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Early effects of Medicare's Bundled Payment for Care Improvement (BPCI) program for lumbar fusion

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Abstract

Study design—Retrospective analysis of Medicare claims linked to hospital participation in the Center for Medicare and Medicaid Innovation's episode-based Bundled Payment for Care Improvement (BPCI) program for lumbar fusion.

Objectives—To describe the early effects of BPCI participation for lumbar fusion on 90-day reimbursement, procedure volume, reoperation, and readmission.

Summary of Background Data—Initiated on January 1st, 2013, BPCI's voluntary bundle payment program provides a predetermined payment for services related to a Diagnosis Related Group-defined "triggering event" over a defined time period. As an alternative to fee-for-service, these reforms shift the financial risk of care on to hospitals.

Methods—We identified fee-for-service beneficiaries over age 65 undergoing a lumbar fusion in 2012 or 2013, corresponding to the years before and after BPCI initiation. Hospitals were grouped based on program participation status as non-participants, preparatory, or risk-bearing. Generalized estimating equation models adjusting for patient age, sex, race, comorbidity, and hospital size were used to compare changes in episode costs, procedure volume, and safety indicators based on hospital BPCI participation.

Results—We included 89,605 beneficiaries undergoing lumbar fusion, including 36% seen by a preparatory hospital and 7% from a risk-bearing hospital. The mean age of the cohort was 73.4 years, with 59% female, 92% White, and 22% with a Charlson Comorbidity Index of 2 or more. Participant hospitals had greater procedure volume, bed size and total discharges. Relative to non-participants, risk-bearing hospitals had a slightly increased fusion procedure volume from 2012 to

2013 (3.4% increase versus 1.6% decrease, $p = 0.119$), did not reduce 90-day episode of care costs (0.4% decrease versus 2.9% decrease, $p=0.044$), increased 90-day readmission rate (+2.7% versus -10.7% percent, $p=0.043$), and increased repeat surgery rates (+30.6% versus +7.1% percentage points, $P=0.043$).

Conclusions—These early, unintended trends suggest an imperative for continued monitoring of BPCI in lumbar fusion.

Keywords

Center for Medicare and Medicaid Innovation; Bundle Payment Program; Episode-based costs; Episode-of-care; reference pricing; low back pain; lumbar fusion; repeat spine surgery; readmission

Key provisions of the Patient Protection and Affordable Care Act include alternative payment models that are intended to provide incentives for improved outcomes and to shift away from fee-for-service payment.[1, 2] Through its Bundled Payment for Care Improvement (BPCI) program, the Center for Medicare and Medicaid Innovation (CMMI) is piloting episode-based bundled payments, setting a predetermined reimbursement for all services related to a targeted diagnosis or procedure over a defined time period.[3] Unlike traditional hospital Diagnosis Related Group (DRG) payments, episode-based bundled payments models also include reimbursement for post-acute care and professional fees. To succeed, hospitals must provide services below the predetermined payment target. The intent of bundled payment programs is to foster joint accountability among providers, hospitals and clinics to coordinate care, eliminate unnecessary services, and improve quality by reducing readmissions, reoperations, or other adverse outcomes.

Bundled payment demonstrations appear to reduce episode costs, leading advocates to suggest that they could slow the rate of Medicare spending and improve patient care if implemented in a large population.[4, 5] However, hospital self-selection into these voluntary plans likely favors high-volume hospitals that have the resources to analyze their potential opportunities, implement necessary changes, negotiate market shares, and absorb financial risk. To provide care at or below the pre-determined payment level, providers might select patients that maximize gain-sharing, overstate the severity of disease and comorbidity, minimize the intensity of services, outsource care to other facilities, or delay post-acute services until the episode-of-care has ended.[1, 6–8] In addition, academic medical centers, safety net, and small-volume hospitals could be disadvantaged under these plans.[9] Such unintended consequences highlight the need for a careful independent evaluation of the impact of bundled payment plans.[10] We sought to examine the early effects of BPCI on lumbar fusion, comparing changes in hospital volume, safety, and episode costs based on hospital participation status.

Methods

Types of Bundled Payment Programs

The Center for Medicare and Medicaid Innovation (CMMI) initially offered four voluntary bundle payment models; three involving hospitals and one for nursing homes (TABLE 1).

We focused on “Model 2”, which includes reimbursement for services through a defined post-acute period subsequent to a specific “triggering” events, and had the largest enrollment among hospitals. Hospitals were allowed to choose from 48 clinical triggering events, defined by Diagnosis Related Groups (DRG) and select the duration of the episode (30, 60 or 90 days). The preparatory period was implemented on January 1, 2013, with a subset of hospitals electing for the risk-bearing contracts, first initiated on October 1, 2013. Under this plan, hospitals continued to submit charges and receive fee-for-service payment from Medicare, but payments were subsequently reconciled with the pre-negotiated target rate discounted at 2–3% for participation. Hospitals could contract with convening organizations or third party administrators to manage their programs, and some received a waiver of Section 186(i) of the Social Security Act requiring a 3-day inpatient stay prior to coverage for skilled nursing facility services.

Approach

We performed a retrospective analysis of 2012 and 2013 Medicare claims linked to public reports of hospital participation in CMMI’s Bundle Payment Program. We focused on the BPCI bundle for lumbar fusion, a high-volume procedure with high variability in hospital and post-acute care costs that is a common target for payment reform.[11, 12] Based on the nature of hospitals’ participation in BPCI for lumbar fusion, we examined differences in patient and hospital characteristics, and compared changes in fusion procedure volume, 90-day episode-of-care and surgical safety following the program initiation.

Data

The Medicare Inpatient Research Identifiable File was used to identify admissions involving DRG for “non-cervical spinal fusion” in 2012 or 2013. The Inpatient RIF is a claims-level database that includes DRG, dates of service, Medicare payment amount, and diagnosis and procedure codes from the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM).[13] We linked each triggering admission to all subsequent hospital outpatient, skilled nursing facility, home health agency, ambulatory medical care, and professional claims occurring within 90-days to capture payments related to these services. We did not include payments for durable medical equipment or prescription medications. The Master Beneficiary Summary file was used to define cohort eligibility and to describe patient demographics, and the American Hospital Association Annual Survey from 2012 was used to summarize hospital bed count and total discharges.[14]

Triggering admissions were grouped by whether the hospital performing the operation enrolled in BPCI’s Model 2 Preparatory (“Prep”) or Risk-bearing (“Risk”) program for lumbar fusion, as publically reported on 3/19/2015.[15] While the status of risk-bearing hospitals was known on 1/1/2013, their contracts did not start until October 2013. As such, our study compares the episode-of-care reimbursement among hospitals that signed on to the risk-bearing contracts during the lead up to the initiation of the reconciliation contracts, but prior to the start of actual financial risk.

Patient characteristics

We included fee-for-service beneficiaries, age 65 or older, eligible for Medicare through the Old Age and Survivors Insurance (OASI) program, and excluded those who had entitlement through Medicare Advantage (not included as part of BPCI), End State Renal Disease (ESRD) or Social Security Disability Insurance (SSDI) programs because of lack of population-level data for these heterogeneous groups. We did not specifically examine dual eligible beneficiaries. A previously validated algorithm was used to refine surgical indications for lumbar fusion to adjust for specific degenerative pathology, and to exclude patients with spinal fractures, spinal cord injuries, and cancer because these are more commonly defined by a separate triggering events.[16] Patient age, sex, race, and comorbidity were included in multivariable analysis as covariates.

Outcomes

The primary outcome was global Medicare payment through a 90-day episode-of-care. To account for inflation, we applied the U.S. Bureau of Economic Analysis Implicit GDP Price Deflator to convert 2012 payments to their 2013 equivalents.[17] Secondary dichotomous outcomes included 90-day reoperation, all-cause readmission, device complications, wound problems, and life-threatening complications, identified from diagnosis and procedure codes submitted following each index surgery.[18] Specific vertebral levels of fusion cannot be identified on the basis of claims data; however, reoperations were restricted to the lumbar region.

Analysis

Generalized estimating equation (GEE) regression was used to compare 90-day episode costs by hospital BPCI participation status, adjusting for patient age, sex, race, comorbidity, log-hospital bed size and log-total discharges. Comorbidity was calculated using Quan's "enhanced" version of the Charlson Comorbidity Index.[19, 20] Differences in reimbursement were attributed to the BPCI groups based on interpreting the coefficients for the interactions between year and BPCI participation status, equivalent to a difference-in-difference analysis. We adjusted standard errors to account for the potential non-independence of patients treated within the same hospital. When comparing changes in outcomes, we only included patients enrolled from January through September of each year in order to ensure that all index cases had a minimum of 90-days of surveillance. Similar models were used to describe changes in the cost trajectories over time based on bundle participation status, separately estimating acute and post-acute care costs at 30-day intervals throughout the full episode of care. Logistic regression models were used to compare changes in repeat operations, all-cause readmission, and surgical safety indicators based on hospital BPCI participation, adjusting for patient age, sex, race, comorbidity and log-hospital bed size and log-total discharges. Analyses were performed using Stata-MP-v14.2 (College Station, TX) and hypothesis testing based on a 2-sided alpha of 0.05.

Results

Hospital and Patient characteristics

A total of 2,050 hospitals provided lumbar fusion trigger cases in 2013, of which 671 (32.7%) participated in the BPCI's preparatory program and 102 (5.0%) in the risk-bearing program. The majority of participant hospitals selected a 90-day bundle with a 2% discount, and over 60% received a waiver of the 3-day admission rule (TABLE 2). Hospitals participating in BPCI had larger procedure volumes, greater bed counts and more discharges. Risk-bearing hospitals were, on average, larger by these three metrics than preparatory hospitals. In addition, the mean annual adjusted volume of lumbar fusion for Medicare beneficiaries in 2012 among non-participant hospitals was 24.3 cases, compared to 30.1 among BPCI preparatory hospitals, and 36.4 among risk-bearing hospitals.

After exclusions, a total of 52,329 patients had lumbar fusion in 2013, including 19,265 (36.8%) from a hospital participating in the preparatory program, and 3,843 (7.3%) in the risk-bearing program. The distribution of patient age, sex, and comorbidity was similar between participant and non-participant hospitals, and from 2012 (pre-BPCI initiation) to 2013 (post-BPCI initiation). A greater proportion of non-white beneficiaries were treated at risk-bearing hospitals ($p=0.006$).

Procedure volumes

From 2012 to 2013, the aggregate volume of fusion procedures among non-participant hospitals decreased 489 cases (-1.6%), while the volume among preparatory hospitals increased by 227 cases ($+1.2\%$, $p=0.158$), and the volume of risk-bearing hospitals increased by 128 cases ($+3.4\%$, $p=0.119$; FIGURE 1). Aggregated to the hospital level, the mean decrease in procedure volume among non-participant hospitals was 1.6%, compared to a mean volume increase of 2.7% among preparatory hospitals ($p=0.608$), and 1.9% among risk-bearing hospitals ($p=0.865$).

Episode of care costs

During the program's preliminary year, hospital participation in BPCI did not yield significant reductions in episode of care costs for lumbar fusions. From 2012 to 2013, the mean 90-day episode-of-care payments among non-participant hospitals decreased 2.9% (\$-1,149 reduction, $p<0.001$ within group), while payments to hospitals in the preparatory program decreased similarly (3.5%; \$-1,338; $p<0.001$ within group, $p=0.448$ compared to non-participants), and those among risk-bearing hospitals were essentially unchanged, which differed significantly from the reduction seen in the non-participant group (-0.4% ; \$-163; $p=0.726$ within group, and $p=0.044$ compared to non-participants; TABLE 3). Longitudinal payment trajectories reveal that the relative inpatient payments increased more from 2012 to 2013 among beneficiaries who received their operation at a risk-bearing hospital, but that post-acute care payments did not differ based on BPCI participation status (FIGURE 2).

Surgical safety indicators

Rates of repeat spine operation and all-cause readmission among hospitals participating in BPCI risk-bearing program for lumbar fusion were lower in 2012 compared to those of non-

participants and preparatory hospitals (TABLE 3). However, from 2012 to 2013 the rates for BPCI hospitals worsened, while those of preparatory and non-participants hospitals improved. Even after adjusting for age, sex, race, comorbidity and hospital size, repeat spine surgery and all-cause readmission increased from 2012 to 2013 among risk-bearing hospitals relative non-participant hospitals ($p=0.043$). Changes in rates of device complications, wound problems, and life-threatening complications based on hospital BPCI participation status were similar and not statistically significant (not shown).

Discussion

Early findings suggest slight trends toward unintended and potentially harmful effects of the BPCI program for lumbar fusion. Relative to non-participant hospitals, risk-bearing hospitals in BPCI's lumbar fusion bundle program failed to achieve cost reductions similar to that of preparatory and non-participant hospitals, and from 2012 to 2013 slightly increased procedure volume, readmission and repeat surgery rates. Because these early data suggests an increase in reoperation and readmission without evidence of cost reductions, it appears that risk-bearing hospitals struggled with implementation during the lead-in period. It is also possible that their initially lower readmission and reoperation rates in 2012 enticed them into BPCI participation (and the converse for non-participants) and the changes seen represent regression to the mean. Their relatively higher costs during the lead-in period may factor into a higher target payment during the risk-bearing period. In any event, given these disconcerting trends, ongoing monitoring of the program's effects on patient outcomes, costs and safety, particularly under the risk-bearing contracts, should be prioritized.

Our findings confirm prior research showing BPCI participant hospitals had greater procedure volume, bed size and number of total discharges, relative to non-participating hospitals.[21, 22] Larger hospitals may have more resources to absorb increased financial risks and less need for "stop loss" protections.[8] The slightly increased volume among risk-bearing hospitals might be attributed to the ability to streamline clinical pathways and reduce length of stay, thus improving efficiency, enabling increased capacity, and serving an unmet need. On the other hand, it may also reflect hospitals' imperative to increase volume to make up for lost revenue in the emerging payment environment.[23] The preferential participation of high-volume hospitals in BPCI, along with their corresponding increases in volume, might signal an emerging trend toward greater consolidation of these specialty procedures.[24, 25] The lack of 90-day episode costs reduction among risk-bearing hospitals may be due to the heterogeneous mix of surgical indications and procedure types included in the lumbar fusion bundles, as well as an increasing use of procedures spanning multiple vertebral levels, and involving stabilizing instrumentation in the Medicare population.[18, 26]

Limitations with difference-in-difference analysis include the assumption of a common trend across groups and attributing observed changes between groups to BPCI participation status. We examined global reimbursements instead of examining only those for services specifically related to spinal care. Our study only examines the first year of the BPCI program, before the actual risk-bearing contracts were initiated. Thus, additional years of

data are needed to examine whether the trends we identified hold true under the BPCI risk-bearing contracts.

Bundle payment programs in orthopedics involve significant levels of financial risk and complicated contractual and reporting arrangements, requiring new institutional investments to meet quality improvement efforts.[27–34] Achieving cost reduction in spine may require concurrent strategies that have been adopted for other conditions,[35, 36] such as redesigning care paths, reducing length of stay, adopting guideline-concordant decision support,[42] integrating measurement processes into electronic medical records,[36] coordinating post-acute care with skilled nursing facilities and home health agencies,[37] and standardize surgical implants.[38]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The manuscript submitted does not contain information about medical device(s)/drug(s).

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Figure 1.

Changes in volume of elective inpatient lumbar fusion from 2012 (pre-BPCI) to 2013 (post-BPCI) based on hospital voluntary participation in the Center for Medicare and Medicaid Innovation's (CMMI's) Bundle Payment for Care Improvement (BPCI) Program.

Figure 2.
Changes in 90-day episode of care payments from 2012 (pre-BPCI) to 2013 (post-BPCI) based on hospital voluntary participation in the Center for Medicare and Medicaid Innovation (CMMI's) Bundle Payment for Care Improvement (BPCI) Program for lumbar fusion.

Table 1

Description of the Center the Medicare and Medicaid Innovation Bundle Payment Models.

	Model 1	Model 2	Model 3	Model 4
Payment	Retrospective	<i>Retrospective</i>	Retrospective	Prospective
Setting	Acute care	<i>Acute & post-acute</i>	Post-acute only	Hospital selected DRG & readmissions
Episode trigger	Inpatient admission for one of 48 included target DRG's	<i>Inpatient admission for hospital selected triggering DRG</i>	Selected DRG's from an acute care hospital with post-acute services initiated within 30 days of discharge	Inpatient admission for hospital selected triggering DRG
Bundled services	All inpatient services included in DRG payment	<i>Related inpatient, ambulatory, skilled nursing home, and home health agency services, including professional fees</i>	Post-acute skilled nursing home, Long-term care facility, and home health agency services, including professional fees and readmissions	Inpatient and acute care professional fees, plus readmissions

Table 2

Hospital & patient characteristics. Preparatory and risk-bearing hospitals had larger size and greater lumbar fusion volumes.

		Non-participant Hospitals	Preparatory Hospitals	Risk-bearing Hospitals
N hospitals		1277	671	102
Bed count, 2012 (mean)		284	315	443
Total discharges, 2012 (mean)		5090	6042	8747
Medicare lumbar fusion volume, 2012 (mean)		24.9	29.7	37.2
Episode duration (%)	30-day	-	2.5	9.8
	60-day	-	0.9	1.0
	90-day	-	96.6	89.2
Discount required	2%	-	95.7	83.3
	3%	-	4.3	16.7
Received 3-day waiver (%)		-	5.5	64.7
N Patients, 2012		29707	19038	3715
Age (mean)		73.4	73.5	73.6
Female (%)		59.6	59.7	59.5
Race (%)	White	92.3	92.2	91.8
	Black	4.4	4.4	5.5
	Other	3.2	3.4	2.7
Charlson Comorbidity Index (%)	None	48.7	49.7	48.7
	One	28.8	28.8	29.1
	Two +	22.6	21.6	22.2
Length of stay, days (mean)		3.7	3.7	4.1
Fusion indication, 2012 (%)	Axial pain	15.0	16.3	15.5
	Disc herniation	9.7	9.8	9.3
	Stenosis	23.0	23.6	24.5
	Spondylolisthesis	40.8	38.5	39.3
	Scoliosis	7.7	7.7	6.8
	Other	3.8	4.1	4.8
3+ disc levels fused, 2012 (%)		15.3%	15.3%	14.6%
Stabilizing instrumentation, 2012 (%)		57.9%	60.3%	53.4%
Bone Morphogenetic Proteins, 2012 (%)		22.4%	22.7%	17.9%
Combined anterior-posterior approach, 2012 (%)		13.2%	11.8%	13.7%

Table 3

Change in lumbar fusion procedure volume from 2012 (pre-BPCI) to 2013 (post-BPCI), by hospital participation in BPCI program for lumbar fusion, adjusted for patient age, sex, **race**, comorbidity and hospital size.

		Non-participant Hospitals	Preparatory Hospitals	Risk-bearing Hospitals
Fusion procedure: Group-level aggregate volume (n)	2012	29707	19038	3715
	2013	29221	19265	3843
	Absolute change	−486	227	128
	Percent change	−1.6%	+1.2%	+3.4%
	p-value (within group)	0.341	0.285	0.051
	p-value (relative to non-participant hospitals)	NA	0.158	0.119
Fusion procedure: (mean hospital volume)	2012	24.7	29.3	36.7
	2013	24.3	30.1	37.4
	Absolute change	−0.4	0.80	0.70
	Percent change	−1.6	2.7	1.9
	p-value (within group)	0.785	0.664	0.906
	p-value (relative to non-participant hospitals)	NA	0.608	0.865
90-day episode of care cost (\$)	2012 mean (sd)	38531 (113)	38264 (143)	41305 (331)
	2013 mean (sd)	37382 (109)	36926 (130)	41142 (324)
	Absolute change	−1149 (158)	−1338 (193)	−163 (462)
	Percent change	−2.9	−3.5	−0.4
	p-value (within group)	<0.001	<0.001	0.7255
	p-value (relative to non-participant hospitals)	NA	0.448	0.044
All-cause readmission	2012	12.2 (11.7, 13.5)	12.9 (12.3, 13.5)	11.3 (10.1, 12.4)
	2013	10.9 (10.4, 11.3)	10.6 (10.1, 11.2)	11.6 (10.3, 12.8)
	Absolute change	−1.3	−2.3	+0.3
	Percent change	−10.7%	−17.8%	+2.7%
	p-value (within group)	<0.001	<0.001	0.689
	p-value (relative to non-participant hospitals)	NA	0.039	0.043
Repeat lumbar spine surgery	2012	4.2 (3.9, 4.5)	4.7 (4.3, 5.1)	3.6 (2.9, 4.2)
	2013	4.5 (4.2, 4.7)	4.2 (3.9, 4.6)	4.7 (3.9, 5.4)
	Absolute change	+0.3	−0.5	+1.1
	Percent change	+7.1%	−10.6%	+30.6%
	p-value (within group)	0.285	0.036	0.006
	p-value (relative to non-participant hospitals)	NA	0.021	0.043