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Journal

Journal of Bone and Joint Surgery, 101(24)

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Publication Date

2019-12-18

DOI

10.2106/JBJS.19.00475

Peer reviewed

HHS Public Access

Author manuscript

J Bone Joint Surg Am. Author manuscript; available in PMC 2024 January 20.

Published in final edited form as:

J Bone Joint Surg Am. 2019 December 18; 101(24): 2212–2218. doi:10.2106/JBJS.19.00475.

Impact of Reference Pricing on Cost and Quality in Total Joint Arthroplasty

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Abstract

Background: Prices for total joint arthroplasty vary widely. Insurers have experimented with reference-based benefit designs (reference pricing) to control costs by setting a contribution limit that covers lower-priced facilities but necessitates higher out-of-pocket payments at higher-priced facilities. The purpose of this study was to evaluate the impact of reference pricing on the cost and quality of care for total joint arthroplasty.

Methods: The California Public Employees' Retirement System (CalPERS) implemented reference pricing for total joint arthroplasty in January 2011. We obtained data on 2,023 CalPERS patients who underwent total joint arthroplasty from January 2009 to December 2013 and comparison group data on 8,024 non-CalPERS patients from the same time period. Trends in 9 cost and quality-related metrics were compared between the CalPERS group and the comparison group: patient choice of a lower-priced hospital, insurer payment, consumer payment, 90-day complication rate, 90-day readmission rate, annual surgical volume of the chosen hospital, length of stay, travel distance, and rate of discharge to home. The impact of reference pricing was estimated with difference-in-differences multivariable regressions, adjusting for covariates.

Results: An increase of 19 percentage points (95% confidence interval [CI], 13.0 to 25.6 percentage points; $p < 0.01$) in the selection of lower-priced hospitals was attributable to reference pricing, with a concurrent mean savings for the insurer of $5,067 (95% CI, $2,315 to $7,819; $p < 0.01$) and an increase in the mean patient out-of-pocket payment of $1,991 (95% CI, $1,053 to $2,929; $p < 0.01$). No significant change in any quality indicator was attributable to reference pricing, with the exception of an 8% reduction (95% CI, 3.3% to 12.7% reduction; $p < 0.01$) in the length of stay for hip replacement.

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Conclusions: Reference pricing motivates patients to choose lower-priced hospitals for total joint arthroplasty, with no measurable adverse impact on quality. Reference pricing represents a viable strategy in the shift toward value-based care.

U.S. prices for total joint arthroplasty vary tenfold despite little evidence of corresponding variation in outcomes[1]. To reduce their exposure to price variation, employers offer high-deductible health plans to encourage consumers to comparison-shop and select lower-priced providers[2]. However, for total joint arthroplasty, prices are rarely made available to patients[3], and patients are unaccustomed to choosing based on price[4]. More importantly, the price of total joint arthroplasty is usually above the deductible limit, so high deductibles do not provide a strong incentive to select lower-priced providers[1].

Reference-based benefit design (reference pricing) is a payment system designed to provide incentives for patients to choose lower-priced health-care providers[1]. Under reference pricing, the insurer sets a ceiling (the reference price) on the amount that they will pay, and the patient pays 100% of the remainder of any price above the reference price. In the current context, consumers were provided with a list of facilities whose prices were at or below the reference price. The California Public Employees' Retirement System (CalPERS) implemented reference pricing for primary total joint arthroplasty for the knee and the hip in January 2011[5], and the mean savings in the first year of implementation was $4,597 per patient as patients increasingly chose lower-priced hospitals[6].

Although the CalPERS reference pricing program has demonstrated savings, a natural question is whether the program had an impact on quality of care[7]. The purpose of this study was to determine whether reference pricing had a measurable impact on available quality metrics: rates of complications, readmissions, discharge to home, surgical volumes of chosen hospitals, lengths of stay, and distances traveled. This study also provides an update on the effect of reference pricing on total consumer expenditures using an additional year of data[6,8]. We hypothesized that the quality of care for CalPERS patients who were subject to reference-based benefits did not differ from the quality of care for non-CalPERS patients not subject to reference-based benefits.

Materials and Methods

Data on Patients

CalPERS provides health insurance for approximately 1.4 million public-sector employees and their dependents and implemented reference pricing in their Preferred Provider Organization (PPO) plans, which have an enrollment of approximately 225,000. The CalPERS reference pricing policy limited hospital coverage for total joint arthroplasty to $30,000. This price was chosen on the basis of regional market prices and was set to ensure adequate geographic availability of hospitals[8]. Patients were subject to their usual deductible and coinsurance rates up to $30,000 of allowed charges, but the patient was required to pay 100% of any portion above $30,000. Any amount paid above the reference price was not applied to either the deductible or maximum out-of-pocket spending limit. The CalPERS reference pricing policy did not include payments to physicians because physician fees were less variable than hospital prices.

CalPERS informed enrollees about the program through a web site and brochure. By the end of 2011, CalPERS had designated 47 hospitals as Value Based Purchasing Design (VBPD) facilities, defined as facilities with prices for total joint arthroplasty of ≤$30,000 and of acceptable quality. Quality was deemed acceptable based on surgical volume, scores on surgical prevention indicators reported to The Joint Commission, results reported to the California hospital quality reporting system, and accreditation by a recognized quality-accrediting entity. Patients who lived >50 miles (80.5 km) from a VBPD facility were exempt from reference pricing.

Cohort Inclusion and Exposure

This study is based on claims data on patients enrolled in CalPERS self-insured PPO products, administered by Anthem Blue Cross, who underwent primary total joint arthroplasty for the knee or hip from January 2009 to December 2013. CalPERS implemented reference pricing in January 2011; thus, 2009 to 2010 is the pre-intervention period and 2011 to 2013 is the post-intervention period. The comparison group is composed of non-CalPERS Anthem Blue Cross patients who underwent total joint arthroplasty for the knee or hip, but were not subject to reference pricing. The study cohort consisted of 10,047 patients: 2,023 CalPERS patients and 8,024 non-CalPERS patients.

Patients excluded were those who were ≥65 years of age; those who underwent a bilateral total joint arthroplasty, a combination knee and hip arthroplasty, or a revision surgical procedure; and those who underwent the procedure outside of California. We excluded patients who were ≥65 years of age because we lacked access to Medicare claims.

Performance Metrics

Price-related performance metrics include patient choice of a VBPD facility, insurer payment, and consumer payment. Quality-related performance metrics include 90-day complication rates, hospital length of stay, 90-day all-cause readmission, rate of discharge to home, and mean hospital total joint arthroplasty surgical volume. The access-related metric is distance traveled to the hospital, measured as the straight-line distance in miles between the patient's home ZIP code and the location of the hospital.

The rates of complications were calculated using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) and the International Classification of Diseases, Ninth Revision, Procedure Coding System (ICD-9-PCS) codes at 7, 30, and 90 days after the procedure date. Complications measured at 7 days include acute myocardial infarction (410, excluding 410.x2), pneumonia (480, 481, 482, 483, 485, 486, 487.0, 488.01, 488.11, 507.0), and sepsis, septicemia, or shock (038, 785.52, 785.59, 790.7, 995.91, 995.92, 998.0). Complications measured at 30 days include surgical site bleeding (86.04 combined with any of the following codes: 998.1, 719.10, 719.16, 719.17, 39.98) and/or pulmonary embolism (415.1). Complications measured at 90 days include mechanical complications (996.4) and/or periprosthetic joint infection or wound infection (998.6, 998.83, 998.3, 998.5, 996.66, 996.67 with at least 1 of the following codes: 86.22, 86.28, 86.04, 81.53, 81.55, 81.59, 00.70, 00.71, 00.72, 00.73, 00.80, 00.81, 00.82, 00.84, 80.05, 80.06, 80.09). We combined all complications into a single measure.

Analytic Methods

Previous research has found that hospitals that miss important process-of-care measures have a 1.8 to 2-percentage point higher frequency of adverse events[9]. This was used as the basis of a power analysis to determine whether patients who underwent total hip arthroplasty or total knee arthroplasty should be analyzed together or separately. Based on the number of patients in the CalPERS and non-CalPERS groups, the baseline complication rate, a significance level of 0.05, and a power of 80%, the minimum detectable change in complication rate is 1.5 percentage points when combining patients who underwent total knee arthroplasty and those who underwent total hip arthroplasty and 2.1 percentage points when separating patients who underwent total knee arthroplasty from those who underwent total hip arthroplasty. To maximize the statistical power to detect a meaningful change in quality, we combined patients who underwent total knee arthroplasty and those who underwent total hip arthroplasty for all outcomes except length of stay and surgical volume, which are procedure-dependent.

To visualize trends, we calculated annual descriptive statistics for each outcome variable. Annual outcomes are graphically presented, illustrating trends before and after the policy change.

To estimate policy impacts, we utilized difference-in-differences multivariable statistical methods using logistic regression for binary end points with a mean of <0.2 or >0.8[10,11], linear probability models for binary end points with a mean from 0.2 to 0.8[12], ordinary least squares models for continuous non-monetary end points, and generalized linear models with a log link and gamma distributions for monetary end points. The difference-in-differences analysis estimates policy effects using observational data on stable treatment and comparison groups that exhibit parallel pre-intervention trends and are equally affected by all events with the exception of the policy in question[13,14]. Policy effects are determined by comparing the pre-intervention to post-intervention difference in the treatment group with that in the comparison group: the difference in the differences[13,14]. Previous work has demonstrated that the parallel trends assumption is not violated for this policy change[8]. Difference-in-differences models were estimated for each outcome, controlling for age, sex, Charlson Comorbidity Index, and hospital referral region[15,16]. For each outcome, we estimated the differential effect of being in the treatment group (CalPERS) and the differential effect of the post-policy time period, 2011 to 2013 (Post-policy). The parameter for the combined difference-in-differences effect (CalPERS × Post-policy) is the estimated effect attributable to reference pricing. All analyses were performed using Stata 15.0 (StataCorp). Standard errors were robust and were clustered at the provider level.

Results

The mean patient age was 57 years, the mean Charlson Comorbidity Index score was 0.78, and the cohort was 54% female (Table I). During 2011, 47 hospitals were designated as VBPD facilities. Four hospitals were added in 2012 and 3 hospitals were added in 2013, bringing the total number of VBPD facilities to 54.

Trends in Outcomes

The mean proportions of patients selecting a VBPD facility prior to policy implementation were 49% for CalPERS members and 55% for non-CalPERS members (Table I). After policy implementation, the mean proportions of patients selecting a VBPD facility were 65% for CalPERS patients and 52% for non-CalPERS patients (Fig. 1).

The mean insurer payments were $31,031 for the CalPERS group and $28,886 for the non-CalPERS group prior to policy implementation and decreased after policy implementation to $24,643 (which implies a decrease of $6,388 [21%]) for the CalPERS group and $28,576 (which implies a decrease of $310 [1%]) for the non-CalPERS group (Table I, Fig. 1).

Out-of-pocket payments for non-CalPERS patients increased by a mean of $42 (2%) between the pre-intervention and post-intervention periods (Table I). Out-of-pocket payments for CalPERS patients increased by a mean of $2,257 (112%) between the pre-intervention and post-intervention years (Fig. 1). Stratifying the change in CalPERS out-of-pocket payments by VBPD selection demonstrated a mean increase of $211 (13%) among patients selecting VBPD facilities and a mean increase of $6,525 (269%) among patients selecting non-VBPD facilities (Table I).

The overall complication rate was 5% in both the non-CalPERS and CalPERS groups, with no increasing or decreasing overall trend visible in either group (Table I, Fig. 2). Readmission rates and lengths of stay exhibited gradually declining trends in both groups (Table I, Fig. 2). When comparing the pre-implementation period with the post-implementation period, the readmission rates declined from 9.5% to 7.5% for CalPERS patients and from 8.5% to 6.9% for non-CalPERS patients. The mean lengths of stay for total hip arthroplasty declined from 3.0 to 2.5 days for CalPERS patients and from 2.7 to 2.4 days for non-CalPERS patients. The mean lengths of stay for total knee arthroplasty declined from 2.7 to 2.5 days for CalPERS patients and from 2.9 to 2.6 days for non-CalPERS patients. The mean annual surgical volumes of chosen hospitals showed a gradually increasing trend in all groups.

The proportion of patients discharged to home after total joint arthroplasty was 91% for CalPERS patients and 93% for non-CalPERS patients, with no evident increasing or decreasing trend in either group (Table I, Fig. 2). The mean distance from the patient's home to the hospital was 14.3 miles for CalPERS patients and 13.5 miles for non-CalPERS patients, with a post-intervention increase of 0.2 mile for CalPERS patients and a post-intervention decrease of 0.2 mile for non-CalPERS patients.

Estimated Impact of Reference Pricing

Multivariable difference-in-difference regression models, adjusted for demographic and clinical covariates, demonstrated that a 19-percentage point increase (95% confidence interval [CI], 13.0 to 25.6 percentage points; $p < 0.01$) in the probability of selecting a VBPD facility was attributable to reference pricing (Table II). Reference pricing also resulted in a decrease in the mean insurer payment of $5,067 (95% CI, $2,315 to $7,819; $p < 0.01$) and an increase in the mean out-of-pocket patient payment of $1,991 (95% CI, $1,053 to $2,929; $p < 0.01$). Among quality-related performance metrics, the only

significant change attributable to reference pricing was an 8% reduction (95% CI, 3.3% to 12.7% reduction; $p < 0.01$) in the length of stay for total hip arthroplasty (Table III).

Discussion

Reference pricing is a health insurance innovation designed to reduce health-care spending by providing incentives for patients to choose lower-priced facilities. Insurers set a ceiling on the price they will pay for a service and inform patients where they can receive care at or below that price. Patients can use their coverage to receive treatment from higher-priced providers if they choose, but must pay the entire portion of the bill above the reference price. In contrast to other cost-saving insurance designs such as high-deductible plans and narrow networks, reference pricing maximizes consumer choice and provides an incentive to comparison-shop. Deductibles only reduce spending on services priced below the deductible, and patients tend to respond by utilizing fewer services altogether rather than shopping for lower prices[17]. Narrow network plans also reduce spending but do so by limiting patient choice[18]. Reference pricing allows patients to use their coverage with any provider, requiring a higher out-of-pocket contribution for higher-priced providers rather than limiting access altogether.

CalPERS implemented reference pricing for total joint arthroplasty in 2011, setting a reference price of $30,000 for the facility charge and encouraging patients to choose VBPD facilities with prices of ≤$30,000. The policy functioned as expected. A 19-percentage-point increase in the choice of VBPD facilities and a corresponding $5,067 reduction in the mean insurer payment can be attributed to the reference pricing policy. Reference pricing caused a $1,991 increase in mean patient out-of-pocket spending, which was almost entirely due to increased cost-sharing for patients who chose non-VBPD facilities. The mean out-of-pocket payment increase for patients selecting non-VBPD facilities was $6,525, whereas the mean increase for patients selecting VBPD facilities was $211. This suggests, as intended by the reference price design, that there was no adverse financial impact on patients who selected VBPD facilities. The policy also arguably motivated 7 non-VBPD hospitals to acquire the VBPD designation by the end of the study period.

More importantly, the reference pricing policy did not adversely impact objective quality indicators. Ninety-day rates of complications and readmissions, as well as annual surgical volumes of chosen hospitals, rates of discharge to home, and travel distances showed the same statistically flat trend in both the CalPERS and non-CalPERS groups. The only change in quality attributable to reference pricing was a reduction of 8% in the length of stay for total hip arthroplasty. These results demonstrated that reference pricing is an effective policy for insurers to control costs for total joint arthroplasty without sacrificing quality or access.

The findings of this study must be interpreted in the context of its limitations. The study cohort consisted of a working-age population covered by employment-based health insurance in California and may not be generalizable to the experience of an older, Medicare-eligible population. However, this is the relevant population within which to test reference pricing because this policy is mainly of interest to private insurers with less negotiating power than Medicare to contractually restrain price increases. Another

limitation was our lack of data on age-adjusted total CalPERS and non-CalPERS enrollment, which could have been used to detect whether some patients responded to reference pricing by avoiding total joint arthroplasty altogether. However, a companion study using comparison-population interrupted time-series analysis, a technique that does not require total enrollment data, found that the CalPERS reference pricing policy had no effect on total joint arthroplasty utilization[19]. A final limitation was the inclusion of only the objective quality indicators available in the CalPERS data, without subjective measures such as patient satisfaction and patient functional status. Including these subjective measures would have provided further evidence of any quality changes, but because these indicators were positively associated with surgical volume[20,21], and reference pricing did not cause any decrease in the surgical volume of chosen hospitals, we would not expect patient satisfaction and functional status to have been adversely affected on a population level.

With health-care spending making up a growing share of the U.S. economy, employers, insurers, and policy-makers are under pressure to constrain costs, especially those that may be inflated relative to the value provided to the patient. An ideal cost containment policy would reduce insurer payments, allowing insurers to sustainably cover a valuable procedure, without adversely affecting quality of care or imposing mandatory cost increases on patients. This study showed that the CalPERS reference pricing policy successfully motivated patients to select lower-priced facilities for total joint arthroplasty without sacrificing the quality of care that they received. This study also demonstrated that reference pricing, unlike high-deductible coverage, enables patients to avoid increased out-of-pocket costs as long as they select a lower-priced facility. With regard to the policy's impact on surgeons, professional fees were excluded from the reference pricing program. As such, the policy would be expected to be more desirable to surgeons than alternative policies such as high deductibles and narrow networks, which place larger burdens on patients that may prevent or delay optimal care[17,18]. It remains to be studied whether this policy is scalable throughout the commercial insurance industry and/or applicable to procedures less standardized than those that have been studied. Reference pricing is one element in a shift toward value-based care that surgeons can contribute to by encouraging local health systems to be transparent about costs and patient outcomes, and ambitious in measuring and pursuing value.

Disclosure:

This research was supported by a grant (RO1 HS022098) from the U.S. Agency for Healthcare Research and Quality. On the **Disclosure of Potential Conflicts of Interest** forms, *which are provided with the online version of the article*, one or more of the authors checked "yes" to indicate that the author had a relevant financial relationship in the biomedical arena outside the submitted work and "yes" to indicate that the author had other relationships or activities that could be perceived to influence, or have the potential to influence, what was written in this work (http://links.lww.com/XXXXXXX).

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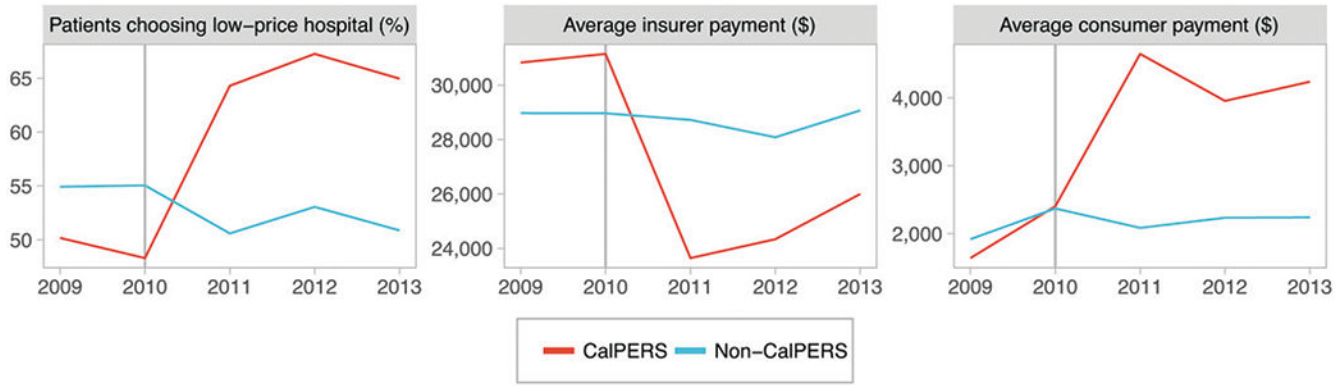

Fig. 1.

Impact of reference pricing on cost-related outcomes. The vertical line represents the introduction of reference pricing for CalPERS patients on January 1, 2011 (data points are end-of-year measures, so the vertical line occurs immediately after December 31, 2010).

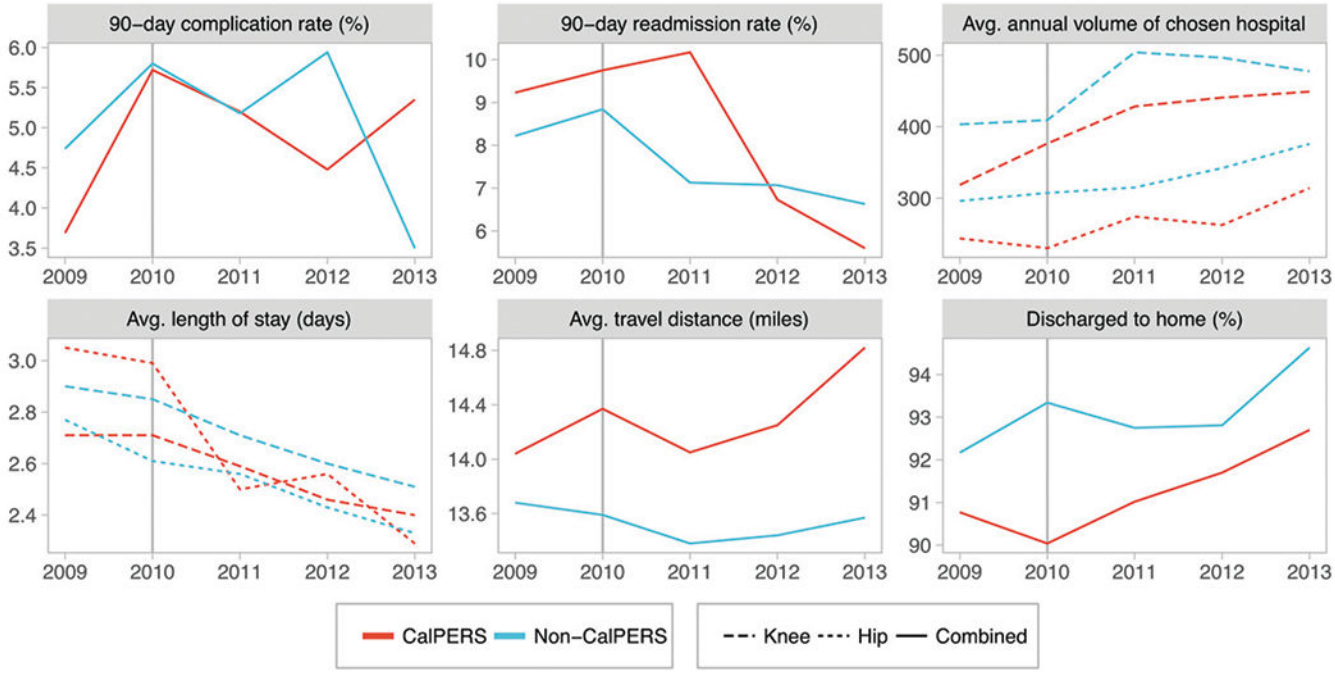

Fig. 2.

Impact of reference pricing on quality-related outcomes. The vertical line represents the introduction of reference pricing for CalPERS patients on January 1, 2011 (data points are end-of-year measures, so the vertical line occurs immediately after December 31, 2010).

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TABLE I

Study Cohort Descriptive Statistics

Study Group	2009	2010	2011	2012	2013
CalPERS Anthem Blue Cross (treatment group)					
No. of procedures	271	472	423	446	411
VBPD facility choice *	50%	48%	64%	67%	65%
Insurer payment *	$30,829	$31,147	$23,646	$24,339	$25,999
Consumer payment *	$1,642	$2,403	$4,646	$3,954	$4,237
To VBPD facilities *	$1,434	$1,771	$1,887	$1,808	$1,744
To non-VBPD facilities *	$1,851	$2,994	$9,617	$8,365	$8,859
Charlson Comorbidity Index *	0.93	0.81	0.93	0.87	0.89
Female sex *	61%	59%	57%	58%	62%
Patient age *(yr)	57.7	58.0	58.0	57.5	58.5
90-day complication rate *	3.7%	5.7%	5.2%	4.5%	5.4%
90-day readmission rate *	9.2%	9.8%	10.2%	6.7%	5.6%
Annual volume of chosen hospital *					
Knee	318.7	376.4	428.3	440.7	449.0
Hip	243.8	230.2	274.3	262.6	314.2
Length of stay *(days)					
Knee	2.7	2.7	2.6	2.5	2.4
Hip	3.1	3.0	2.5	2.6	2.3
Travel distance *(mi)	14.0	14.4	14.1	14.3	14.8
Discharged to home *	91%	90%	91%	92%	93%
Non-CalPERS Anthem Blue Cross (comparison group)					
No. of procedures	1,034	1,742	1,739	1,683	1,826
VBPD facility choice *	55%	55%	51%	53%	51%
Insurer payment *	$28,970	$28,965	$28,722	$28,082	$29,069
Consumer payment *	$1,920	$2,371	$2,086	$2,235	$2,240

Study Group	2009	2010	2011	2012	2013
Charlson Comorbidity Index*	0.81	0.81	0.79	0.78	0.62
Female sex*	51%	52%	53%	51%	54%
Patient age* *(yr)*	56.8	56.6	56.6	56.7	57.2
90-day complication rate*	4.7%	5.8%	5.2%	5.9%	3.5%
90-day readmission rate*	8.2%	8.8%	7.1%	7.1%	6.6%
Annual volume of chosen hospital*					
Knee	403.3	409.2	504.0	496.6	477.4
Hip	296.2	307.4	315.0	342.1	376.0
Length of stay* *(days)*					
Knee	2.9	2.9	2.7	2.6	2.5
Hip	2.8	2.6	2.6	2.4	2.3
Travel distance* *(mi)*	13.7	13.6	13.4	13.4	13.6
Discharged to home*	92%	93%	93%	93%	95%

*The values are given as the mean.

J Bone Joint Surg Am. Author manuscript; available in PMC 2024 January 20.

TABLE II

Multivariable Regression Results for Cost and Access-Related Metrics for 10,047 Patients

	Probability of Selecting VBPD Facility*	Dollar Difference in Payments*,†		Travel Distance*,‡
		For Insurers	For Consumers	
CalPERS × Post-policy§	0.193 ± 0.032#	−5,067 ± 1,404#	1,991 ± 478.6#	−1.717 ± 2.622
CalPERS	−0.060 ± 0.026**	621.3 ± 911.1	−396.4 ± 214.6	1.996 ± 1.977
Post-policy	−0.027 ± 0.038	640.8 ± 1,566	−281.8 ± 486.7	1.442 ± 1.983
Age				
25 to 34 yr	−0.092 ± 0.123	1,270 ± 4,822	754.5 ± 906.1	1.768 ± 13.152
35 to 44 yr	−0.193 ± 0.111	−1,004 ± 3,373	576.4 ± 687.9	−17.560 ± 9.884
45 to 54 yr	−0.178 ± 0.117	−3,891 ± 3,716	918.0 ± 612.7	−20.706 ± 10.336**
55 to 64 yr	−0.191 ± 0.118	−3,889 ± 3,839	499.6 ± 592.9	−20.923 ± 10.506**
Female sex	0.005 ± 0.009	1,305 ± 347.2#	166.1 ± 208.1	−1.626 ± 0.912
Charlson Comorbidity Index	−0.002 ± 0.005	1,023 ± 236.8#	−178.5 ± 60.6#	1.768 ± 13.152
No. of patients	10,047	10,047	10,047	9,215

*The values are given as the coefficient and the standard error.

†The dollar values for the insurer and consumer payments are obtained via mathematical transformation of the original model parameters.

‡These are the distance in miles.

§The post-policy time period (2011 to 2013) was when reference pricing was in force, relative to the pre-policy time period (2009 to 2010). The coefficients for the interaction term CalPERS × Post-policy represent the estimated effect attributable to reference pricing in the difference-in-differences models.

#Significant at $p < 0.01$.

**Significant at $p < 0.05$.

J Bone Joint Surg Am. Author manuscript; available in PMC 2024 January 20.

TABLE III

Multivariable Regression Results for Quality-Related Metrics

	Volume of Chosen Hospital[*,†]		Length of Stay[*,†] *(days)*		Probability of Discharge Home[†]	Probability of 90-Day Complication[†]	Probability of 90-Day Readmission[†]
	Total Knee Arthroplasty	Total Hip Arthroplasty	Total Knee Arthroplasty	Total Hip Arthroplasty			
CalPERS × Post-policy[‡]	0.041 ± 0.088	0.156 ± 0.079[§]	−0.005 ± 0.025	−0.080 ± 0.024[#]	0.010 ± 0.012	0.006 ± 0.011	−0.006 ± 0.014
CalPERS	0.010 ± 0.070	−0.106 ± 0.075	−0.018 ± 0.021	0.075 ± 0.020[#]	−0.018 ± 0.011	−0.002 ± 0.009	0.007 ± 0.010
Post-policy	0.125 ± 0.120	0.092 ± 0.139	−0.059 ± 0.022[#]	−0.060 ± 0.020[#]	0.002 ± 0.008	−0.006 ± 0.005	−0.013 ± 0.006[§]
Age							
25 to 34 yr	−0.769 ± 0.501	0.391 ± 0.507	0.118 ± 0.199	−0.058 ± 0.148	−0.736 ± 0.181[#]	−0.004 ± 0.056	−0.038 ± 0.069
35 to 44 yr	−0.741 ± 0.227[#]	0.181 ± 0.461	−0.217 ± 0.186	−0.010 ± 0.131	−0.751 ± 0.113[#]	0.016 ± 0.051	−0.019 ± 0.054
45 to 54 yr	−0.664 ± 0.238[#]	0.191 ± 0.463	−0.249 ± 0.185	−0.059 ± 0.128	−0.753 ± 0.141[#]	−0.010 ± 0.049	−0.033 ± 0.056
55 to 64 yr	−0.615 ± 0.239[§]	0.153 ± 0.457	−0.224 ± 0.184	−0.046 ± 0.128	−0.786 ± 0.193[#]	−0.009 ± 0.048	−0.029 ± 0.056
Female sex	−0.030 ± 0.029	0.071 ± 0.033[§]	0.069 ± 0.009[#]	0.093 ± 0.012[#]	−0.049 ± 0.010[#]	−0.003 ± 0.005	−0.001 ± 0.006
Charlson Comorbidity Index	−0.029 ± 0.013[§]	−0.026 ± 0.021	0.030 ± 0.004[#]	0.030 ± 0.004[#]	−0.014 ± 0.003[#]	0.006 ± 0.001[#]	0.014 ± 0.001[#]
No. of patients	4,605	4,276	5,205	4,842	10,047	10,047	10,047

[*] The outcome was log-transformed.

[†] The values are given as the coefficient and standard error.

[‡] The post-policy time period (2011 to 2013) was when reference pricing was in force, relative to the pre-policy time period (2009 to 2010). The coefficients for the interaction term CalPERS × Post-policy represent the estimated effect attributable to reference pricing in the difference-in-differences models.

[§] Significant at $p < 0.05$.

[#] Significant at $p < 0.01$.