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Medicare's Acute Care Episode Demonstration: Effects of Bundled Payments on Costs and Quality of Surgical Care

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Received Date : 14-Apr-2016

Revised Date : 04-Nov-2016

Accepted Date : 22-Nov-2016

Article type : Research Article

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Abstract

Objective: To evaluate whether participation in Medicare's Acute Care Episode (ACE) Demonstration Program -- an early, small, voluntary episode-based payment program -- was associated with a change in expenditures or quality of care.

Data sources/study setting: Medicare claims for patients who underwent cardiac or orthopedic surgery from 2007 to 2012 at ACE or control hospitals.

Study design: We used a difference-in-differences approach, matching on baseline and pre-enrollment volume, risk-adjusted Medicare payments, and clinical outcomes to identify controls.

Principal findings: Participation in the ACE Demonstration was not significantly associated with 30-day Medicare payments (for orthopedic surgery: -$358 with 95% CI: -$894, +$178; for cardiac surgery: +$514 with 95% CI: -$1,517, +$2,545), or 30-day mortality (for orthopedic surgery: -0.10 with 95% CI: -0.50, 0.31; for cardiac surgery: -0.27 with 95% CI: -1.25, 0.72). Program participation was associated with a decrease in total 30-day post-acute care payments (for cardiac surgery: -$718; 95% CI: -$1,431, -$6; and for orthopedic surgery: -$591; 95% CI: $-$1,161, -$22).

Conclusions: Participation in Medicare's ACE Demonstration Program was not associated with a change in 30-day episode-based Medicare payments or 30-day mortality for cardiac or orthopedic surgery, but it was associated with lower total 30-day post-acute care payments.

Introduction

The Centers for Medicare & Medicaid Services (CMS) have set ambitious goals to replace fee-for-service payments with alternative payment models (Burwell 2015). One such model is bundled payments, where a fixed payment is provided for a longitudinal episode of care that may span several different care settings and include multiple providers. Bundling payments around an "episode" of care may incentivize providers to better coordinate care, improve quality, and decrease costs. CMS currently has at least four active or proposed bundled payment programs: the Bundled Payments for Care Improvement (BPCI) initiative for up to 48 medical and surgical conditions; the Comprehensive Care for Joint Replacement (CCJR) Model for hip and knee replacement; the Oncology Care Model; and the recently proposed cardiac and orthopedic bundled payment models (Centers for Medicare & Medicaid Services, 2015b, 2015c; Tsai et al. 2015) (Centers for Medicare & Medicaid Services 2016).

Despite enthusiasm for bundled payment, there is limited evidence supporting its effectiveness in reducing costs or improving quality outcomes (Hussey et al. 2012; Shih, Chen, and Nallamothu 2015). Hospitals participating in the ACE Demonstration -- an early, small, voluntary episode-based payment program -- accepted discounted bundled payments from Medicare for cardiovascular and orthopedic inpatient care from 2009 to 2012. We used a difference-in-differences approach to evaluate the impact of the ACE Demonstration Program on Medicare expenditures and clinical outcomes for cardiac and orthopedic surgery.

Methods

ACE Demonstration Overview

The ACE Demonstration was a three-year initiative to test the impact of bundled payments for 28 cardiovascular and 9 orthopedic inpatient services (Centers for Medicare & Medicaid Services 2015a). It built on CMS' earlier experiments with bundled payments: the Cataract Surgery Alternate Payment Demonstration and the Medicare Participating Heart Bypass Demonstration. In the ACE Demonstration, participating organizations received discounted payments for Part A and B services provided during an inpatient stay (see **Appendix Table 1**), and shared in any savings if they met requirements for quality reporting and monitoring (Calsyn and Emanuel 2014). Participating organizations could elect to incentivize physicians through gainsharing. Medicare agreed to share savings with participating beneficiaries, up to the amount of the annual Part B premium (Centers for Medicare & Medicaid Services 2015a).

CMS invited physician hospital organizations that met minimum volume thresholds (e.g., 100 bypass surgeries or 90 hip and knee replacements in 2007), and were located in Texas, Oklahoma, Colorado, and New Mexico, to apply for the ACE Demonstration in May 2008. CMS selected participants based on a number of factors, including ongoing quality improvement efforts, strength of organizational infrastructure, and the proposed discount, which did not include disproportionate share hospital (DSH) or indirect medical education (IME) payments. Participants were announced in January 2009, and CMS launched the program in April 2009. The start date for participants was staggered from April 2009 through November 2010 (Centers for Medicare & Medicaid Services 2015a).

Data Source and Study Population

We used data from the MedPAR (Medicare Analysis Provider and Review) and Master Beneficiary Summary files from 2007-2012 to identify clinical cohorts, identify patient risk factors, and calculate study outcomes. We used the American Hospital Association Annual Survey to identify hospital characteristics.

We included patients who underwent any of the cardiac or orthopedic surgical procedures included in the ACE Demonstration (i.e., cardiac bypass (CABG), cardiac valve surgery, or hip or knee replacement or revision) (**Appendix Table 2**). We excluded patients who were under 65 years of age or over 99 years and patients who were not enrolled in both Medicare Part A and B in the 6 months prior to the index admission and the 3 months after discharge. To increase clinical homogeneity, we also

excluded patients who were nursing home residents prior to surgery. For patients who had multiple admissions for the same procedure in a given year, we chose the first admission in that year.

This study was approved by the University of Michigan Institutional Review Board.

Medicare Expenditures

Our primary spending outcome was total, 30-day episode payments, which we defined as Medicare spending from admission up until 30 days after discharge for any of several components of care: 1) index hospitalization (DRG payments plus outlier payments); 2) re-hospitalization (DRG payments plus outlier payments); 3) physician services at any time during the episode; and 4) post-acute care payments (home health, skilled nursing facility, inpatient rehabilitation facility, and outpatient). Our other spending outcomes were hospital payments and physician payments occurring during the index hospitalization. We chose these spending outcomes, because the ACE Demonstration bundled Part A and B payments during the index hospitalization only. We price-standardized Medicare payments to account for regional differences in prices, using a method that has been previously described (Gottlieb et al. 2010), and adjusted for inflation such that the results are presented in 2012 dollars (Bureau of Labor Statistics 2016). We examined payments prior to the discount that ACE Demonstration hospitals granted to CMS.

Outcome Measures

Our main quality outcomes were mortality within 30 days of the index surgical procedure, serious complications, and 30-day readmissions. We used previously validated algorithms to identify eight common post-operative complications (i.e., pulmonary failure, pneumonia, myocardial infarction, deep venous thrombosis and pulmonary embolism, acute renal failure, postoperative hemorrhage, surgical site infection, and gastrointestinal hemorrhage) with claims data (**Appendix Table 3**) (Iezzoni et al. 1994; Weingart et al. 2000). Similar to prior work, we defined serious complications as any complication accompanied by a length of stay greater than the 75th percentile for the procedure (Osborne et al. 2015). We defined 30-day readmissions as any admission to an acute care hospital that occurred within 30 days of discharge, excluding transfers. The 30-day timeframe has been adopted as the standard timeframe in quality improvement efforts around readmissions (Tsai et al. 2013).

Statistical Analyses

We used difference-in-differences analyses to compare the change in episode payments and clinical outcomes before vs. after enrollment in the ACE Demonstration, compared to control hospitals. In order to select controls that resembled ACE hospitals as closely as possible, we used stratified exact matching (as described in the **Methods Appendix and Appendix Table 4**) to identify control hospitals as participating hospitals. We used multivariate models to adjust for potential confounders not included in the exact matching.

We compared the patient and hospital characteristics of ACE vs. control hospitals, before and after stratified exact matching to check the balance (**Table 1A and 1B**). For each payment and clinical outcome, we also confirmed similar pre-enrollment trends in ACE and control hospitals (Dimick and Ryan 2014).

We next performed the difference-in-differences analyses. We used multivariate generalized linear models with log link to estimate episode payments before and after participation. ACE hospitals had exactly 2 years in the pre-intervention time period, and the post-intervention time period. For our three dichotomous clinical outcomes, we used multivariate logistic regression models. We adjusted our models for patient risk factors including age (continuous), gender, race (black vs. white) and 29 Elixhauser comorbidities (Elixhauser et al. 1998). We also adjusted our models for hospital characteristics that we hypothesized were most likely to be associated with outcomes (i.e., number of beds: <250, 250-499, ≥ 500; profit status: for-profit, non-profit; teaching status; and geographic region: Midwest, Northeast, South and West), when not able to perform an exact match on these characteristics. To account for secular trends over time in payments and clinical outcomes, we also adjusted for year of the procedure. All of our models included an interaction term (ACE x After ACE implementation], with the coefficient for this interaction term being the difference-in-differences estimator. In our primary analyses, we accounted for clustering at the hospital level with robust standard errors. We performed two additional sensitivity analyses: first accounting for clustering at the propensity score strata level and then not accounting for any clustering.

P-values<0.05 were considered to be statistically significant. All analyses were conducted in Stata Version 12.0.

Results

During the study period, a total of 5,017 patients underwent cardiac surgery at the 4 hospitals that enrolled in the ACE Demonstration for these procedures (**Appendix Table 1**). These participating hospitals were matched with 9 control hospitals that cared for 9,617 cardiac surgery patients. For orthopedic surgery, a total of 10,462 patients underwent hip or knee replacement or revision at the 5 hospitals that enrolled in the ACE Demonstration for orthopedics. These participating hospitals were matched with 22 control hospitals that cared for 42,312 patients who underwent one of these procedures during the study period.

Compared to controls, hospitals participating in the ACE Demonstration for cardiac procedures were more likely to be smaller (39% vs. 9% with <250 beds), for-profit (77% vs. 12%), and non-teaching hospitals (100% vs. 71%), but except for profit status, these differences were not statistically significant (p-values >0.05). Similarly ACE hospitals had fewer full-time-equivalent (FTE) employees (1,416 vs. 1,824), and fewer operations per year (11,495 vs. 13,390), but these differences also were not

statistically significant (**Table 1**). Results were similar for orthopedic surgery, except that orthopedic ACE hospitals were more likely to be larger (81% vs. 26% with 500+ beds), have more FTE employees, and perform more operations (29,316 vs. 11,213) compared to non-ACE hospitals. However, these differences were not statistically significant.

The characteristics of patients at ACE hospitals also differed from the characteristics of patients seen at control hospitals (**Appendix Tables 5**, **6** and **7**). Compared to controls, hospitals participating in the ACE Demonstration for cardiac procedures had slightly younger patients (74.1 vs. 74.5 years; p-value<0.01), and a higher proportion of white patients (90% vs. 89%; p-value<0.01). Compared to controls, hospitals participating in the ACE Demonstration for orthopedic procedures had a lower proportion of white patients (88% vs. 95%; p-value<0.01), and were more likely to care for patients with at least two co-morbidities (72% vs. 61%; p-value<0.01). For both cardiac and orthopedic procedures, the proportion of patients with individual co-morbidities at ACE and control hospitals did not differ in clinically meaningful ways.

There were parallel pre-intervention trends in cost and quality outcomes at ACE hospitals and matched controls (**Figure 1**). For example, total 30-day episode payments for cardiac surgery decreased from $45,558 to $43,820 at ACE hospitals during the pre-intervention period, and from $47,057 to $45,524 at control hospitals during this same time period (p-value=0.21). There were also parallel trends for other cost and quality outcomes. Similarly, total 30-day episode payments for orthopedic surgery showed minimal change at ACE hospitals during the pre-intervention period ($22,111 to $21,707), and little change at control hospitals during this same time period ($22,251 to $21,940) (p-value=0.32). Trends at ACE hospitals also mirrored trends at control hospitals for other cost and quality outcomes.

In difference-in-differences analyses, there were no statistically significant changes in total, price-standardized, 30-day episode payments for cardiac surgery at ACE Demonstration hospitals compared to controls, in the post-intervention vs. pre-intervention periods ($514; 95% CI: -$1,517 to $2,545) (**Table 2**). Similarly, program participation was not associated with any change in payments for the index hospitalization ($862; 95% CI: -$396 to $2,120) or inpatient physician care after cardiac surgery ($20; 95% CI: -$423 to $463). Results were similar for payment outcomes for orthopedic surgery. However, program participation was associated with a decrease in total post-acute care payments (for cardiac surgery: -$718; 95% CI: -$1,431, -$6; and for orthopedic surgery: -$591; 95% CI: $-$1,161, -$22).

With regards to clinical outcomes, participation in the ACE Demonstration was not associated with any statistically significant changes in 30-day mortality after cardiac surgery (-0.27; 95% CI: -1.25 to 0.72) (**Table 3**). Program participation also was not associated with any statistically significant changes in readmissions (0.21; 95% CI: -1.67 to 2.09) or serious complications after cardiac surgery (0.81; 95%

CI: -1.80 to 3.42). Results were similar for orthopedic surgery, except ACE hospitals had a statistically significant decrease in readmission rates compared to controls (-2.22; 95% CI: -3.25 to -1.19).

Discussion

We found that participation in the ACE Demonstration Program for cardiac and orthopedic surgery was not associated with a reduction in total 30-day episode payments, hospital payments, or physician payments during the index hospitalization. However, it was associated with a reduction in total 30-day, post-acute care payments. Participation in the ACE Demonstration was not associated with a consistent improvement in clinical outcomes.

Our study adds to existing literature on bundled payments by evaluating the ACE Demonstration using intervention and control hospitals that have parallel pre-intervention trends, one of the major assumptions of the difference-in-differences approach for policy evaluation (Dimick and Ryan 2014). A prior evaluation of the ACE did not explicitly confirm parallel pre-intervention trends for ACE and non-ACE hospitals for all analyses (IMPAQ International and The Hilltop Institute 2013). With our approach, we found no association between participation in the ACE Demonstration and total 30-day episode spending or most clinical outcomes. However, program participation was associated with lower total 30-day, post-acute care spending.

Our findings should be interpreted in the context of earlier evidence in support of "bundling" health care payments. The Inpatient Prospective Payment System (IPPS) bundled payments for hospital care excluding physician services, reimbursing hospitals a fixed payment per admission based on a patient's diagnosis. The IPPS dramatically reduced length of stay but did not adversely affect mortality or readmission rates (Chulis 1991; Feinglass and Holloway 1991; Kahn et al. 1990; Lave 1989). Research also suggests that the Medicare Heart Bypass Demonstration – which bundled inpatient hospital and physician payments and readmissions for 7 hospitals – reduced Medicare spending primarily through discounted payments but also through decreases in post-discharge care (Cromwell et al. 1998).

There may be several reasons why the ACE Demonstration did not succeed in reducing total 30-day episode payments. It is possible that incentives were not large enough for providers to fully engage in the initiative. Hospitals negotiated their own discounts with Medicare, but not all hospitals engaged in gainsharing with physicians (IMPAQ International and The Hilltop Institute 2013). Recent attempts at bundled payments also make clear that there are substantial barriers to implementation, such as lack of advanced information technology as well as lack of established mechanisms to distribute physician payments (Hussey, Ridgely, and Rosenthal 2011; Ridgely et al. 2014). Our findings, in conjunction with the fact that payments to physicians make up a small proportion of total episode payments for surgery (Birkmeyer et al. 2010; Miller et al. 2011), should temper enthusiasm for an inpatient-only bundle.

However, they leave open the possibility that more inclusive bundles may have a larger impact on utilization and quality of care. Early evidence suggests that a broad bundle for lower extremity joint replacement can lower total episode spending (Dummit et al. 2016).

Even though the ACE Demonstration only bundled inpatient payments, we found that total 30-day post-acute care payments were lower for ACE vs. non-ACE hospitals. This was surprising. It could be that ACE hospitals were more involved in non-ACE initiatives that bundled payments over a longer time period. CMS' criteria for selecting participating organizations included the presence of strong organizational infrastructure and experience with quality improvement activities (Centers for Medicare & Medicaid Services 2015a). It may also be that efforts to increase inpatient efficiencies for the ACE Demonstration fostered a culture of "value" that affected discharge decisions (e.g., fewer discharges to post-acute care facilities when those services were not believed to be unnecessary). We did not have the qualitative data to explore these hypotheses.

Our study had several potential limitations. First, our primary goal was to assess how participation in the ACE Demonstration affected both utilization within an episode of care and quality of care. Therefore, we cannot make any conclusions about the ACE Demonstration's impact on either hospitals' costs of care or actual payments disbursed by Medicare. Second, because we performed a quasi-experimental study of a voluntary program, our results may be biased by selection. Although we matched hospitals on outcomes at baseline, pre-intervention year 1, and pre-intervention year 2, differences still remained after matching, most notably with profit status. We also compared each hospital both to itself in a pre-/post- comparison and to controls. Third, since the number of hospitals participating in the ACE Demonstration was very small (4 for cardiac surgery and 5 for orthopedic surgery), we did not have the power to detect small differences in utilization or clinical outcomes. Finally, we did not have complete information about participation in other value-based purchasing programs, which may have provided additional incentives for lower episode payments. In the few areas where the ACE Demonstration was associated with lower utilization (i.e., total post-acute care payments and readmissions), we cannot rule out the possibility that the effects may in part have been due to participation in non-ACE value-based purchasing programs.

In spite of these limitations, it is worth considering the implications of our results for the current expansion of episode-based payment models (Centers for Medicare & Medicaid Services, 2015b; Kline et al. 2015). First, our results suggest that the limited scope of some of the BPCI models may limit their effectiveness (e.g., Model 1, which bundles Part A and B payments during the inpatient stay, like the ACE Demonstration; Model 3, which bundles post-acute care alone; and Model 4, which bundles the index admission and any readmissions) (Centers for Medicare & Medicaid Services 2014). Second, the

magnitude of the incentives in the evolving CCJR and Oncology Care Models may need to be larger than those extended to ACE hospitals in order to have a larger impact on utilization and quality.

Bundled payment is alternative to fee-for-service that is increasingly being considered by payers. Nonetheless, we cannot assume that it will improve value. To be effective, bundled payment must ultimately incentivize lower utilization. Our results suggest that the ACE Demonstration – evaluate small, voluntary, early bundled payment program -- was associated with lower total 30-day post-acute care utilization. It would be important to assess whether broader bundles with more participants – such as those that have been implemented or proposed by CMS – have similar or larger effects for a broad range of conditions. Medicare may initially save money through bundled payment programs that incorporate discounted episode payments to providers (e.g., BPCI), but discounted episode payments amount to the same thing as rate cuts. Research must strive to understand the designs of bundled payment programs that can improve value over the long term by lowering utilization without compromising quality.

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Table 1. Characteristics of hospitals participating in the ACE Demonstration compared with nonparticipating (control) hospitals before and after propensity score matching

Hospital characteristics	ACE	Non-ACE		p-value
		Before matching	After matching	
Cardiac surgery				
No. of hospitals	4	1,116	9	
No. of patients	5,017	671,767	9,617	
Annual cardiac surgery volume in enrollment year, median (IQR)	260 (169-478)	184 (110-307)	236 (212-292)	0.46
Profit status, %				0.02
For-profit	77	10	12	
Nonprofit	23	82	88	
Other	0	8	0	
Number of beds, %				0.96
<250	39	16	9	
250-499	23	42	48	
≥500	37	42	44	
Geographic region, %				0.33
Northeast	0	21	0	
West	25	16	33	
Midwest	0	25	14	
South	75	38	53	
Other characteristics, median (IQR)				
Non-teaching, %	100	66	71	0.16
Technology hospital, %	100	99	100	.
Urban, %	100	94	100	.
Nurse ratio	8 (5-10)	7 (6-9)	8 (6-9)	0.63
Medicaid, %	11	17	15	0.33
Total admissions	9,982 (8,990-63,438)	21,668 (14,575-31,600)	17,347 (13,705-47,442)	0.76

FTEs	1,416 (734-4,344)	2,452 (1,575-4,254)	1,824 (1,498-5,196)	0.99
Operations/y	11,495 (7,108-29,316)	15,124 (9,505-23,384)	13,390 (11,351-28,591)	0.93
Operating rooms	24 (5-52)	21 (14-33)	26 (22-49)	0.96

Table 1. Characteristics of hospitals participating in the ACE Demonstration compared with nonparticipating (control) hospitals before and after propensity score matching (cont'd)

Hospital characteristics	ACE	Non-ACE		p-value
		Before matching	After matching	
Orthopedic surgery				
No. of hospitals	5	2,959	22	
No. of patients	10,462	2,643,304	42,312	
Orthopedic surgery volume in enrollment year, median (IQR)	1152 (249-1152)	335 (183-585)	459 (382-643)	0.97
Profit status, %				<0.001
For-profit	98	10	10	
Nonprofit	2	80	90	
Other	0	9	0	
Number of Beds, %				0.05
<250	17	40	29	
250-499	2	37	45	
≥500	81	23	26	
Geographic region, %				0.10
Northeast	0	18	16	
West	17	18	19	
Midwest	0	28	44	
South	83	36	21	
Other characteristics, median (IQR)				
Non-teaching, %	100	82	84	0.16
Technology hospital, %	95	78	90	0.08

Urban, %	100	92	88	0.16
Nurse ratio	5 (5-6)	7 (6-9)	7 (6-9)	0.83
Medicaid, %	21	16	11	0.27
Total admissions	63,438 (10,232-63,992)	14,637 (8,101-23,325)	18,474 (9,912-24,358)	0.63
FTEs	4,852 (924-5,479)	1,611 (883-2,739)	1,938 (1,227-3,096)	0.96
Operations/y	29,316 (10,170-30,531)	10,414 (6,364-17,389)	11,213 (7,554-17,166)	0.87
Operating rooms	52 (19-60)	14 (9-24)	18 (14-23)	0.61

Abbreviations: ACE is Acute Care Episode; FTE is full-time equivalent employees; Operations/y is total annual surgical operations.

Figure 1. Cost and quality before vs. after participating in the ACE Demonstration compared with matched non-ACE control hospitals

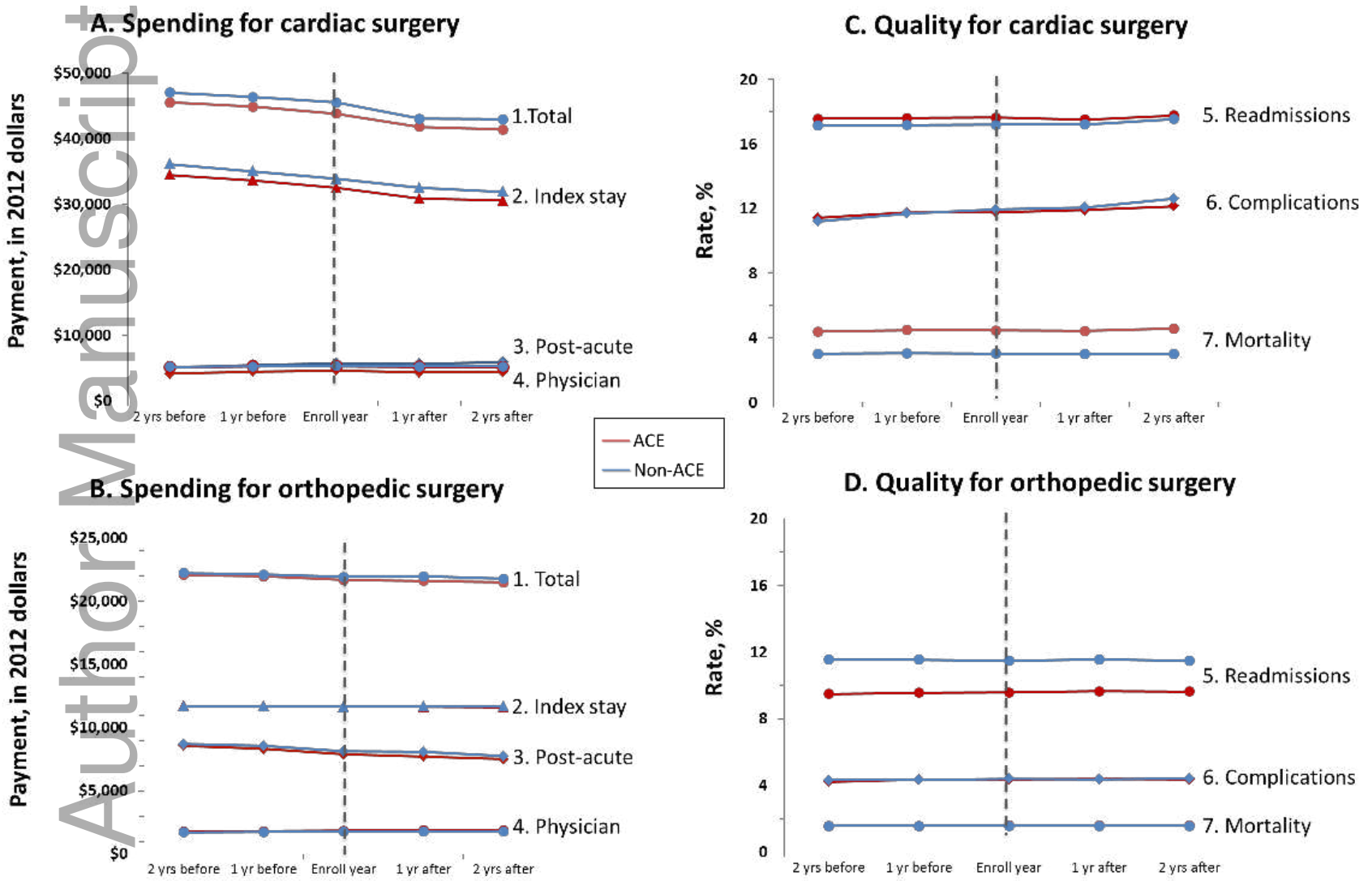

Table 2. Thirty-day total and component episode payment outcomes before vs. after participating in the ACE Demonstration compared with matched non-ACE (control) hospitals

Cost Outcome, by procedure	Marginal predicted payments, $s		Difference in Average Medicare Payments After vs. Before the ACE Demonstration, compared to Controls (95% CI), $s
	Pre-enrollment	Post-enrollment	
Cardiac Surgery			
Home health (N=5,095)			
ACE	1,584	1,637	16 (-196, 229)
Non-ACE	1,780	1,816	
Skilled nursing facility (N=2,020)			
ACE	8,422	10,166	1,013 (-154, 2,180)
Non-ACE	7,063	7,817	
Inpatient rehabilitation (N=144)			
ACE	22,262	29,129	5,234 (-3,868, 14,336)
Non-ACE	13,662	14,615	
Other post-acute care (N=5,755)			
ACE	2,103	1,481	-684 (-1,733, 364)
Non-ACE	4,031	4,182	
Total post-acute care (N=8,128)			
ACE	4,772	4,363	-718 (-1,431, -6)
Non-ACE	5,429	5,772	
Index admission (N=10,667)			
ACE	31,144	31,556	862 (-396, 2,120)
Non-ACE	34,666	34,231	
Physician (N=10,860)			

ACE	4,339	4,489	20 (-423, 463)
Non-ACE	5,987	6,187	
Total episode (N=9,735)			
ACE	40,673	40,315	514 (-1,517, 2,545)
Non-ACE	47,186	46,192	

Table 2. Thirty-day total and component episode payment outcomes before vs. after participating in the ACE Demonstration compared with matched non-ACE (control) hospitals (cont'd)

Cost Outcome, by procedure	Marginal predicted payments, $s		Difference in Average Medicare Payments After vs. Before the ACE Demonstration, compared to Controls (95% CI), $s
	Pre-enrollment	Post-enrollment	
Orthopedic Surgery			
Home health (N=10,375)			
ACE	2,703	2,840	6 (-288, 300)
Non-ACE	2,804	2,938	
Skilled nursing facility (N=7,377)			
ACE	7,804	8,189	-204 (-737, 330)
Non-ACE	9,490	10,077	
Inpatient rehabilitation (N=652)			
ACE	14,495	15,527	-410 (-1,656, 837)
Non-ACE	12,771	14,371	
Other post-acute care (N=8,147)			
ACE	3,555	4,367	-154 (-1,298, 991)
Non-ACE	4,416	5,404	
Total post-acute care (N=17,641)			
ACE	8,595	7,904	-591 (-1,161, -22)
Non-ACE	8,069	7,987	

Index admission (N=23,706)			
ACE	11,445	11,864	-1 (-88, 86)
Non-ACE	11,490	11,908	
Physician (N=18,213)			
ACE	2,068	2,104	8 (-80, 96)
Non-ACE	2,210	2,237	
Total episode (N=19,680)			
ACE	22,501	22,413	-358 (-894, 178)
Non-ACE	21,705	21,899	

Abbreviations: ACE is Acute Care Episode; PAC is post-acute care; no. is number; CI is confidence interval and ref is reference.**Table 3. Thirty-day total and component quality outcomes before vs. after participating in the ACE Demonstration compared with matched non-ACE (control) hospitals**

Quality Outcome, by procedure	**Marginal Predicted Rate of Outcomes**		**Difference in Rates of Adverse Outcomes After vs. Before the ACE Demonstration, Compared to Control Hospitals (95% CI)**
	Pre-enrollment	**Post-enrollment**	
Cardiac Surgery			
Serious complications (N=14,634)			
ACE	9.29	12.55	0.81 (-1.8, 3.42)
Non-ACE	10.76	14.28	
Readmissions (N=23,423)			
ACE	15.29	16.42	0.21 (-1.67, 2.09)
Non-ACE	16.7	17.53	
Mortality (N=26,675)			
ACE	1.77	2.03	-0.27 (-1.25, 0.72)
Non-ACE	4.37	4.65	
Orthopedic Surgery			
Serious complications (N=52,774)			

ACE	3.85	2.65	-1.14 (-2.33, 0.04)
Non-ACE	4.37	3.81	
Readmissions (N=43,046)			
ACE	9.94	7.96	-2.22 (-3.25, -1.19)
Non-ACE	11.48	11.61	
Mortality (N=37,645)			
ACE	1.66	1.37	-0.1 (-0.5, 0.31)
Non-ACE	1.72	1.48	

ACE is Acute Care Episode; no. is number; CI is confidence interval and ref is reference.

Table 1. Characteristics of hospitals participating in the ACE Demonstration compared with nonparticipating (control) hospitals before and after propensity score matching

Hospital characteristics	ACE	Non-ACE		p-value
		Before matching	After matching	
Cardiac surgery				
No. of hospitals	4	1,116	9	
No. of patients	5,017	671,767	9,617	
Annual cardiac surgery volume in enrollment year, median (IQR)	260 (169-478)	184 (110-307)	236 (212-292)	0.46
Profit status, %				0.02
For-profit	77	10	12	
Nonprofit	23	82	88	
Other	0	8	0	
Number of beds, %				0.96
<250	39	16	9	
250-499	23	42	48	
≥500	37	42	44	
Geographic region, %				0.33
Northeast	0	21	0	
West	25	16	33	
Midwest	0	25	14	
South	75	38	53	
Other characteristics, median (IQR)				
Non-teaching, %	100	66	71	0.16
Technology hospital, %	100	99	100	.
Urban, %	100	94	100	.
Nurse ratio	8 (5-10)	7 (6-9)	8 (6-9)	0.63
Medicaid, %	11	17	15	0.33
Total admissions	9,982 (8,990-63,438)	21,668 (14,575-31,600)	17,347 (13,705-47,442)	0.76

FTEs	1,416 (734-4,344)	2,452 (1,575-4,254)	1,824 (1,498-5,196)	0.99
Operations/y	11,495 (7,108-29,316)	15,124 (9,505-23,384)	13,390 (11,351-28,591)	0.93
Operating rooms	24 (5-52)	21 (14-33)	26 (22-49)	0.96

Table 1. Characteristics of hospitals participating in the ACE Demonstration compared with nonparticipating (control) hospitals before and after propensity score matching (cont'd)

Hospital characteristics	ACE	Non-ACE		p-value
		Before matching	After matching	
Orthopedic surgery				
No. of hospitals	5	2,959	22	
No. of patients	10,462	2,643,304	42,312	
Orthopedic surgery volume in enrollment year, median (IQR)	1152 (249-1152)	335 (183-585)	459 (382-643)	0.97
Profit status, %				<0.001
For-profit	98	10	10	
Nonprofit	2	80	90	
Other	0	9	0	
Number of Beds, %				0.05
<250	17	40	29	
250-499	2	37	45	
≥500	81	23	26	
Geographic region, %				0.10
Northeast	0	18	16	
West	17	18	19	
Midwest	0	28	44	
South	83	36	21	
Other characteristics, median (IQR)				
Non-teaching, %	100	82	84	0.16
Technology hospital, %	95	78	90	0.08

Urban, %	100	92	88	0.16
Nurse ratio	5 (5-6)	7 (6-9)	7 (6-9)	0.83
Medicaid, %	21	16	11	0.27
Total admissions	63,438 (10,232-63,992)	14,637 (8,101-23,325)	18,474 (9,912-24,358)	0.63
FTEs	4,852 (924-5,479)	1,611 (883-2,739)	1,938 (1,227-3,096)	0.96
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Table 2. Thirty-day total and component episode payment outcomes before vs. after participating in the ACE Demonstration compared with matched non-ACE (control) hospitals

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