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Cost of Joint Replacement Using Bundled Payment Models

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IMPORTANCE Medicare launched the mandatory Comprehensive Care for Joint Replacement bundled payment model in 67 urban areas for approximately 800 hospitals following its experience in the voluntary Acute Care Episodes (ACE) and Bundled Payments for Care Improvement (BPCI) demonstration projects. Little information from ACE and BPCI exists to guide hospitals in redesigning care for mandatory joint replacement bundles.

OBJECTIVE To analyze changes in quality, internal hospital costs, and postacute care (PAC) spending for lower extremity joint replacement bundled payment episodes encompassing hospitalization and 30 days of PAC.

DESIGN, SETTING, AND PARTICIPANTS This observational study followed 3942 total patients with lower extremity joint replacement at Baptist Health System (BHS), which participated in ACE and BPCI.

EXPOSURES Lower extremity joint replacement surgery under bundled payment at BHS.

MAIN OUTCOMES AND MEASURES Average Medicare payments per episode, readmissions, emergency department visits, prolonged length of stay, and hospital savings from changes in internal hospital costs and PAC spending.

RESULTS Overall, 3942 patients (mean [SD] age, 72.4 [8.4] years) from BHS were observed. Between July 2008 and June 2015, average Medicare episode expenditures declined 20.8%, from $26 785 to $21 208 ($P < .001$) for 3738 episodes of joint replacement without complications. It declined 13.8% from $38 537 to $33 216 ($P = .61$) for 204 episodes of joint replacement with complications. Readmissions and emergency department visits declined 1.4% ($P = .14$) and 0.9% ($P = .98$), respectively, while episodes with prolonged length of stay decreased 67.0% ($P < .001$). Patient illness severity remained stable. By 2015, 51.2% of overall hospital savings had come from internal cost reductions and 48.8% from PAC spending reductions. Reductions in implant costs, down on average $1920.68 (29%) per case, contributed the greatest proportion of hospital savings. Average PAC spending declined $2443.12 (27%) per case, largely from reductions in inpatient rehabilitation and skilled nursing facility spending but only when bundles included financial responsibility for PAC.

CONCLUSIONS AND RELEVANCE During a period in which Medicare payments for joint replacement episodes increased by 5%, bundled payment for procedures at BHS was associated with substantial hospital savings and reduced Medicare payments. Decreases in PAC spending occurred only when it was included in the bundle.

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The Centers for Medicare and Medicaid Services (CMS) is committed to changing 50% of reimbursement to alternative payment models by 2018.[1] One strategy for achieving this goal is to bundle payments by applying a fixed price to individual episodes of care, such as joint replacement or coronary artery bypass graft plus postacute rehabilitation. By including services from multiple health care providers within the fixed target price, bundled payment incentivizes care coordination and efficiency.

In 2009, CMS tested bundles for 37 orthopedic and cardiac procedures among 5 health systems through the voluntary Acute Care Episode (ACE) demonstration.[2] Under ACE, bundles included physician professional fees and hospital facility fees, enabling hospitals to share savings with physicians to incentivize cost reductions beyond those occurring under prospective payment alone. In 2013, CMS expanded bundled payments through the voluntary Bundled Payment for Care Improvement (BPCI) program.[3] "Major joint replacement of the lower extremity" (MJRLE) was the most commonly selected BPCI bundle, both overall and among the 451 participants in BPCI Model 2, in which episodes encompassed both acute hospital and postacute care (PAC).[4]

In April 2016, amid continued nationwide increases in joint replacement expenditures, CMS initiated the Comprehensive Care for Joint Replacement (CJR) program, a mandatory bundled payment for MJRLE directly based on BPCI Model 2 (information available from authors on request).[5] Under CJR, all hospitals (approximately 800) in 67 urban geographic areas are required to accept bundled payment for hospital, physician, and PAC services for 90 days.[5] Medicare pays all providers using fee-for-service until the end of the episode, when total spending is reconciled against a fixed target price and participating hospitals either receive a bonus payment for below-target episode spending or pay a recoupment amount if spending exceeds the target.

Under both CJR and BPCI, hospitals are incentivized to redesign care across the care continuum because, while savings to Medicare occur only when total episode payments decrease, hospitals accrue savings (ie, increased margins) by reducing either internal costs during hospitalizations and/or total episode payments from Medicare. In contrast to BPCI, CJR involves a 90-day bundle, incorporates risk-adjusted hospital complications such as acute myocardial infarction and pneumonia into quality measurement, and uses regional benchmarks in computing hospital baselines.[5]

Our study complements recent studies of MJRLE in BPCI by including hospital internal cost data and a comparison of ACE and BPCI to create a more complete view of bundled payment effects.[6,7] We analyzed the cost and quality performance of Baptist Health System (BHS), a clinically integrated network of 5 hospitals in San Antonio, Texas. The BHS has participated in all the Medicare joint replacement bundles, starting with ACE in 2008 and including BPCI Model 2, and cared for over 3000 patients under these programs.

Key Points

Question What are the drivers of reductions in Medicare payments and hospital savings (ie, increased margin) in bundled payment for joint replacement surgeries?

Findings In this observational study of 3942 patients who received joint replacement surgery, there was a decrease of $5577 (20.8%) in total spending per episode. Most of the hospital savings came from implants and supplies and most of the postacute care savings came from decreased use of institutional care.

Meaning A large portion of savings came from declines in implant prices and usage of high cost postacute services—both changes that may be implemented rapidly without intensive investment in care coordination.

Methods

Data

Claims and internal cost data were obtained directly from BHS. We used Medicare claims to construct care episodes encompassing acute hospitalization plus 30 days of PAC after hospital discharge based on BHS' selected BPCI arrangement with CMS. Internal cost data for hospitalizations were aggregated at the level of individual physician per quarter. Data were not available from the transition period between ACE and BPCI (July 2012 to September 2013), during which BHS was not paid under bundled payment and did not collect internal cost data because of the resource intensity required.

Study Population

The study sample included all Medicare patients discharged from BHS hospitals from July 2008 to June 2015 for episodes corresponding to Medicare severity diagnosis related groups (MS-DRGs) 469 and 470 (MJRLE with and without major complications or comorbidities, respectively), excluding those discharged during the transition period between ACE and BPCI. Of the 4248 patient episodes, 3942 (93%) were matched to BHS internal cost data. Of these, 3738 (94.8%) were for MJRLE without complications.

Four Study Periods

We defined four study periods. First, the "ACE baseline period" was from July 2008 to December 2008, when BHS was paid nonbundled fee-for-service prior to participation in ACE. Second, the "ACE period" was from July 2009 to June 2012, when BHS implemented orthopedic bundles for acute hospitalization only. Third, the "transition period" was from July 2012 and September 2013, when BHS prepared for BPCI Model 2 but did not receive bundled payments. Fourth, the "BPCI period" was October 2013 to June 2015 when BHS implemented bundles spanning acute hospitalization and 30 days of PAC.

Spending and Cost Categories

Episode payment (ie, the sum of Medicare payments for an episode) was constructed by combining all acute hospital facility

Table 1. Characteristics of Patients Admitted for Joint Replacement Surgery With and Without Major Comorbidities or Complications (DRGs 469 and 470)

Characteristic	ACE Year 1 (7/2009-6/2010)	ACE Year 2 (7/2010-6/2011)	ACE Year 3 (7/2011-6/2012)	BPCI Year 1 (10/2013-6/2014)	BPCI Year 2 (7/2014-6/2015)
Quarterly volume, cases, mean, No.					
DRG 470[a]	177	182	183	205	239
DRG 469[b]	15	13	9	9	7
Patient demographics					
Male, %	33.5	34.1	33.9	33.9	36.9
Age, mean (SD), y	73.2 (8.5)	72.4 (8.6)	72.1 (8.8)	72.3 (7.9)	71.9 (8.1)
Primary diagnosis, %					
Osteoarthrosis of lower leg	43.0	51.3	49.3	46.3	41.3
Osteoarthrosis of pelvis and thigh	12.6	12.7	13.2	12.8	12.1
Lower leg pain	3.4	7.3	11.6	14.0	16.9
Closed fracture of femur	1.6	3.0	6.6	8.2	11.7
Pelvis and thigh pain	9.1	8.6	8.6	5.9	4.3
Coexisting condition, %					
Hypertension	67.0	69.5	68.9	69.0	63.5
Diabetes mellitus, uncomplicated	20.6	22.2	22.4	22.7	19.1
Hypothyroidism	19.3	18.9	18.5	22.2	21.9
Chronic pulmonary disease	16.5	16.9	16.8	15.7	15.2
Obesity	13.4	16.1	20.5	21.5	20.1
Congestive heart failure	4.8	4.4	4.7	4.1	2.6
Renal failure	8.0	9.4	7.5	7.0	7.2
Fluid and electrolyte abnormalities	4.5	3.4	5.8	10.1	6.1
Elixhauser comorbidity score, mean (SD)[c]					
DRG 470[a]	1.1 (4.0)	1.2 (4.5)	1.2 (4.7)	1.1 (4.8)	1.2 (4.7)
DRG 469[b]	7.4 (7.0)	6.2 (6.6)	6.1 (6.0)	8.0 (7.3)	5.4 (7.5)
Combined	1.6 (4.6)	1.5 (4.8)	1.4 (4.9)	1.4 (5.1)	1.3 (4.8)
Length of stay, mean (SD), d					
DRG 470	3.9 (1.5)	3.6 (1.4)	3.5 (1.2)	2.9 (1.4)	2.7 (1.2)
DRG 469	6.8 (4.0)	6.7 (4.2)	7.2 (5.2)	8.3 (6.1)	7.2 (5.3)
Combined	4.1 (2.0)	3.8 (1.8)	3.6 (1.8)	3.2 (2.1)	2.8 (1.6)
Discharge location, %					
Home with services	45.1	53.3	53.4	60.3	67.5
IRF	17.6	18.1	18.1	9.5	7.4
SNF	26.2	23.0	23.6	23.6	20.1
Home	8.9	4.4	4.2	5.4	4.5
LTAC	0.8	0.4	0.1	0.3	0.2
Other	1.3	0.5	0.7	0.6	0.2
Quality metrics, %					
Episodes with a readmission	6.4	6.0	8.7	6.5	4.4
Episodes with an ER visit	7.4	7.5	7.0	9.1	6.5
Episodes with prolonged length of stay	21.2	16.9	13.4	9.2	6.6

Abbreviations: ACE, Acute Care Episodes bundled payment program by Medicare; BPCI, Bundled Payments for Care Improvement program by Medicare; ER, emergency department; IRF, inpatient rehabilitation facility; LTAC, long-term acute care facility; MS-DRG, Medicare severity diagnosis-related group; SNF, skilled nursing facility.

[a] The patients in MS-DRG 470 underwent major joint replacement or reattachment of lower extremity without major complications or comorbidities.

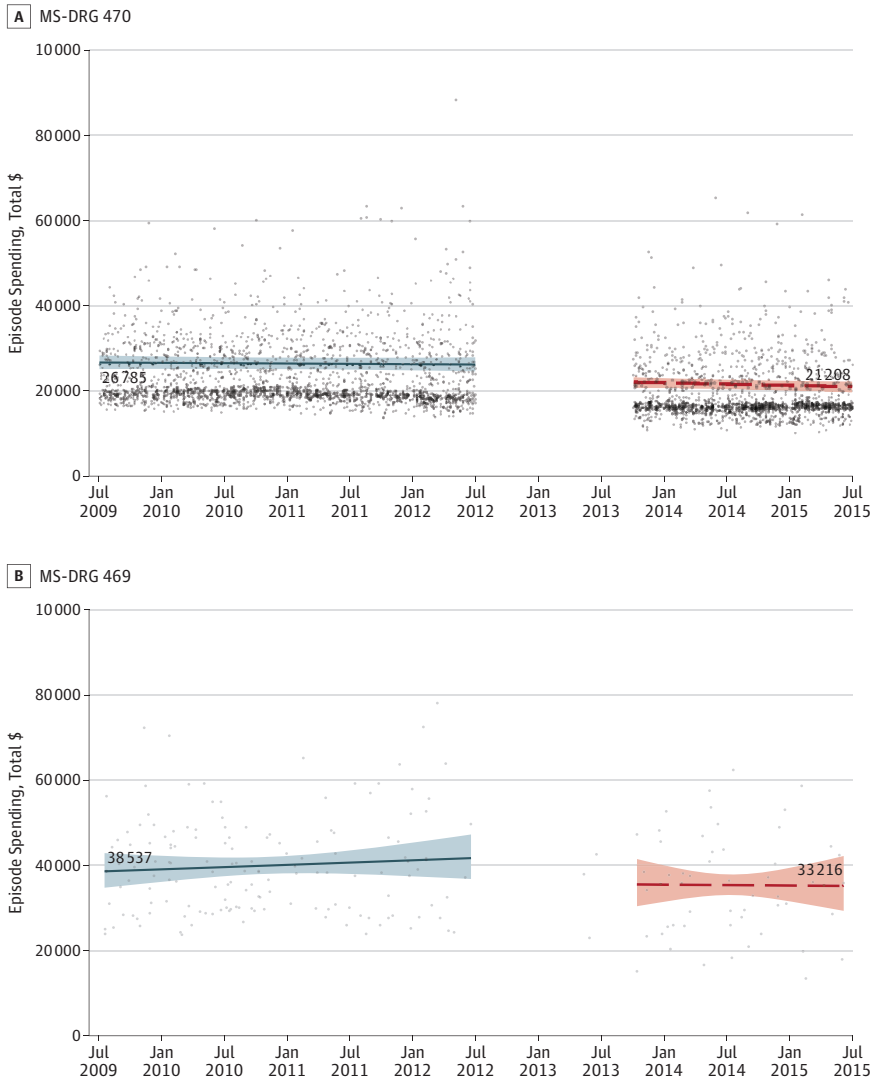
[b] The patients in MS-DRG 469 underwent major joint replacement or reattachment of lower extremity with major complications or comorbidities.

[c] The Elixhauser comorbidity score is an index of severity with a range of −20 to +90 with increasing scores highly correlated with in-hospital death.[10]

payments, professional (physician) fees during hospitalization, and PAC payments up to 30 days posthospital discharge. We disaggregated PAC spending into 9 categories: (1) professional—physician fees; (2) durable medical equipment (DME); (3) outpatient visits (OP); (4) emergency department visits (ER); (5) readmission; (6) skilled nursing facilities (SNF); (7) inpatient rehabilitation facilities (IRF); (8) home health agencies (HH); and (9) long-term acute care providers (LTAC).

Similarly, we used BHS internal cost data to divide total hospital costs into 8 components. Costs were measured using the time-driven activity-based costing (TDABC) technique, in which labor and capital costs are allocated based on time studies and in-person observations of shift activities.[8,9] The CMS-approved protocol required BHS to collect cost data on 7 components deemed to be within the influence of surgeons: (1) implant costs—costs of orthopedic implants; (2) OR costs—operating room staffing and equipment; (3) room and board costs—room and board from inpatient days including staffing (length of stay); (4) supply costs—hospital supplies and equipment excluding implants; (5) prescription costs—

Figure 1. Episode Spending for Major Joint Replacements of Lower Extremities With and Without Major Complications or Comorbidities Over ACE and BPCI



A, Total spending for each joint replacement performed at Baptist Health System (BHS) under the Medicare severity diagnosis related groups (MS-DRG) 470 during the ACE and BPCI programs. The gap represents a transition period during which BHS was preparing for BPCI. The average episode spending dropped 20.8% from $26 785 at the start of ACE to $21 208 ($P < .001$) in Q2 2015 (end of BPCI year 2). The blue line shows the fitted episode spending using a piecewise linear model in each program period. The red line shows the CMS episode target price under BPCI. B, Total spending for each joint replacement performed at BHS under the MS-DRG 449 during the ACE and BPCI programs. The gap represents a transition period during which BHS was preparing for BPCI. The average episode spending dropped 13.8% from $38 537 at the start of ACE to $33 216 ($P = .54$) in Q2 2015 (end of BPCI Year 2). The blue line shows the fitted episode spending using a piecewise linear model in each program period. The red line shows the CMS episode target price under BPCI. ACE indicates acute care episodes Medicare demonstration project; BPCI, bundled payments for care improvement Medicare demonstration project.

medications; (6) blood costs—costs associated with blood products and transfusion; and (7) ICU costs—costs from admission to the intensive care unit including staffing. Other fixed and variable costs that were applied consistently across all admissions, whether for MJRLE or not, were aggregated into a separate, eighth component—other costs.

Hospital Savings

In ACE, hospitals earned savings (ie, additional margin) by decreasing internal costs against the fixed bundled payment that covered hospital and physician fees. In BPCI, hospitals had 2 avenues for savings: decreasing internal costs against the prospective payment for the hospitalization and/or decreasing PAC spending against an overall target episode price that included PAC.

Conversely, savings to Medicare accrued primarily when total episode payments decreased as a result of reduced PAC spending because, in most cases, CMS pays a prospective payment to the hospital for hospitalizations independent of internal cost.

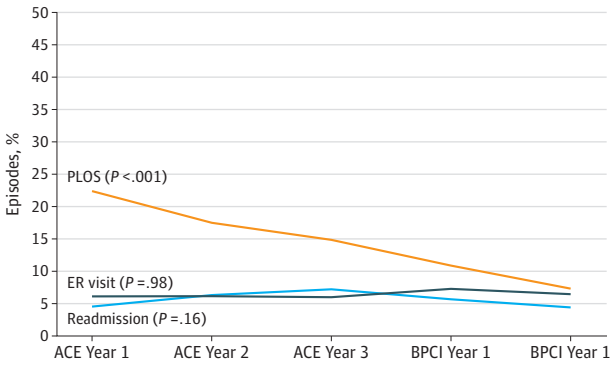
Quality Measurement

We evaluated 3 quality measures based on CMS demonstration project specifications[7,10] and sensitivity for detecting quality of care in joint replacement.[11] We calculated the 30-day readmission and ER visit rates. We also computed the proportion of episodes with a prolonged length of stay (PLOS), a validated measure of complications for MJRLE.[12,13] The Elixhauser Comorbidity Index was used to evaluate illness severity.[14-16]

Statistical Analysis

We analyzed changes in episode payments and PAC spending using Medicare data, changes in internal hospital cost using

Figure 2. Quality of Care for Major Joint Replacements of Lower Extremities With and Without Major Complications or Comorbidities as Measured by ER Visits, Readmissions, and PLOS Over ACE and BPCI



The proportion of episodes in which patient experienced a prolonged length of stay from a likely complication decreased over both ACE and BPCI. The proportion of episodes in which patients visited the ER or experienced a readmission in the postdischarge period was stable during both ACE and BPCI. The *P* values correspond to the test of trend. The gap represents a transition period during which BHS was preparing for BPCI. ACE indicates acute care episodes Medicare demonstration project; BPCI, bundled payments for care improvement Medicare demonstration project; ER, emergency department; PLOS, prolonged length of stay.

BHS internal cost data, and changes in hospital savings using both. Physician-quarter level internal hospital cost analyses were weighted by episode volume.

Descriptive statistics were reported using means and standard deviations for continuous variables and percentages for categorical variables. Changes in patients' illness severity were estimated using the Mann Kendall nonparametric test of trend based on the average quarterly Elixhauser comorbidity score.[17] Readmissions, ER visits, and PLOS were evaluated by plotting the percentage of episodes with each outcome over time. Prolonged length of stay thresholds were determined by computing the Hollander-Proschan statistic separately for cases with and without major complications.[12] We fit a logistic regression model to test the effect of the program period on these outcomes separately.

Trends in episode payments over time were evaluated using scatterplots. To test whether episode payments decreased significantly over ACE and BPCI, we fit a generalized linear model of episode payments on year of program using a log-link with γ distribution. Because of the transition period, we allowed different intercepts and slopes for each period and tested for a difference in the slopes.

To analyze which components drove changes in the ACE and BPCI time periods, we compared reductions in internal hospital costs and PAC spending between the final and baseline years of ACE and BPCI. Changes attributable to individual components, as a percentage of the overall change, were reported as proportions.

We also analyzed internal hospital cost and PAC spending components separately. The average amounts per episode attributable to each component were plotted over time as a percentage of the baseline period. To test for significance of changes in each component over time, we log-transformed variables, fit generalized linear models on internal hospital costs and generalized estimating equation models on PAC spending, and tested for equality of slopes. As a sensitivity analysis, we conducted Mann-Kendall tests by quarter. In specifications with log transformation, log dollars were retransformed using the Duan smearing factor.[18] We adjusted for multiple testing using the Holm-Bonferroni correction separately for internal hospital cost and PAC spending components.[19]

All analyses used clustered standard errors to account for multiple patients per physician and used the Huber-White correction for heteroscedasticity. Cost and spending data were adjusted for inflation and reported in 2015 dollar equivalents. Analyses were conducted using R version 3.2.4 (R Foundation) and SAS version 9.4 (SAS Institute Inc). All tests of significance were 2-tailed at an α of .05.

The University of Pennsylvania institutional review board approved the study.

Results

Sample Characteristics

Between 2009 and 2015, there were 3942 joint replacement episodes, including 204 (5.2%) for MJRLE with complications (MS-DRG 469) and 3738 (94.8%) without complications (MS-DRG 470). Patient age and proportion of male patients were stable over time. Severity of illness did not change significantly over time for MS-DRG 470 (*P* = .78) or MS-DRG 469 (*P* = .53) (**Table 1**). Volume rose steadily from 192 to 246 episodes per quarter, with increases driven by MJRLE without complications (177 to 239 cases per quarter) (Table 1).

Episode Payments

Average Medicare episode payments for MJRLE without complications declined significantly 20.8% from $26 785 in 2008 to $21 208 in 2015 (*P* < .001) (**Figure 1**A). Decreases in Medicare payment were not statistically significant during the ACE period (*P* = .62) but were significant during the BPCI period (*P* < .001). Similarly, MJRLE with complications (MS-DRG 469) episode payments declined 13.8% from $38 537 in 2008 to $33 216 in 2015 (Figure 1B) but did not achieve statistical significance in either the ACE (*P* = .47) or BPCI (*P* = .75) periods.

Quality of Care

There were no statistically significant changes in readmissions or ER visits, while rates of PLOS decreased significantly. From 2009 to 2015, the proportion of episodes with readmissions decreased from 6.4% to 5.0% (*P* = .16), the proportion with ER visits decreased from 7.4% to 6.5% (*P* = .98), and the proportion of episodes with PLOS decreased from 22.4% to 7.3% (*P* < .001) (**Figure 2**).

Hospital Savings by Changes in Internal Cost and PAC Spending Components

The majority of total hospital savings during the ACE period came from reductions in implant costs ($1615.20 of $2006.21 [80.5%]) (**Table 2**) (eTable 1 in the Supplement). Total hospital

Table 2. Total and Within-Component Savings by Internal Hospital Cost and Post Acute Spending Component

Component	ACE Program				BPCI Program			
	Baseline Cost, $ (7/2008-12/2008)	ACE Year 3 Cost, $ (7/2011-6/2012)	Total Savings in ACE, %	Savings Within Component, %	Baseline Cost, $ (7/2011-6/2012)	BPCI Year 2 Cost, $ (7/2014-6/2015)	Total Savings in BPCI, %	Savings Within Component, %
Internal hospital costs[a]								
Implant	6636.42	5021.22	80.5	24.3	5021.22	4715.74	9.8	6.1
Room and board	1240.98	963.16	13.8	22.4	963.16	829.43	4.3	13.9
Supply	1226.94	694.05	26.6	43.4	694.05	498.46	6.3	28.2
OR	1190.38	1707.30	−25.8	−43.4	1707.30	1691.23	0.5	0.9
Prescription	604.67	561.47	2.2	7.1	561.47	636.99	−2.4	−13.5
ICU	134.33	104.70	1.5	22.1	104.70	59.41	1.5	43.3
Blood	80.55	56.16	1.2	30.3	56.16	1.69	1.7	97.0
Other	3208.93	6028.90	...	...	6028.90	6242.25	...	...
Total	14 323.20	15 136.96	...	...	15 136.96	14 675.19	...	...
Postacute care spending[b]								
IRF	2339.68	2600.87	−13.0	−11.2	2600.87	1184.99	45.4	54.4
SNF	2798.63	2476.14	16.1	11.5	2476.14	1874.89	19.3	24.3
HH	2139.44	2045.66	4.7	4.4	2045.66	2233.63	−6.0	−9.2
Professional	883.32	802.08	4.0	9.2	802.08	653.75	4.8	18.5
Readmission	506.19	712.04	−10.3	−40.7	712.04	388.00	10.4	45.5
DME	295.19	299.55	−0.2	−1.5	299.55	277.60	0.7	7.3
LTAC	202.45	135.37	3.3	33.1	135.37	6.90	4.1	94.9
OP	132.23	131.78	0.0	0.3	111.40	106.45	0.2	4.4
ER	21.48	20.37	0.1	5.2	20.37	34.15	−0.4	−67.6

Abbreviations: ACE, Acute Care Episodes bundled payment program by Medicare; BPCI, Bundled Payments for Care Improvement program by Medicare; HH, home health agencies; IRF, inpatient rehabilitation facility; LTAC, long-term acute care facility; SNF, skilled nursing facility; ellipsis, not applicable or no data available.

[a] The 8 hospital cost components were: (1) implant—costs of orthopedic implants; (2) room and board—room and board from inpatient days including staffing (length of stay) costs; (3) supply—hospital supplies and equipment costs excluding implants; (4) OR—operating room staffing and equipment costs; (5) prescription—medication costs; (6) ICU costs—costs from admission to the intensive care unit including staffing; (7) blood—costs associated with blood products and transfusion; (8) other costs—other fixed and variable costs that were applied consistently across all admissions, whether for MJRLE or not, were aggregated into a separate, eighth component.

[b] The 9 postacute care spending categories were: (1) inpatient rehabilitation facilities (IRF); (2) skilled nursing facilities (SNF); (3) home health agencies (HH); (4) professional—physician fees; (5) readmission; (6) durable medical equipment (DME); (7) long-term acute care providers (LTAC); (8) outpatient visits (OP); and (9) emergency department visits.

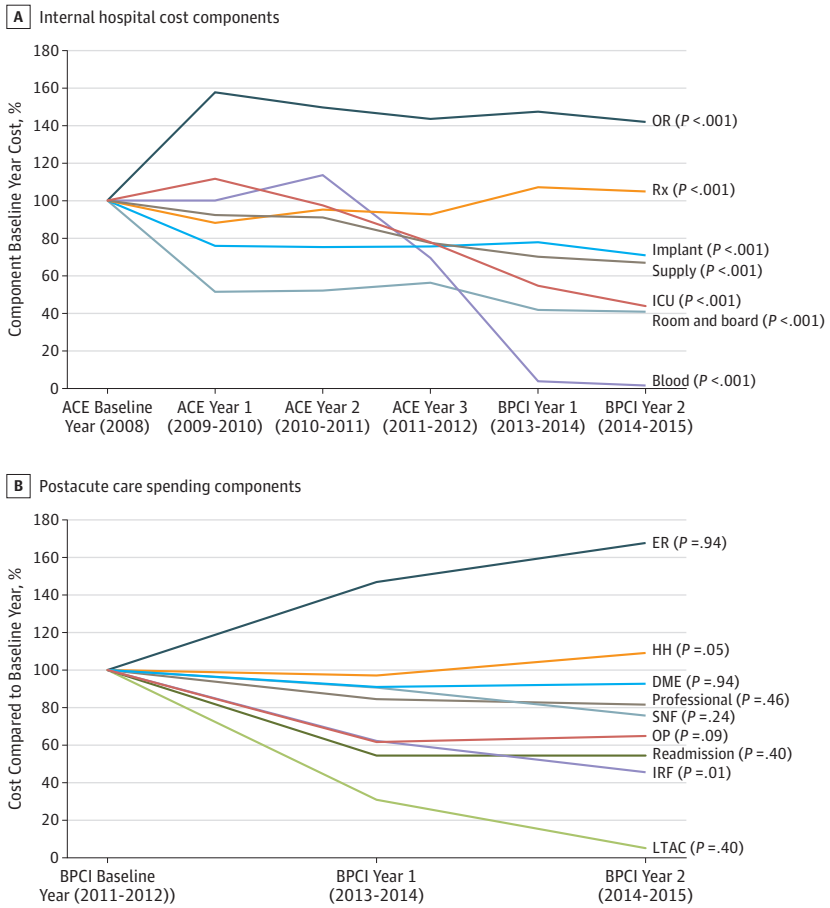
savings during the BPCI period were driven by both reductions in internal hospital costs ($675.12 or 21.7% of savings per episode) and PAC spending ($2443.12 or 78.4% of savings per episode) in BPCI year 2 (Table 2). Taking ACE and BPCI together, 51.2% of savings came from internal hospital cost reductions and 48.8% of savings from decreases in PAC spending. Decreases in implant costs and institutional (IRF and SNF) PAC spending represented the largest portion of in-hospital cost reduction and postacute spending reductions, respectively (Table 2).

Reductions in implant costs accounted for the greatest proportion of total hospital savings across ACE and BPCI. Between the baseline period and BPCI year 2, the average implant cost decreased 29% from $6636.42 to $4715.74 ($P < .001$) (**Figure 3**A; Table 2). This decline accounted for 80.5% of total hospital savings by ACE year 3 and an additional 9.8% by BPCI year 2. Reductions in supply costs and room and board costs were the next 2 biggest savings areas (Supplement). The OR costs increased 42% from $1190.38 in 2009 to $1691.23 in 2015 ($P < .001$), reducing total hospital savings by 25.8% in ACE year 3 before subsequently contributing 0.5% to savings by BPCI year 2. The ICU costs and blood costs experienced significant declines but generated small total hospital savings per episode (Table 2).

During BPCI, there were substantial reductions in postacute institutional spending. From 2013 to 2015, average IRF spending per episode declined 54% from $2600.87 to $1184.99 ($P = .01$), accounting for 45.4% of total hospital savings (Table 2; Figure 3B) (eFigure 1 in the Supplement). Average SNF spending per episode fell 24.3% from $2476.14 to $1874.89 and accounted for 19.3% of total hospital savings. This decrease was not statistically significant in generalized estimating equation models ($P = .24$) but was significant in nonparametric trend testing ($P = .02$). A 9% increase in home health care spending per episode, from $2045.66 to $2233.58 ($P = .05$), offset 6.0% of total hospital savings; ER spending increased in BPCI year 2 only, which was driven by a few cases and thus was not statistically significant ($P = .94$).

Sensitivity analyses were robust to alternate specifications accounting for skewness of health spending data and separately evaluating costs and payments for the 7% of episodes for which these data could not be matched.

Figure 3. Hospital Savings Within Internal Cost and Postacute Care Spending Components for Major Joint Replacements of Lower Extremities With and Without Major Complications or Comorbidities Over ACE and BPCI



A, Each component of internal hospital cost as a percentage of its cost in the ACE baseline year (2008). Blood costs decreased by 98% by BPCI Year 2, the greatest reduction in any component. The decreases in ICU costs by 56% and supply costs by 40% were the next greatest reductions. In contrast, OR costs increased and in BPCI Year 2 were 42% greater than in the ACE baseline year. B, Each component of post-acute care spending as a percentage of its cost in the BPCI baseline year. The greatest reductions were in LTAC (95% decrease in BPCI year 2), IRF (54%), and SNF (24%). In contrast, ER spending and HH increased by 68% and 9% respectively. The gap represents a transition period during which BHS was preparing for BPCI. ACE indicates acute care episodes Medicare demonstration project; BPCI, bundled payments for care improvement Medicare demonstration project; OR, operating room; ICU, intensive care unit; Rx, pharmacy costs; ER, emergency department; OP, outpatient visits; OR, operating room; IRF, inpatient rehabilitation facility; DME, durable medical equipment; HH, home health agency; LTAC, long-term acute care facility; SNF, skilled nursing facility.

Discussion

In this study of MJRLE bundled payments at a single institution, we report a $5577 or 20.8% decrease in total Medicare payments per joint replacement episode without complications compared to an approximately 5% increase nationwide (information available from authors on request). Our findings add to recent literature by demonstrating how BHS outperformed the 8% decrease in Medicare payments at the average BPCI participant[6,7] while achieving total hospital savings—approximately 25% of which accrued during hospitalization via increased margin on the hospital portion of the procedure and 75% of which accrued during the postacute period—at a time when costs were stable to increasing nationally.[20] Four points are worth noting.

First, a large portion of total hospital savings came from reductions in implant costs and high cost PAC use, both changes that may be implemented without intensive care coordination investments. For example, BHS increased its MJRLE margin by reducing implant costs by almost 30%, outpacing the national trend of 15.5% reductions.[20] This finding is particularly striking because all hospitals should be similarly incentivized under DRG payment, and it therefore highlights the critical role of BHS' gainsharing mechanism in influencing surgeons to standardize implant use and reduce costs during ACE and BPCI.

Baptist Health System worked with its surgeons to review medical evidence, identify a list of clinically equivalent implants (with exceptions allowed for unique anatomical or clinical considerations), determine a lower target implant price, and contract with only manufacturers that met that price; BHS subsequently implemented an online process through which manufacturers anonymously bid against each other. Because most manufacturers ultimately agreed to lower prices, BHS was able to reduce implant costs while retaining surgeon choice.

Second, as measured through claims data, the observed savings to Medicare and BHS do not appear to be driven by selection of healthier patients or stinting on quality. There were no changes in patient risk scores, readmission and ER visit rates were consistent with national trends,[13,21] and PLOS dropped 67%, suggesting that quality was similar or perhaps better than observed in recent BPCI evaluations.[6,7] The observed increase in volume of cases without complications may reflect surgeons shifting procedures to BHS from other non-BPCI hospitals, though the possibility of operating on patients who oth-

erwise would not have undergone surgery cannot be excluded. However, because the cases were profitable to hospitals and surgeons on average, it is unlikely that volume increases were compensatory in response to reduced costs or episode payments.

Third, while Medicare payments for MJRLE increased approximately 5% nationally and decreased 8% for the average BPCI participant (information available from authors on request), they declined 20.8% at BHS. This large drop may reflect BHS' experience with bundles through ACE, preceding BPCI, during which it established data infrastructure and an orthopedic working group to track hospital and PAC variation. Organizational and market characteristics may have also been favorable, with surgeons able to create efficiencies by moving cases to BHS and the local availability of home-based services such as physical therapy allowing BHS to safely reduce institutional PAC.

Fourth, reductions in expensive, institutional PAC drove decreases in Medicare episode payments only once PAC was bundled in BPCI, a finding not observed during the ACE period in this study or described in recent BPCI evaluations.[6,7] Along with the likely opportunity for additional cost reductions in areas such as operating room efficiency and PAC complications, these results suggest that careful bundle design is critical. Physicians and hospitals seem likely, at least initially, to redesign care for specific activities that are financially incentivized.

While the BHS experience may not generalize to all providers, our results provide guidance to CJR participants and other organizations engaging in MJRLE bundles by delineating performance for a high-performing system at a granular level. Several strategies, such as reducing implant costs and rationalizing PAC facility use, would seem to be generally applicable to the 90-day episode in CJR.[22]

Other fundamental aspects of BHS' care redesign include the organization of cost, spending, usage, and quality data into transparent reports, creation of explicit performance targets, and data-driven management led by a working group of 4 nonemployed, affiliated orthopedic surgeons, a physiatrist, a hospitalist, and hospital executives. In addition, BHS developed a physician gainsharing program that leveraged principles from behavioral economics, aligned incentives, and allowed surgeons to share in hospital savings generated by redesign activities.[22]

Limitations

Our study has several limitations. First, it did not employ comparison group design, instead comparing BHS to itself over program periods. However, the savings to BHS and Medicare via deceased internal costs and episode payments, respectively, are strikingly large compared with those from national trends and recent BPCI evaluations,[6,7] and the use of multiple periods (pre-ACE, ACE, and BPCI) mitigates the chance of confounding. Second, this analysis is descriptive rather than causal. Nonetheless, it provides important data for hospitals implementing joint replacement bundles, particularly under CJR. Third, the quality analysis does not include patient-reported outcomes such as functional status. Fourth, organizational and market environments may differ between BHS and other providers. Finally, this analysis evaluates direct variable costs and Medicare payments but not how changes in fixed and indirect hospital cost allocations affects savings.

Conclusions

Based on promises of better quality, tighter care coordination, and lower costs, CJR has thrust 800 hospitals and thousands of orthopedic surgeons into bundled payment. By detailing a successful health system's performance and identifying implant costs and institutional PAC use as areas of potentially rapid and significant savings without decrements in quality or patient selection, this study can help guide other organizations in care redesign. If such approaches are successfully implemented on a broad scale with similar results, the magnitude of savings that could accrue to Medicare—and possibly private payers—would be substantial. In turn, the success of CJR participants could accelerate the shift toward bundled payments for more conditions and procedures.

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Invited Commentary

Alternative Alternative Payment Models

Katherine Baicker, PhD; Michael E. Chernew, PhD

Some of the most promising strategies for controlling spending and improving the quality of care delivered in the United States are payment reforms that aim to give health care providers an incentive to improve value. Health care providers are often in the best position to identify ways to reduce waste and help their patients chose the most efficient sites and types of care. Giving health care providers a financial stake in driving value can be much more effective and palatable than runaway health care spending, pushing the risk onto patients, or subjecting them to one-size-fits-all insurer rules.

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There are several types of payment reforms. Some approaches target total population spending, such as Accountable Care Organizations. These models typically provide incentives for physician groups or delivery systems to reduce per-capita spending and improve quality. The savings are generally shared with the organization that employs the primary care physician. Other payment models focus on episodes (bundles) of care, creating incentives for providers to limit spending during the episode while achieving quality benchmarks. The savings typically accrue to the organization that controls the hospital or specialist responsible for the episode. Medicare is currently experimenting with both approaches.

In this issue of *JAMA Internal Medicine*, Navathe et al[1] study the effect of episode payment on lower extremity joint replacement in a single hospital system. Their findings are striking: After approximately 5 years under 2 different bundled payment programs for these procedures, spending at the Baptist Health System was about 20% lower. Much of that stems from savings on postacute care, suggesting the importance of whether postacute care is included in the bundle. The changes they document are much larger than most of those seen in other studies of similar bundles. For example, an earlier study[2] examining all participants in 1 of the 2 bundled payment demonstrations studied by Navathe et al at Baptist Health System found average savings of about 4%.[2] This could reflect differences in the duration of the episode (shorter in the study by Navathe and colleagues), experience with episode payment (greater in the study by Navathe and colleagues), research methodology (Navathe and colleagues do not formally incorporate an external control group), or variation across program participants (Navathe and colleagues examine 1 system). While the results of the study by Navathe et al are promising, further research will be needed to assess how well this comparison of