

Original Investigation

Association of Reference Pricing for Diagnostic Laboratory Testing With Changes in Patient Choices, Prices, and Total Spending for Diagnostic Tests

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 Invited Commentary

IMPORTANCE Prices for laboratory and other clinical services vary widely. Employers and insurers increasingly are adopting “reference pricing” policies to create incentives for patients to select lower-priced facilities.

OBJECTIVE To measure the association between implementation of reference pricing and patient choice of laboratory, test prices, patient out-of-pocket spending, and insurer spending.

DESIGN, SETTING, AND PARTICIPANTS We conducted an observational study of changes in laboratory pricing and selection by employees of a large national grocery firm (n = 30 415) before and after the firm implemented a reference pricing policy for laboratory services and compared the findings with changes over the same period for policy holders of a large national insurer that did not implement reference pricing (n = 181 831). The grocery firm established a maximum payment limit at the 60th percentile of the distribution of prices for each laboratory test in each region. Employees were provided with data on prices at all laboratories through a mobile digital platform. Patients selecting a laboratory that charged more than the payment limit were required to pay the full difference themselves. A total of 2.13 million claims were analyzed for 285 types of in vitro diagnostic tests between 2010 and 2013.

MAIN OUTCOMES AND MEASURES Patient choice of laboratory, price paid per test, patient out-of-pocket costs, and employer spending.

RESULTS Compared with trends in prices paid by insurance policy holders not subject to reference pricing, and after adjusting for characteristics of tests and patients, implementation of reference pricing was associated with a 31.9% reduction (95% CI, 20.6%-41.6%) in average price paid per test by the third year of the program. In these 3 years, total spending on laboratory tests declined by \$2.57 million (95% CI, \$1.59-\$3.35 million). Out-of-pocket costs by patients declined by \$1.05 million (95% CI, \$0.73-\$1.37 million). Spending by the employer declined by \$1.70 million (95% CI, \$0.92-\$2.48 million).

CONCLUSIONS AND RELEVANCE When combined with access to price information, reference pricing was associated with patient choice of lower-cost laboratories and reductions in prices and payments by both employer and employees.

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The prices charged for laboratory tests vary widely within and across regions in the United States. Laboratories have traditionally wielded considerable pricing power because physician reimbursement has not been linked to the cost of prescribed care, and consumers have been insulated from costs due to insurance. In North Carolina, for example, laboratories charge private insurers between \$5 and \$284 for a basic metabolic panel and between \$8 and \$196 for a lipid panel.¹

Employers and insurers have been raising the share of out-of-pocket health care costs that must be paid by patients, in part to offset the ability of hospitals, clinical laboratories, and other providers to raise prices without penalty.² Some employers and insurers are adopting reference pricing strategies similar to those used in Europe for pharmaceuticals.³ Under *reference pricing*, insurers provide payment up to a defined contribution limit and require the patient to pay the difference between this limit and the actual price charged. Reference pricing in the United States has led to substantial changes in consumer choices and spending for surgical and diagnostic procedures.⁴⁻⁶ In this study, we compare changes in laboratory prices and selection by employees before and after their employer implemented reference pricing for laboratory services and compare these findings with changes over the same period for policy holders of an insurer that did not use reference pricing.

Methods

Data on Patients and Diagnostic Tests

The study was approved by the institutional review board of the University of California, Berkeley, waiving patient written informed consent.

Data on patient choice of laboratory and on the type, volume, and price of in vitro diagnostic assays were obtained from Safeway, a national US chain of retail grocery stores and food processing factories. The company operates a self-insured health plan for its employees, dependents, and retirees. In March of 2011 Safeway implemented reference pricing for laboratory tests as part of its efforts to sensitize employees to the level and variation in prices within each local market.

The prices paid by Safeway and its employees were in-network rates negotiated on their behalf by the insurer managing the Safeway self-insured health plan. Under the reference pricing initiative, Safeway established a maximum amount it would pay for each test, set at the 60th percentile of the distribution of these negotiated prices in each region. Employees who selected a laboratory that charged less than or equal to this maximum amount were subject to the plan's usual out-of-pocket costs (deductible) but did not pay anything additional for laboratory tests. Employees who selected a laboratory that charged more than the reference price were responsible for the entire extra amount, in addition to their deductible.

Individual employees faced an annual deductible of \$1200 and then coinsurance of 20% up to the annual out-of-pocket payment maximum of \$4000. Employees with dependents and

Key Points

Question What has been the effect of "reference pricing" initiatives implemented by employers and insurers to channel utilization toward clinical laboratories that charge lower prices for in vitro diagnostic tests?

Findings Reference pricing was associated with a 32% reduction in the average price paid for 285 different types of tests. Total spending in the first 2 years after program implementation declined by \$2.6 million, of which 41% accrued to employees, and the remainder to the employer.

Meaning Reference pricing for laboratory tests can lead to savings for both employers and employees.

families faced correspondingly higher deductibles and annual maximums. Payments made by employees to laboratories that charged more than Safeway's reference price limit did not count toward the deductible or the annual out-of-pocket maximum.

The focus of the Safeway reference pricing initiative was on well-established tests that were obtained for nonurgent health care needs. The initiative excluded tests provided in the inpatient hospital, emergency department, urgent care, or other settings where the consumer lacked the opportunity to compare prices across laboratories. Laboratory tests were also excluded if they were prescribed to a patient as part of active treatment for serious medical conditions including cancer, renal failure, infertility, and severe mental illness. Genetic tests were excluded. Laboratory tests accounted for 5.12% of total medical care spending by Safeway. The subset of tests subject to reference pricing accounted for 3.04% of total Safeway spending.

Employees were given access to prices of covered tests at every clinical laboratory using the mobile information platform of a private firm that obtains pricing data from large insurers and self-insured employers.⁷ They could access price data on all laboratories either through their mobile phone or from a computer.

We obtained claims data from Safeway for laboratory tests conducted on nonunionized employees from January 2010 through December 2013. Unionized employees were excluded because their insurance was governed by collective bargaining contracts negotiated prior to the development of reference pricing. Retirees aged 65 years or older, eligible for the public Medicare insurance program, were excluded because Medicare was the primary payer for laboratory tests. Safeway claims data included the Current Procedural Terminology (CPT) code for each test or test panel, the date of testing, the price, and demographic information on the patient (age, sex, and zip code of residence). The price data included the total negotiated and paid amount (allowed charge) and, separately, the amount paid by the employer and the amount paid by the patient.

To account for changes over time in the laboratory market that were not related to reference pricing, we obtained claims data from Anthem Inc, the largest private insurer in the

United States. Anthem operates Blue Cross and Blue Shield insurance plans in 14 states and other insurance products across the nation. In 2013, Anthem provided insurance to 39 million enrollees through individual, employer-based, and governmental programs.⁸ The Anthem claims data we obtained covered the same period as the Safeway claims data. The laboratories used by Safeway and Anthem patients were under contract with those entities, and the variation in prices was due to variation in bargaining power across laboratory entities.

The Anthem claims contained test and patient data similar to those in the Safeway laboratory claims (test CPT code, allowed charge, insurer-paid amount, enrollee-paid amount, and patient age, sex, and zip code). Given the large size of the Anthem database, we randomly selected 5% of claims, stratified by geographic region. The Anthem data were used as the comparison group. Not all laboratory tests included in the Safeway reference pricing initiative were included in the Anthem database. We therefore restricted the analysis to those tests represented in both the Safeway and Anthem data sets. This resulted in an analysis of 285 types of laboratory tests, accounting for 63% of all laboratory claims from Safeway. The final data set consisted of 344 413 laboratory tests used for Safeway employees and 1781 640 tests used for Anthem enrollees over the 2010-2013 period.

Statistical Analysis

We studied 4 end points in this analysis: the price paid for each test, whether the test was obtained at a laboratory that charged more than the Safeway reference price limit, the amount paid by the patient, and the amount paid by the employer (Safeway) or insurer (Anthem). To illustrate variation in the price of the same test in different clinical laboratories, 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 62% of total spending by Safeway for the 285 tests covered in this study.

The principal measure of reference pricing program success, as interpreted by Safeway, was the extent to which employees switched their choice of laboratory based on the prices charged.⁹ We measured the percentage of laboratory tests that occurred in clinical laboratories that charged more than the reference payment for 14 months before and 34 months after the implementation of the reference pricing initiative.

We measured the amount paid directly by the patient (ie, out-of-pocket cost) for laboratory tests. For Safeway employees, out-of-pocket cost in 2010 was owing solely to the annual deductible provisions because reference pricing had not yet been implemented. Starting in March 2011, it was derived from patient payments under both the deductible provision and the reference pricing provision, if the patient selected a higher-priced laboratory. For Anthem enrollees, cost sharing was due to deductibles in their health insurance, with no role played by reference pricing.

Reference pricing could be associated with either increases or decreases in total patient out-of-pocket spending. To the extent Safeway employees responded to the new initiative by switching to lower-priced laboratories, they would

avoid the supplemental reference pricing payment and reduce their required payments under their deductible obligation. However, to the extent employees continued using higher-priced laboratories, they would add to their out-of-pocket cost obligations.

We analyzed the association between implementation of reference pricing and the 4 end points after adjusting for characteristics of the tests and patients using multivariable regression analysis. These multivariable analyses adjusted for marketwide trends in laboratory price, choice, and consumer out-of-pocket costs through difference-in-differences statistical techniques. Difference-in-differences analysis uses the same logic for observational data as used in controlled trials featuring a treatment and a comparison group. Two differences are computed with respect to each end point: the change over time for the treatment group (Safeway) and the change over time for the comparison group (Anthem). The difference-in-differences analysis quantifies the extent to which the change experienced by the treatment group differs from the change experienced by comparison group, after adjusting for characteristics of the tests and patients in each group each year.¹⁰

Difference-in-differences analysis requires that the time trends of the outcome variable for the treatment and comparison groups be parallel prior to the policy intervention. It also requires that any event occurring during or after the policy intervention equally affect each group.¹⁰ To evaluate this parallel trends assumption, we constructed monthly difference-in-difference parameters for the preintervention period. The assumption of parallel trends in the outcome variable would have been violated if any of the monthly difference-in-differences parameters prior to the intervention had been statistically significant, indicating measurably different trends. If the null hypothesis of parallel trends could not be rejected, however, then analyzing the data on an annual basis would be reasonable. In our examination of the data, we were unable to reject the null hypothesis of parallel trends. Moreover, in interviews with Safeway health executives, we were told that there were no changes after initial implementation of reference pricing that would have affected the end points used here.

The difference-in-differences regressions adjusted for test year, whether the patient was insured by Safeway or Anthem, interaction terms between year and insurance (Safeway or Anthem), type of test (CPT code), age categories, sex, and zip code of residence. The price, patient out-of-pocket cost, and insurer spending regressions were analyzed using generalized linear model (GLM) regressions, each with a log link and a gamma distribution. To calculate changes in financial terms, we used the marginal effects of the GLM coefficients.¹¹ Percentage changes were derived from the GLM coefficients.¹²

The regressions for whether the laboratory price was above the reference price were analyzed using both ordinary least squares (OLS) and logistic regression. The results using each statistical model were similar, and we present OLS results for ease of interpretation. All analyses were performed with Stata software, version 14.0 (StataCorp LP). Heteroscedasticity robust standard errors were clustered at the 2-digit zip code level to account for autocorrelation.^{13,14}

Table 1. Characteristics of Patients and Diagnostic Tests, Safeway and Anthem, 2010-2013

Characteristic	Safeway				Anthem			
	2010	2011	2012	2013	2010	2011	2012	2013
Patients, No.	16 445	15 925	14 479	13 744	68 082	76 217	82 777	84 379
Laboratory tests, No.	92 606	89 635	82 638	79 532	387 638	436 899	480 530	476 573
Patients using higher-priced laboratories, %	45.6	17.9	14.0	15.6	83.6	79.4	75.6	73.4
Per-test price, mean, \$	27.72	19.64	18.43	18.56	28.88	29.22	29.28	29.72

Table 2. Distribution of Prices Paid by Safeway Across Laboratories in 2010 for the 10 Most Commonly Used Diagnostic Tests

Laboratory Test	Percentile, \$				
	5th	25th	50th	75th	95th
Panel					
Basic metabolic	5.75	6.15	17.15	44.00	126.44
General health	20.58	21.88	23.88	53.66	121.86
Comprehensive metabolic	7.18	7.68	15.98	33.37	132.48
Lipid	8.85	9.46	11.73	30.03	74.92
Hepatic function	5.56	5.94	11.32	24.51	85.14
Iron test	4.40	4.71	4.71	13.62	58.47
Total prostate-specific antigen	12.50	13.36	13.36	37.27	88.75
Thyroxin free test	6.13	6.55	8.19	20.50	64.00
Thyroid-stimulating hormone	11.42	12.20	28.53	55.87	101.70
Uric acid test	3.07	3.28	3.47	9.63	30.60

Results

Changes in Patient Choices and Laboratory Prices

Table 1 lists descriptive statistics on the Safeway and Anthem patients and the laboratory tests they utilized. Employment declined at Safeway during this period, resulting in a decline in the number of employees using laboratory tests and the number of tests used. The annual number of tests per patient did not meaningfully change, ranging from 5.63 per person per year in 2010 to 5.79 in 2013.

Prior to the implementation of reference pricing, 46% of the tests used by Safeway employees were at laboratories that charged more than the subsequently imposed reference price limit. This declined to 16% in the third year after program implementation. Not all of this decline can be attributed to reference pricing. In 2010, 84% of the tests used by Anthem enrollees were conducted by laboratories that charged more than the reference price established by Safeway. This declined to 73% in the third year of the Safeway program, for reasons not related to reference pricing. The difference in baseline prices paid by Safeway and Anthem were owing to differences in the geographic location and other characteristics of the patients and laboratories, and they highlight the importance of adjusting for these differences using multivariable statistical methods.

Table 2 details the distribution of prices charged to Safeway in 2010, the year before implementation of reference pricing, for the 10 most commonly prescribed laboratory tests. Across all 10 tests, the 95th percentile price exceeded the 5th

percentile price by an average factor of 10. The price for the most commonly prescribed test, the basic metabolic panel, ranged from \$5.75 to \$126.44, the highest price 22 times higher than the lowest. Prices for the lipid panel ranged from \$8.85 to \$74.92. The variability in prices for Safeway was similar to the variability reported by a different insurer in North Carolina.¹

The Figure presents monthly average (mean) prices paid per test by Safeway and Anthem from 2010 to 2013. These averages are substantially higher than the prices listed in Table 1 for the 10 most commonly used tests because the mean reflects the prices of less common but substantially more expensive tests. In the first year after the implementation of reference pricing, the average price paid per test by Safeway declined by 31.9%, from \$27.72 to \$18.90. This divergence was sustained over the following 2 years. Average prices remained constant during these 3 years for Anthem enrollees not subject to reference pricing.

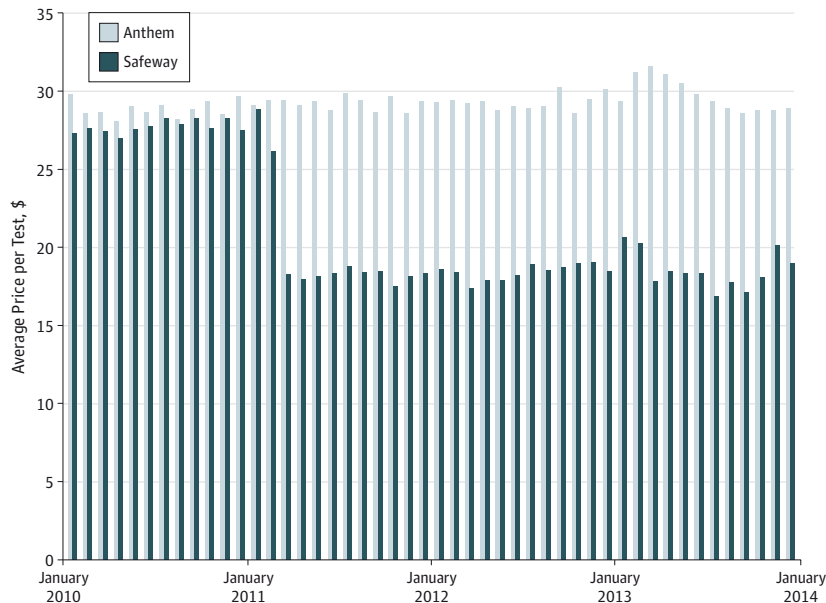
Multivariable regression estimates of the probability that a Safeway patient selected a higher-price laboratory are listed in the first data column of Table 3. After accounting for differences in the mix of tests, patient demographics, and broader market changes, Safeway employees were 25.2% less likely than Anthem enrollees to select a higher-priced laboratory. The implementation of reference pricing further decreased the probability that a Safeway employee would select a higher-priced laboratory by 23.6% in the first year, 22.1% in the second year, and 18.6% in the third year.

Difference-in-differences regression analyses of test prices are listed in the second data column of Table 3. At baseline, prices were similar for Safeway employees and Anthem enrollees. Compared with the 2010 baseline year, Safeway's initiative was associated with a \$9.75 (29.5%) price reduction per test in the first year following implementation, \$10.20 (30.6%) reduction in the second year, and \$10.76 (32.0%) reduction in the third year.

Changes in Patient Out-of-Pocket Costs

As indicated in the third data column of Table 3, implementation of reference pricing by Safeway was associated with a \$3.58 (34.2%) reduction in the patient's average out-of-pocket payment per test in the first year after implementation. These reductions in total patient out-of-pocket costs indicate that the changes in patient choice of laboratory reduced the out-of-pocket payments under the deductible as well as avoided the supplemental financial responsibilities created by reference pricing. The reduction in patient out-of-pocket cost per test grew to \$4.37 (40.1% reduction from 2010) in the second year and stabilized at \$4.58 (41.5% reduction from 2010) in the third year after implementation of reference pricing.

Figure. Average Price Paid per Diagnostic Test by Anthem and Safeway Before and After Implementation of Reference Pricing by Safeway, 2010-2013



Safeway implemented reference pricing in March 2011.

Table 3. Changes in Study Outcomes Among Safeway Patients After Safeway Implemented Reference Pricing for Diagnostic Laboratory Tests, 2010-2013^a

Characteristic ^b	Probability That Patient Chose Higher-Priced Laboratory	Price Paid per Test, \$	Patient Out-of-Pocket Cost per Test, \$	Employer Payment per Test, \$
Safeway × 2013	-0.1860 (0.0717) ^c	-10.760 (2.195) ^d	-4.577 (0.602) ^d	-7.114 (1.879) ^d
Safeway × 2012	-0.2210 (0.0744) ^d	-10.198 (2.109) ^d	-4.371 (0.742) ^d	-6.324 (1.603) ^d
Safeway × 2011	-0.2360 (0.0656) ^d	-9.754 (1.692) ^d	-3.577 (0.602) ^d	-6.817 (1.288) ^d
2013	-0.1000 (0.0186) ^d	0.225 (0.288)	1.006 (0.228) ^d	-0.808 (0.278) ^d
2012	-0.0813 (0.0200) ^d	-0.077 (0.258)	1.046 (0.216) ^d	-1.394 (0.343) ^d
2011	-0.0426 (0.0103) ^d	0.106 (0.228)	0.216 (0.124) ^e	-0.189 (0.247)
Safeway	-0.252 (0.0861) ^d	-0.267 (2.154)	4.546 (0.657) ^d	-5.549 (1.478) ^d
Male patient	0.0072 (0.0031) ^c	0.365 (0.223)	0.372 (0.083) ^d	0.069 (0.238)
Patient age, y				
30-39	0.0032 (0.0055)	-2.104 (0.549) ^d	-0.91 (0.115) ^d	-1.266 (0.472) ^d
40-49	0.0040 (0.0074)	-3.033 (0.698) ^d	-1.135 (0.155) ^d	-2.024 (0.577) ^d
50-59	0.0072 (0.0061)	-2.693 (0.676) ^d	-1.118 (0.159) ^d	-1.713 (0.544) ^d
60-64	0.0095 (0.0081)	-1.905 (0.912) ^c	-0.821 (0.206) ^d	-1.177 (0.790)

^a Sample included 2 089 033 laboratory claims; regressions include covariates for zip code of residence and Current Procedural Terminology (CPT) code of test; robust standard errors are reported in parentheses.

^b The Safeway × covariate represents the interaction between the indicator variable that the patient was covered by Safeway (as distinct from Anthem, the comparison group) and the indicator variable that the test was conducted in the noted year (as distinct from 2010, the comparison group); year alone represents the calendar year (as distinct from 2010, the comparison year);

Safeway [no X] represents the indicator variable that the patient was covered by Safeway (not Anthem), and the coefficient on this variable reflects the differences in end point values for Safeway vs Anthem patients in the benchmark year 2010

^c $P < .05$.

^d $P < .01$.

^e $P < .10$.

The benefits of reference pricing accrued to Safeway as well as to its employees. As indicated in the fourth data column of Table 3, the implementation of reference pricing was associated with a \$6.82 (30.0%) reduction in the amount paid by Safeway per laboratory test in the first year, \$6.32 (28.3%) reduction in the second year, and \$7.11 (31.1%) reduction in the third year after implementation.

Distribution of Spending Reductions From Reference Pricing Table 4 summarizes the reductions in spending on laboratory tests in the first, second, and third years after implementation of reference pricing. Changes are presented in terms of out-of-pocket spending by employees, spending by Safeway, and total spending (the combination of employees and the employer). Changes are measured in terms of the difference

Table 4. Cost Savings Associated With Reference Pricing for Laboratory Tests, 2010-2013

Savings, \$	2011	2012	2013	2011-2013
Total	874 496	842 755	855 624	2 572 875
Patients	320 768	361 063	364 197	1 046 028
Employer	611 072	522 177	565 380	1 698 629

between what Safeway and its employees spent on laboratory tests and what they would have spent, had laboratory choices and prices evolved at the same rate as those experienced by Anthem (ie, without reference pricing).

Combined employee and employer savings per year ranged from \$0.87 million in 2011 to \$0.86 million in 2013, with a cumulative savings of \$2.57 million. This amounts to a 35% reduction in spending on laboratory tests compared with what would have been spent in the absence of reference pricing.

Both patients and the firm experienced significant savings. Savings accruing to Safeway employees grew from \$0.32 million in 2011 to \$0.36 million in 2013, with a 3-year total of \$1.05 million. Savings accruing to the firm ranged from \$0.61 million in 2011 to \$0.57 million in 2013, with a 3-year total of \$1.70 million. The percentage of total savings accruing to patients, as distinct from the employer, rose from 36.7% in 2011 to 42.6% in 2013 and averaged 40.6% over the 3-year period.

Discussion

Employers and insurers are increasing the extent to which patients are required to pay a portion of the health care expenditures they incur. The most common form of cost sharing is the deductible, which requires that the patient cover a specified amount in annual out-of-pocket payments before the insurer begins to pay.^{2,15} Deductibles have been associated with reductions in adherence to physician prescriptions and evidence-based care processes.^{16,17} Partly in response, some employers are developing cost-sharing designs that adopt principles of reference pricing from European pharmaceutical purchasing.³

Under reference pricing, the employer or insurer establishes a maximum that will be paid for a particular test or treatment,

typically choosing a value between the median and the 80th percentile in the distribution of prices in the local market. Patients who select a facility charging below that threshold receive full coverage, but those who select one charging above the reference limit must pay the full difference themselves. Reference pricing does not target the decision to seek care but rather the decision of where to seek care.

This study analyzed the association between reference pricing, patient choices, and prices paid for in vitro diagnostic tests. Program effects were measured after adjusting for changes in test mix and patient demographics. They were adjusted for changes in the broader laboratory market, as reflected in the comparison group of enrollees in the nation's largest private health insurer.

This analysis is not without limitations. We were not able to obtain data on the total number of Safeway employees and Anthem enrollees in each year but only on those using laboratory services (for which a reimbursement claim was made). We therefore were unable to ascertain the association, if any, between implementation of reference pricing and the probability that a patient decides to obtain a test. There is no strong reason to believe that reference pricing will affect decisions over whether to seek care, as distinct from decisions of where to seek care, since the program offers good coverage at laboratories charging prices below the reference limit. Nevertheless, we were unable to test for any association.

Conclusions

The reference price program reduced spending on the 285 laboratory tests included in this study by \$2.57 million over 3 years compared with what would have been paid had the prices continued to reflect the broader market, with the benefits accruing to both employees and the employer. Under the assumption that the savings to Safeway and its employees were similar for the laboratory tests not included in this study, one would multiply the \$2.57 million in estimated savings by the inverse of the fraction of total spending devoted to the tests included in this study (0.63). This creates a total estimated savings from reference pricing for laboratory tests of \$4.08 million.

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Study concept and design: Robinson, Whaley, Brown.

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Drafting of the manuscript: Whaley.

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