance design that offers good coverage to patients up to a defined contribution limit but requires the patients who select high-priced facilities to pay the remainder out of pocket.

Objectives: To measure the association between implementation of reference pricing and patient choice of facility, test prices, out-of-pocket spending, and insurer spending for advanced imaging (CT and MRI) procedures.

Research Design: Difference-in-differences multivariable analysis of insurance claims data. Study included 4751 employees of a national grocery chain (treatment group) and 23,428 enrollees in the nation's largest private insurance plan (comparison group) that used CT or MRI tests between 2010 and 2013.

Measures: Patient choice of facility, price paid per test, patient out-of-pocket cost-sharing, and employer spending.

Results: Compared with trends in prices paid by insurance enrollees not subject to reference pricing, and after adjusting for characteristics of tests and patients, implementation of reference pricing was associated with a 12.5% (95% CI, -25.0%, 2.1%) reduction in average price paid per test by the end of the second full year of the program for CT scans and a 10.5% (95% CI, -16.9%, 3.6%) for MRIs. Out-of-pocket cost-sharing by patients declined by \$71,508 (13.8%). The savings accruing to employees amounted to 45.5% of total savings from reference pricing, with the remainder accruing to the employer.

Conclusions: Implementation of reference pricing led to reductions in payments by both employer and employees.

Key Words: reference pricing, cost-sharing, imaging, price variation

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The past 2 decades have witnessed significant innovation in imaging technology, permitting ever more accurate and less-invasive screening for risk and diagnosis of disease. On the basis of a retrospective analysis of several large integrated health systems across the United States, computed tomography (CT) scans have grown from 52 per 1000 enrollees in 1996 to 149 per 1000 in 2010 (7.8% annual increase), whereas magnetic resonance imaging (MRI) procedures have grown from 17 per 1000 enrollees in 1996 to 65 per 1000 in 2010 (10% annual growth).¹

This rapid diffusion has raised concerns, however, about clinical appropriateness. Rapid diffusion and utilization increase the potential for overdiagnosis, the identification of subclinical pathologies that will never result in meaningful disease.² Patients also are exposed to radiation and to the clinical and psychological side effects of the follow-on tests, biopsies, and surgical procedures. For these reasons, advanced imaging has been one of the principal targets of the “Choosing Wisely” campaign sponsored by the American Board of Internal Medicine (ABIM) and other professional societies.^{3,4}

The concern with inappropriate utilization derives in part from the financial incentives facing the physicians and hospitals that administer imaging tests. The cost of the imaging equipment is substantial, with the price of CT and MRI machines exceeding \$1 million, while the cost of each image is inconsequential.⁵ Once a facility or professional practice has acquired a machine, there is a strong incentive to run as many tests per day as possible.

The association between profitability, incentives for equipment acquisition, and subsequent growth of volume has focused insurers' attention on the prices paid for imaging procedures.^{6,7} Prices charged for imaging procedures vary widely across physician-owned, freestanding, and hospital-based centers, and they typically far exceed the rates paid by Medicare. Lacking Medicare's ability to unilaterally control prices, private payers are raising consumer cost-sharing in the hopes that price-conscious decision-making will channel volume to more efficient providers and induce price competition in the market.⁸

The most common cost-sharing strategy is to raise the annual deductible that consumers must satisfy before being eligible for insurance reimbursement. In 2015, 46% of covered workers were enrolled in health coverage with an individual deductible of \$1000 or more. Some insurers and self-insured employers have begun experimenting with reference pricing as a new benefit design that targets high-priced providers while supporting access to lower-priced

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competitors. Under reference pricing, the sponsor establishes a maximum contribution it will make toward payment for a procedure, with the enrollee or employee required to pay the remainder. The contribution limit is set at the median or other intermediate point on the distribution of prices in the relevant geographic market.

This study evaluates the impact of a reference-pricing initiative for CT and MRI tests that was implemented by a large, self-insured employer, measuring trends in prices paid, consumer cost-sharing, and employer expenditures. The study compares these trends to those in a matched patient sample from a national insurer that did not use reference pricing for imaging tests.

METHODS

Data on Patients and Procedures

Claims data on type, volume, place of service, and price of CT and MRI procedures were obtained from Safeway, a national chain of retail grocery stores and food-processing factories in the United States. In November of 2011, Safeway implemented reference pricing for imaging services for its self-insured health plan. Unionized employees were excluded because their insurance was governed by collective bargaining contracts negotiated before the development of reference pricing. We obtained claims from January 2010 through December 2013, containing 20 months of claims experience before implementation and 26 months of experience after implementation of reference pricing.

Safeway established a maximum reimbursable amount for each imaging procedure and geographic market. In each market, the reference price was set at approximately the 60th price percentile in 2010, the year before the program's implementation. The 60th percentile reflects Safeway's efforts to balance the potential for spending reductions with the desire to uphold patient choice and access. The prices used by Safeway were those negotiated by CIGNA, the national insurer that administered Safeway's self-insured plan. Employees who received a procedure from an imaging provider that had negotiated a price below or equal to the reference price were responsible only for the plan's standard cost-sharing (eg, deductible). Employees who selected an imaging provider with negotiated prices above the reference price limit, however, were responsible for standard cost-sharing plus the full difference between the provider's price and Safeway's contribution limit.

Safeway only applied the reference pricing initiative to nonemergency imaging services, that is, cases when the patient had the opportunity to choose among alternative providers. The initiative excluded imaging tests received in inpatient and emergency department settings. To navigate the program, patients were given access to an online price transparency tool developed by Castlight Health. This tool presented the prices applicable to Safeway employees (eg, the CIGNA allowed charge and expected patient cost-sharing), not the facility's list price, the prices charged to other insurers, or an average of all prices charged. Patients were permitted to use high-priced providers without extra charge if their physicians indicated clinical reasons or if the patient

lived in a remote area without reasonable access to a low-priced alternative.

Theoretically, reference pricing could either increase or decrease patient out-of-pocket spending. To the extent Safeway employees responded to the new initiative by switching to providers charging low prices, they would avoid the supplemental reference pricing payment and also reduce their deductible obligation. However, to the extent employees continued using high-priced providers, they would add to their out-of-pocket cost-sharing obligation.

To control for trends in the market for advanced imaging that occurred during the same period as reference pricing, we obtained 2010–2013 CT and MRI claims data from Anthem Inc., the nation's largest private health insurance plan. For computational efficiency, we limited the size of the Anthem comparison group by matching 10 Anthem claims to each Safeway claim at the 3-digit zip geographic code, Current Procedural Terminology (CPT) code, and year level.

Patient demographics included patient age, sex, and 3-digit zip code. Patients over the age of 64 were excluded. The price data included the paid amount (allowed charge) and, separately, the amount paid by the employer and the amount paid by the patient.

Statistical Methods

To illustrate the variation across providers in the prices charged to Safeway for the same test, we measured the 5th percentile, 25th percentile, median, 75th percentile, and 95th percentile of the price distribution for the 10 tests with the highest spending in 2010. These 10 tests collectively accounted for 59.8% of total spending by Safeway on the CT and MRI procedures covered by reference pricing.

We used 4 endpoints in the analysis. The first measures the extent to which Safeway employees selected providers that charged less than or equal to the reference price in each year. The second measures the total price paid (allowed charge) to the facility. The third endpoint is the amount paid for the test by the patient under cost-sharing obligations. The fourth is the amount paid by Safeway (or Anthem, for patients not subject to reference pricing).

We analyzed the association between implementation of reference pricing and the 4 endpoints after adjusting for characteristics of the tests and patients using difference-in-differences multivariable regression analysis. Difference-in-differences analysis uses the same logic for observational data as is used in controlled trials featuring a treatment and a comparison group. Two differences are computed with respect to each endpoint: the change over time for the treatment group (Safeway) and the change over time for the comparison group (Anthem).

The difference-in-differences regressions adjust for test year, patient insurance provider (Safeway or Anthem), interaction terms between year and insurance, type of test (CPT code), patient age categories, sex, and zip code of residence. The price, patient cost-sharing, and insurer spending endpoints were analyzed using generalized linear model (GLM) regressions with a log link and a gamma-distributed error term. To calculate changes in financial

terms, we used the marginal effects of the GLM coefficients. Percentage changes were derived from the GLM coefficients by taking the exponent of each coefficient, subtracting one, and then multiplying by 100. To test the applicability of the differences-in-differences model to these data, we tested monthly differences in prices between Safeway and Anthem by interacting month fixed effects with an indicator for Safeway employment. Relative to the price differences observed in January 2010, we found no significant difference in prices between Safeway and Anthem throughout 2010, which supports the parallel trends assumption.

All analyses were performed with Stata 14.0 (Stata-Corp, College Station, TX) and all SEs were clustered at the 2-digit zip code level and were robust to heteroskedasticity. This study was approved by the Institutional Review Board at the University of California, Berkeley.

RESULTS

Table 1 presents the distribution of prices paid for the 10 CT and MRI tests most commonly used by Safeway employees in 2010, the year before implementation of reference pricing. The variation is remarkable, with typically a 10-fold difference between the 5th and the 95th percentiles in each test's price distribution. For example, prices paid for maxillofacial CT without dye, the most commonly ordered test, ranged from \$109 up to \$1039 even after trimming the minimum and maximum outliers. By way of comparison, the national average Medicare payment for this test in 2010 was \$195, substantially below the 25th percentile in the price distribution for Safeway. Similar price levels and variation are observed for the other imaging procedures. These are the data that motivated Safeway to implement reference pricing the following year.

Figure 1 presents unadjusted trends in the average prices paid for MRI and CT tests by Safeway and Anthem, respectively, over the 2010–2013 interval. Before the implementation of reference pricing in November of 2011, the prices paid by Safeway were declining slightly for MRI while increasing slightly for CT scans. After implementation, prices continued declining for MRI and declined sharply for CT scans. By way of contrast, prices paid by Anthem in-

creased in the years after Safeway implemented reference pricing, leading to a growing divergence between the treatment and comparison group prices.

Table 2 presents difference-in-differences multivariable regression results for the determinants of facility choice, prices paid, and consumer out-of-pocket cost-sharing for MRI procedures. The key parameters are those associated with the interaction terms (Safeway $\times$ year), as they capture the trend for Safeway before and after implementation, compared with the trend over the same time period for Anthem.

As indicated in the first column of Table 2, implementation of reference pricing was associated with a 6.9% reduction in the probability of selecting a high-priced facility in the year of implementation (2011), a 16.6% reduction in the first complete year after implementation (2012), and a 16.0% reduction in the second complete year after implementation (2013). These reductions are noteworthy in light of the general market price increases during these years, as evident in the positive parameters on the year indicator variables (1.9% increase in 2011, 5.4% in 2012, and 7.8% in 2013). Before the implementation of reference pricing, Safeway employees were 30.2% more likely to use a high-priced facility than were Anthem enrollees, as indicated in the parameter on the Safeway indicator variable in the first column of the Table 2.

The second column of Table 2 presents parameters from the analysis of the prices paid by Safeway and Anthem, respectively, for MRI procedures over the 2010–2013 period. Reference pricing did not exert a significant impact on prices in the year of implementation, but by the first full year after implementation it was associated with a reduction in \$103 (12.8%) paid per test. In the second full year after implementation reference pricing was associated with an \$84 (10.5%) reduction in prices.

The third column of Table 2 analyzes consumer cost-sharing for MRI procedures. In 2010, before implementation of reference pricing, Safeway employees paid out-of-pocket an average of \$126 (96.4%) more per test than did Anthem enrollees. Cost-sharing for MRI tests was rising generally during the 2010–2013 period, as evident in the significantly positive parameters on the year indicator variables. However,

TABLE 1. 2010 Distribution of Prices Paid by Safeway and Price Paid by Medicare: 10 Imaging Procedures Most Commonly Used by Safeway Employees

Imaging Procedure	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile	Medicare
CT maxillofacial wo dye (CPT 70486)	\$109	\$318	\$376	\$455	\$1039	\$195
CT pelvis wo dye (CPT 72192)	\$77	\$192	\$355	\$412	\$614	\$195
CT pelvis w dye (CPT 72193)	\$68	\$190	\$362	\$506	\$979	\$297
CT abdomen w dye (CPT 74160)	\$75	\$244	\$418	\$664	\$1241	\$297
CT abdomen wo&w dye (CPT 74170)	\$127	\$394	\$473	\$598	\$1904	\$333
MRI brain wo&w dye (CPT 70553)	\$219	\$637	\$773	\$1414	\$2272	\$535
MRI neck spine wo dye (CPT 72141)	\$147	\$523	\$597	\$773	\$1294	\$349
MRI lumbar spine wo dye (CPT 72148)	\$448	\$573	\$598	\$863	\$1515	\$349
MRI joint upper extremity wo dye (CPT 73221)	\$143	\$573	\$597	\$723	\$1328	\$349
MRI joint of lower extremity wo dye (CPT 73721)	\$145	\$548	\$597	\$700	\$1082	\$349

Percentiles are for 2010 prices paid for Safeway employees, including the component paid by the employer and the component paid by the employee (consumer cost-sharing). Medicare price is the 2010 average OPPS Payment Amount.

CPT indicates Current Procedural Terminology; CT, computed tomography; MRI, magnetic resonance imaging; w, with; wo, without.

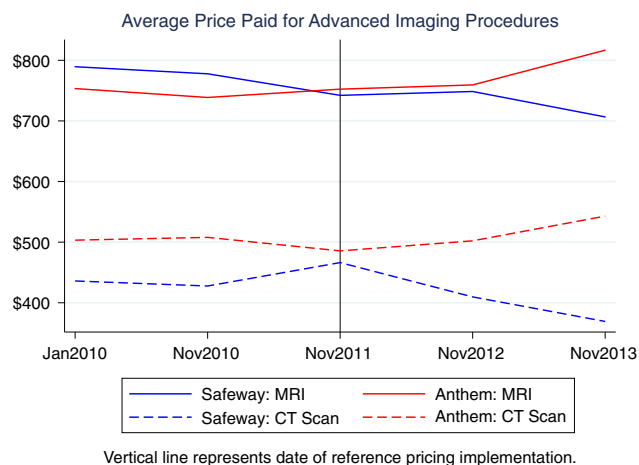


FIGURE 1. Average prices paid for advanced imaging procedures, before and after implementation of reference pricing. CT indicates computed tomography; MRI, magnetic resonance imaging.

implementation of reference pricing counteracted the trend for Safeway employees. Reference pricing was associated with a \$33 (16.3%) reduction in consumer cost-sharing per test in 2012 and a \$44 (20.9%) reduction in 2013.

Table 3 presents difference-in-differences regression results for patient choice, pricing, and cost-sharing for CT scans. Results are similar to those for MRI procedures, albeit of smaller magnitude.

As indicated in the first column, implementation of reference pricing had no observed impact on the probability that an employee chose a high-priced provider in the first full year after implementation (2012), but by the second year (2013), it was associated with a 9.0-percentage point reduction.

As indicated in the second column of the Table 3, implementation of reference pricing was associated with a \$66 (12.5%) reduction in the average price paid for CT scans by the second year of the program. As indicated in the third column, this reduction in average prices resulted in a \$27 (22.3%) reduction in consumer cost-sharing per CT scan, compared with trends in copayments by Anthem enrollees.

The reductions in prices paid for the 2082 CT and MRI procedures received by Safeway employees in 2012 and 2103, after full implementation of reference pricing, resulted in savings for both the employer and the employees. Total savings summed to \$157,229, of which \$85,722 (54.5%) accrued to Safeway and \$71,507 (45.5%) accrued to its employees.

DISCUSSION

The rapid diffusion of CT and MRI equipment, and the subsequent rise in utilization, has raised concerns over the potential for overdiagnosis of clinically inconsequential pathologies, exposure to harmful doses of radiation, and morbidity due to unnecessary follow-on tests, biopsies, and procedures. The potential for inappropriate utilization is illustrated by the wide variation in rates of testing for Medi-

TABLE 2. Association Between Implementation of Reference Pricing and Patient Choice of Facility, Test Prices, and Patient Cost-Sharing for MRIs, 2010–2013

	(1) Probability Patient Selects High-priced Provider	(2) Price Paid Per Test (\$)	(3) Patient Spending Per Test (\$)
Safeway × 2013	−0.160*** (0.0391)	−83.57*** (28.67)	−43.72*** (11.37)
Safeway × 2012	−0.166*** (0.0403)	−102.9*** (31.24)	−33.22** (14.15)
Safeway × 2011	−0.0694*** (0.0246)	21.97 (18.07)	32.14*** (11.96)
2013	0.0778*** (0.0155)	13.18 (14.34)	38.93*** (8.641)
2012	0.0539*** (0.0146)	9.478 (13.34)	40.75*** (6.848)
2011	0.0185* (0.0107)	−16.14* (9.670)	12.57* (6.427)
Safeway	0.302*** (0.0321)	90.94*** (17.79)	125.8*** (10.31)
Male	0.00379 (0.00580)	−6.393 (7.263)	21.48*** (4.000)
Age 18–29	−0.00232 (0.0129)	19.80 (14.73)	38.78*** (8.619)
Age 30–39	−0.00564 (0.0117)	−2.419 (14.73)	25.39*** (7.009)
Age 40–49	0.00632 (0.00985)	2.534 (12.70)	25.00*** (7.704)
Age 50–59	−0.00482 (0.0112)	−2.137 (12.70)	12.76* (7.346)
Observations	22,788	22,788	22,788

Robust SEs are shown in parentheses.

* $P < 0.1$.

** $P < 0.05$.

*** $P < 0.01$.

MRI indicates magnetic resonance imaging.

care patients, without concomitant variation in either underlying need or improved outcomes.⁶

Imaging has been of particular concern for physician organizations seeking to position the profession as the steward of the nation's health care resources. Fully 24 of the 45 procedures selected by the professional societies collaborating in the "Choosing Wisely" campaign to reduce low-value care were for diagnostic imaging, and the American Board of Radiology has launched its parallel "Imaging Wisely" campaign.⁴ Recent reports suggest, however, that these educational efforts have been of limited success in dampening utilization, as they do not address the financial incentives for testing.⁵

The importance of financial incentives for imaging procedures was documented originally through studies that found rates of use to be higher on the part of physicians who owned their own imaging equipment and hence received the facility as well as professional fee for the procedure, compared with those who only received the professional fee.^{9,10} Rates of use are higher among nonradiologists, for whom purchase of imaging equipment is primarily an ancillary and financially driven decision, than among radiologists.⁷

Changing the financial incentives faced by physicians to prescribe imaging tests is important but, without

TABLE 3. Association Between Implementation of Reference Pricing and Patient Choice of Facility, Test Prices, and Patient Cost-Sharing for CT Scans, 2010–2013

	(1) Probability Patient Selects High-priced Provider	(2) Price Paid Per Test (\$)	(3) Patient Spending Per Test (\$)
Safeway × 2013	−0.0903* (0.0474)	−65.55* (38.78)	−26.62** (11.38)
Safeway × 2012	0.00668 (0.0490)	12.56 (41.54)	−23.01* (13.52)
Safeway × 2011	0.0309 (0.0302)	31.85 (23.39)	0.641 (9.704)
2013	0.0282 (0.0202)	7.409 (15.79)	25.04*** (6.385)
2012	0.0335 (0.0211)	4.924 (15.90)	26.94*** (5.879)
2011	0.0292* (0.0154)	11.31 (12.27)	15.13*** (5.140)
Safeway	0.0404 (0.0297)	−69.42*** (23.19)	53.86*** (6.990)
Male	−0.00432 (0.00797)	4.652 (7.409)	8.031** (3.413)
Age 18–29	0.0644*** (0.0166)	43.86*** (13.59)	37.14*** (6.526)
Age 30–39	0.0174 (0.0146)	26.97* (15.11)	24.96*** (5.548)
Age 40–49	0.0270** (0.0133)	8.866 (13.86)	21.39*** (5.223)
Age 50–59	0.0280** (0.0133)	16.82 (13.62)	11.54** (5.147)
Observations	14,962	14,962	14,962

Robust SEs are shown in parentheses.

* $P < 0.1$.** $P < 0.05$.*** $P < 0.01$.

CT indicates computed tomography.

commensurate changes in the incentives facing patients, is likely to have only limited effects. Consumers may perceive advanced imaging procedures as evidence of high-quality care and thus resist physician efforts to avoid testing. Case studies of ACOs report that some physicians have expressed interest in cost-sharing that aligns the interests of the patients with those of the physician for use of low-priced freestanding imaging centers over their high-priced hospital-based counterparts.¹¹

The most important trend in consumer cost-sharing over recent years has been the increase in annual deductibles. By 2015, 26% of employers—and 52% of employers with 1000 or more workers—offered high-deductible health plans; in addition, 85% of enrollees in the state and federal health insurance exchanges selected “bronze” and “silver” benefit designs featuring high deductibles.¹² Deductibles have been shown to reduce the use of imaging procedures,⁸ but have been criticized as “blunt instruments” for improving the value of diagnostic imaging.¹³ Some insurers have sponsored “price transparency” initiatives for diagnostic imaging procedures and observed shifts in utilization from high-priced to low-priced providers.¹⁴ These changes in site of care increase when insurers impose prior authorization as a prerequisite for reimbursement and supplement this with

outreach initiatives to inform consumers of lower-priced alternatives.¹⁵

Reference pricing is a new component of benefit design that can pair with price transparency and supplement or substitute for annual deductibles. The employer or insurer establishes a limit to what it will contribute toward payment for a procedure. If the patient selects a high-priced facility, this approach requires the patient to pay the difference between the established limit and the price charged. Reference pricing has been shown to induce significant shifts in consumer choices toward lower-priced providers for inpatient surgery, ambulatory surgery, and clinical laboratories in the United States.^{16–18} It builds on extensive experience with pharmaceutical reference pricing in Europe.¹⁹

As reported in this paper, the implementation of reference pricing for CT and MRI procedures led to significant changes in market shares, favoring imaging facilities that charged less than the employer’s contribution limit and disadvantaging those that charged more. By the second year after program implementation, the probability that a Safeway employee would select a high-priced facility was reduced by 16.6% for MRIs and 9.0% for CT scans. This change in market shares was associated with lower average prices being paid by Safeway.

The average price paid by Safeway for MRI procedures declined from \$792 in 2011, the year of reference pricing implementation, to \$733 two years later. For CT scans, the average price paid declined from \$459 to \$388. The magnitude of these reductions was greater in percentage terms for CT scans (22.3%) than for MRIs (10.5%). During those years the average price paid for similar procedures and in similar markets by Anthem, which had not implemented reference pricing, increased from \$735 to \$772 for MRI and from \$505 to \$515 for CT procedures. It should be emphasized that these reductions in prices paid by Safeway stem from changes in the choices made by employees, rather than from changes in the prices charged by any particular facility. Safeway accounted for a very small part of any one geographic market, and so it is not to be expected that facilities were aware of its initiative and motivated to reduce their prices to obtain greater patient volume. However, if reference pricing comes to be adopted by a larger number of employers and insurers, facilities will come to recognize they face a more elastic demand for their services and will adjust their pricing strategy accordingly.

Reference pricing can increase or decrease the total amount of out-of-pocket spending by consumers, depending on the extent to which they respond by selecting lower-priced facilities. In this case, out-of-pocket spending by consumers declined, from an average of \$164 and \$344 for CT and MRI procedures in 2011 to \$136 and \$287 in 2013. Over the same period, out-of-pocket spending for the Anthem comparison population increased from \$99 to \$115 for CT procedures and from \$148 to \$187 for MRI procedures. Almost half of the savings from the program (45%) accrued to the employees rather than to the employer.

The decrease in cost-sharing payments by Safeway employees, during a time period when such payments were increasing for Anthem enrollees not subject to reference

pricing, is of note for policy discussions on the appropriate design of health insurance benefits. The most common form of cost-sharing today is the annual deductible, which gives enrollees incentives primarily to reduce utilization and secondarily to select lower-priced facilities for the services they decide to pursue. In contrast, reference pricing creates an incentive for enrollees to select lower-priced facilities but not to forgo care altogether. When coupled with information on price differences across facilities in the same market, reference pricing can lead to reductions in total cost-sharing, as found in this study.

Advances in diagnostic imaging are an important complement to advances in surgical and medical treatment, but rapid diffusion has raised questions of clinical appropriateness and economic cost. Our study does not directly address the impact of reference pricing on the rate of testing, as we were not able to obtain data on the number of employees and dependents covered by Safeway and Anthem, but only the number using imaging tests. Reference pricing may, however, exert an indirect effect on the rate of imaging. Reference pricing encourages consumers to select lower-priced facilities, thereby diminishing the incentive for providers to prescribe testing in contexts of low therapeutic value.

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