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Changes in cardiovascular spending, care utilization, and clinical outcomes associated with participation in bundled payments for care improvement - Advanced

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ORIGINAL RESEARCH ARTICLE

Changes in Cardiovascular Spending, Care Utilization, and Clinical Outcomes Associated With Participation in Bundled Payments for Care Improvement – Advanced

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BACKGROUND: Bundled Payments for Care Improvement – Advanced (BPCI-A) is a Medicare initiative that aims to incentivize reductions in spending for episodes of care that start with a hospitalization and end 90 days after discharge. Cardiovascular disease, an important driver of Medicare spending, is one of the areas of focus BPCI-A. It is unknown whether BPCI-A is associated with spending reductions or quality improvements for the 3 cardiovascular medical events or 5 cardiovascular procedures in the model.

METHODS: In this retrospective cohort study, we conducted difference-in-differences analyses using Medicare claims for patients discharged between January 1, 2017, and September 30, 2019, to assess differences between BPCI-A hospitals and matched nonparticipating control hospitals. Our primary outcomes were the differential changes in spending, before versus after implementation of BPCI-A, for cardiac medical and procedural conditions at BPCI-A hospitals compared with controls. Secondary outcomes included changes in patient complexity, care utilization, healthy days at home, readmissions, and mortality.

RESULTS: Baseline spending for cardiac medical episodes at BPCI-A hospitals was $25 606. The differential change in spending for cardiac medical episodes at BPCI-A versus control hospitals was $16 (95% CI, −$228 to $261; *P*=0.90). Baseline spending for cardiac procedural episodes at BPCI-A hospitals was $37 961. The differential change in spending for cardiac procedural episodes was $171 (95% CI, −$429 to $772; *P*=0.58). There were minimal differential changes in physicians' care patterns such as the complexity of treated patients or in their care utilization. At BPCI-A versus control hospitals, there were no significant differential changes in rates of 90-day readmissions (differential change, 0.27% [95% CI, −0.25% to 0.80%] for medical episodes; differential change, 0.31% [95% CI, −0.98% to 1.60%] for procedural episodes) or mortality (differential change, −0.14% [95% CI, −0.50% to 0.23%] for medical episodes; differential change, −0.36% [95% CI, −1.25% to 0.54%] for procedural episodes).

CONCLUSIONS: Participation in BPCI-A was not associated with spending reductions, changes in care utilization, or quality improvements for the cardiovascular medical events or procedures offered in the model.

Key Words: cardiovascular diseases ■ health care reform ■ health expenditures ■ Medicare ■ mortality ■ patient readmission ■ value-based health care

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Clinical Perspective

What Is New?

- The Bundled Payments for Care Improvement – Advanced (BPCI-A) program did not meet its goal of incentivizing spending reductions for cardiovascular care events or procedures.
- Participation in BPCI-A was also not associated with clinically meaningful changes in care patterns (including the avoidance of high-need, high-cost patients) or patient outcomes (including 90-day readmissions or mortality).

What Are the Clinical Implications?

- The largest bundled payment program of Medicare did not lead to meaningful changes in clinical spending, physician care patterns, or patient outcomes for any of the cardiovascular events or procedures included in the model.
- Policymakers should consider other approaches to incentivize spending reductions and quality improvements for cardiovascular care or change the format of BPCI-A.

Nonstandard Abbreviations and Acronyms

BPCI-A	Bundled Payments for Care Improvement – Advanced
CMS	Centers for Medicare & Medicaid Services
PAC	postacute care

Health care spending in the United States is rising, driven in large part by cardiovascular disease.[1,2] In response, the Centers for Medicare & Medicaid Services (CMS) is implementing payment models meant to incentivize clinicians and health systems to provide more efficient care. For example, the opt-in Bundled Payments for Care Improvement – Advanced (BPCI-A) model, launched in 2018, rewards participants if they reduce spending for any of 29 inpatient conditions chosen, including 8 cardiovascular care events and procedures.[3] BPCI-A assigns hospitals a target spending price for patient care episodes that begin with an admission and end 90 days after discharge. If episode spending falls below the target, CMS rewards the hospital with a financial bonus; if spending ends up above the target, the hospital must pay CMS a penalty.

Participation in BPCI-A has been associated with small reductions in clinical episode spending (on the order of −$78 per quarter) and small improvements in outcomes in analyses that grouped all conditions in the model.[4,5] However, little is known about changes in care for each individual condition. This gap is particularly salient for cardiovascular conditions, which collectively drive a significant proportion of Medicare spending. Participation in the precursor of BPCI-A was not associated with changes in spending or quality for any cardiac bundle in that model.[6–10] Despite this disappointing precedent, cardiovascular care comprises the plurality of bundles offered in the first iteration of BPCI-A, and some of these bundles are among those most commonly chosen for participation.[3,5]

Moreover, there is worry that BPCI-A could inequitably affect vulnerable patients with cardiovascular disease. To cut costs to meet spending targets, hospitals must either lower care utilization or avoid high-cost patients, including those who are medically complex due to frailty and multimorbidity[11–17] or socially complex due to living in poverty.[18–23] Whether BPCI-A hospitals participating in cardiac bundles began to selectively avoid these high-need but high-cost patients is unknown and has significant equity implications for this and other payment models.

BPCI-A is an expensive program that is expected to cost CMS more than $2 billion to administer after accounting for the payout of financial bonuses.[24,25] Therefore, understanding the association of BPCI-A with changes in spending, utilization, and outcomes for cardiovascular care has clinical and policy ramifications as CMS increasingly invests in alternative payment models. In undertaking our evaluation, we had 3 aims focused on the first year of BPCI-A (October 1, 2018–September 30, 2019): (1) to describe the characteristics of patients initiating cardiovascular episodes in BPCI-A; (2) to explore whether medically or socially complex patients were selectively precluded from initiating these episodes; and (3) to evaluate changes in spending, care utilization, and clinical outcomes for cardiovascular bundles.

METHODS

This study was approved by the Human Research Protection Office at Washington University; the requirement for informed consent was waived due to the deidentified nature of the data. Because of the sensitive nature of the claims data in this study, all data are secure and available on the Medicare Virtual Research Data Center to signatories of a data use agreement.

Data

BPCI-A hospitals could choose to participate in any of 29 inpatient conditions in the model, including 3 medically managed cardiovascular events (medical bundles: acute myocardial infarction, arrhythmia, and congestive heart failure) and 5 cardiac procedures (procedural bundles: coronary artery bypass graft, defibrillator implantation, pacemaker insertion, percutaneous coronary intervention, and valve procedures). We identified hospitals participating in BPCI-A and the bundles they selected using public CMS data.[3] Hospital and market characteristics were linked from the 2017 American Hospital

Association Annual Survey and Area Health Resources File, respectively. Sixteen hospitals that did not match to the data files were excluded. We used Medicare claims data to capture spending, care utilization, and outcomes for patient care episodes before the program period (January 1, 2017–September 30, 2018) and program period (October 1, 2018–September 30, 2019). Data consisted of all payments associated with each episode, including inpatient, postacute, and outpatient spending, as well as payments for physician fees and durable medical equipment.

Identifying Patient Care Episodes and Calculating Episode Spending

We identified episodes in the 8 cardiovascular bundles using diagnosis-related groups (Table S1). Per BPCI-A methodology,[26] we included only fee-for-service beneficiaries who were continuously enrolled in Medicare parts A and B during the episode and the previous year, and we excluded patients who were eligible for Medicare on the basis of end-stage renal disease, whose primary payer was not Medicare, or who died during the index admission. We standardized spending to account for differences in Medicare payments across geographical regions and types of hospitals and, per BPCI-A rules, winsorized values at the 1st and 99th percentiles.[5] Our analyses adjusted for inflation through the use of the Consumer Price Index, and we report spending in 2019 US dollars.

Covariates

We analyzed patients by several characteristics, including age, sex, race, and eligibility for Medicare on the basis of disability. Comorbidities were quantified with the Chronic Conditions Data Warehouse, which identifies up to 27 chronic conditions from claims data. We included multimorbidity, frailty, and poverty as indicators of medical and social complexity. Patients were categorized as multimorbid if they had ≥6 Chronic Conditions Data Warehouse conditions, as frail if they ranked in the top quintile of a frailty index used to score the overall Medicare population,[27] and as living in poverty if they were dually enrolled in Medicare and Medicaid.[21,28] Finally, we measured the proportion of patients coded at each of 3 diagnosis-related group complexity levels (no complication, with minor complication, and with major complication) and the proportion of patients with outlier payments, representing the highly complex or those with unexpected complications.[4]

Outcomes

Our 2 primary outcomes were the differential changes in mean episode spending, before versus after implementation of BPCI-A, for the aggregate of cardiac medical and cardiac procedural bundles at BPCI-A hospitals versus control hospitals. Secondary outcomes included differential changes in other end points: spending (episode spending for individual cardiac bundles, overall and by individual payment components), selection (proportion of medically or socially complex patients initiating cardiac episodes), utilization (postacute care [PAC] use and length of stay), and quality (90-day mortality, readmissions, and healthy days at home). "Healthy days at home" measures the number of days during the 90-day postdischarge window that a patient is alive and at home.[29]

Statistical Analysis

We first compared the characteristics of patients initiating cardiac medical and procedural episodes at BPCI-A hospitals with the characteristics of patients admitted for the same diagnoses at BPCI-A–nonparticipating, control hospitals. All acute care hospitals in the Inpatient Prospective Payment System were eligible for inclusion in the control group except those that subsequently joined BPCI-A in January 2020, midway through the program.[3] We used a one-to-one matching algorithm to match each BPCI-A hospital with a control using a propensity score for program participation that was based on hospital and market characteristics (Table S2). Five BPCI-A hospitals did not have a satisfactory match and were excluded (Figure S1). Standardized mean differences between matched BPCI-A and control hospitals were <0.2, signifying appropriate matching between the groups (Table S2).

We then estimated associations between BPCI-A and our spending and clinical outcomes by using difference-in-differences models comparing the 540 BPCI-A hospitals participating in cardiovascular conditions with their matched control hospitals. For each cardiac condition, we included control-intervention–matched pairs only if both hospitals in the pair admitted patients for that condition during the study period (Table S3). We used an intention-to-treat approach to address dropout among hospitals, although sensitivity analyses using a treatment-on-the-treated approach demonstrated similar results for our primary outcomes (Table S4). Models were estimated at the patient-episode level and included a match group fixed effect to control for correlation over time and to exclude confounding between match groups. Models also controlled for age, sex, primary diagnosis-related group, comorbidities (except models examining frail patients), and disability status. For both medical and procedural episodes, visual inspection (Figure S2) and statistical tests (Table S5) revealed similar spending trends at BPCI-A hospitals and control hospitals before implementation of BPCI-A, upholding the parallel trends assumption that lends validity to our primary difference-in-differences models.

As previously mentioned, per the BPCI-A rule, patients who died during the index admission were excluded from our main analyses because these patients are, by definition, not considered to have initiated a BPCI-A episode.[26] However, it is possible that BPCI-A–associated changes in hospital-based care may have affected in-hospital survival. Therefore, we conducted sensitivity analyses on 90-day mortality that included hospitalizations ending in either death or discharge (Table S6).

All analyses were conducted with SAS (SAS Institute Inc) on the Medicare Virtual Research Data Center. For our 2 primary outcomes, we considered a Bonferroni-adjusted 2-tailed value of $P<0.025$ (ie, 0.05÷2) to be statistically significant. Because of the potential for type I error due to multiple comparisons, secondary outcomes should be considered exploratory, and P values are not reported.

RESULTS

Patient Characteristics

During the first year of BPCI-A, 389 349 patients were admitted for cardiovascular episodes at BPCI-A hospitals, and 252 258 patients were admitted for the same

diagnoses at control hospitals (Table 1). Of the 389 349 BPCI-A episodes, 322 941 (82.9%) were for medical bundles, and 66 408 (17.1%) were for procedural bundles. BPCI-A patients initiating medical episodes had more comorbidities than their non–BPCI-A counterparts (7.1 versus 6.9 Chronic Conditions Data Warehouse conditions, respectively), and slightly higher proportions were frail (24.9% versus 23.6%) and multimorbid (68.7% versus 66.8%). Similar patterns were observed for patients initiating procedural episodes. Medical and procedural episodes at BPCI-A hospitals incurred outlier payments less frequently than those at control hospitals (0.8% of BPCI-A episodes versus 4.7% of control episodes for medical bundles and 6.5% of BPCI-A episodes versus 7.1% of control episodes for procedural bundles).

Avoidance of Medically or Socially Complex Patients

At hospitals before implementation of BPCI-A, 25.3% of patients initiating cardiovascular medical episodes were frail compared with 24.2% during the program period (difference, −1.1%; Table 2). At control hospitals, this difference was −0.7% (23.8% before the program period versus 23.1% in the program period). The difference-in-differences at BPCI-A versus control hospitals was thus −0.4% (95% CI, −0.9% to 0.1%). Similarly, the differential change at BPCI-A compared with control hospitals in the proportion of vulnerable patients who initiated medical episodes was 0.0% (95% CI, −0.5% to 0.5%) among multimorbid patients and 0.4% (95% CI, −0.1% to 0.9%) among patients living in poverty. There were no clinically meaningful differential changes in the share of frail, multimorbid, or dually enrolled patients admitted for the 5 cardiovascular procedures at BPCI-A versus control hospitals before versus after BPCI-A implementation (Table S7).

Changes in Spending and Care Utilization

For the aggregate of cardiac medical bundles at BPCI-A hospitals, mean episode spending was $25 606 before the program period and $24 245 during the program period (Figure); the difference was −$1362 (Table 3). At control hospitals, this difference was −$1378 ($25 026 before the program period compared with $23 648 in the program period). The differential change in episode

Table 1. Characteristics of Patients Admitted for Cardiovascular Conditions at BPCI-A Compared With Non–BPCI-A Control Hospitals

	Cardiac medical bundles		Cardiac procedural bundles	
	Comparison	BPCI-A	Comparison	BPCI-A
n	220 017	322 941	32 241	66 408
Mean admissions per hospital per bundle per quarter, n	23.5	30.7	12.4	14.1
Mean CCW conditions, n	6.9	7.1	4.9	4.9
Age, n (%)				
<65 y	19 419 (8.8)	27 565 (8.5)	3275 (10.2)	5788 (8.7)
65–80 y	90 881 (41.3)	131 245 (41.0)	19 608 (60.8)	41 055 (61.8)
>80 y	109 717 (49.9)	164 131 (50.8)	9358 (29.0)	19 565 (29.5)
Female	118 210 (53.7)	175 019 (54.2)	12 328 (38.2)	24 976 (37.6)
Medicaid, n (%)	57 440 (26.1)	83 697 (25.9)	5736 (17.8)	11 005 (16.6)
Disabled, n (%)	50 292 (22.9)	71 267 (22.1)	7098 (22.0)	13 245 (19.9)
Race and ethnicity, n (%)				
White	177 118 (80.5)	252 949 (78.3)	27 466 (85.2)	55 774 (84.0)
Black	24 805 (11.3)	39 340 (12.2)	1983 (6.2)	3904 (5.9)
Hispanic	11 193 (5.1)	18 984 (5.9)	1526 (4.7)	3335 (5.0)
Asian/Pacific Islander, American Indian/Alaska Native, Other, and Unknown	6901 (3.1)	11 668 (3.6)	1266 (3.9)	3395 (5.1%)
Complications, n (%)				
Major complication	131 689 (59.9)	193 102 (59.8)	10 622 (32.9)	22 948 (34.6)
Minor complication	29 721 (13.5)	44 461 (13.8)	18 672 (57.9)	36 453 (54.9)
No complication	58 607 (26.6)	85 378 (26.4)	2947 (9.1)	7007 (10.6)
Outlier payments, n (%)	10 387 (4.7)	2435 (0.8)	2275 (7.1)	4304 (6.5)
Frail, n (%)	51 850 (23.6)	80 465 (24.9)	3187 (9.9)	6575 (9.9)
Multimorbid, n (%)	146 874 (66.8)	221 841 (68.7)	13 143 (40.8)	27 466 (41.4)

Race and ethnicity are based on self-report at the time of Social Security enrollment, which are collected in mutually exclusive categories as listed in the table. BPCI-A indicates Bundled Payments for Care Improvement – Advanced; and CCW, Chronic Conditions Data Warehouse.

Table 2. Changes in Percentage of Medically or Socially Complex Patients Admitted for Cardiovascular Conditions, Before Vs After Implementation of BPCI-A

	Comparison, %			BPCI-A, %			
	Before period	After period	Difference	Before period	After period	Difference	DiD (95% CI)
Cardiac medical bundles							
Frail	23.8	23.1	−0.7	25.3	24.2	−1.1	−0.4 (−0.9, 0.1)
Multimorbid	66.5	66.9	0.4	68.6	69.0	0.4	0.0 (−0.5, 0.5)
Dually enrolled	26.8	25.2	−1.6	26.3	25.0	−1.2	0.4 (−0.1, 0.9)
Cardiac procedural bundles							
Frail	10.1	9.6	−0.5	10.0	9.8	−0.2	0.2 (−0.6, 1.1)
Multimorbid	40.3	41.1	0.8	41.0	42.4	1.4	0.6 (−0.8, 1.9)
Dually enrolled	18.2	16.5	−1.8	17.2	15.7	−1.6	0.2 (−0.8, 1.2)

BPCI-A indicates Bundled Payments for Care Improvement – Advanced; and DiD, difference in differences.

spending for medical bundles at BPCI-A compared with control hospitals was thus $16 (95% CI, −$228 to $261; *P*=0.90). For the aggregate of cardiac medical bundles, BPCI-A was not associated with changes in the individual payment components comprising episode spending except a small increase in home health agency

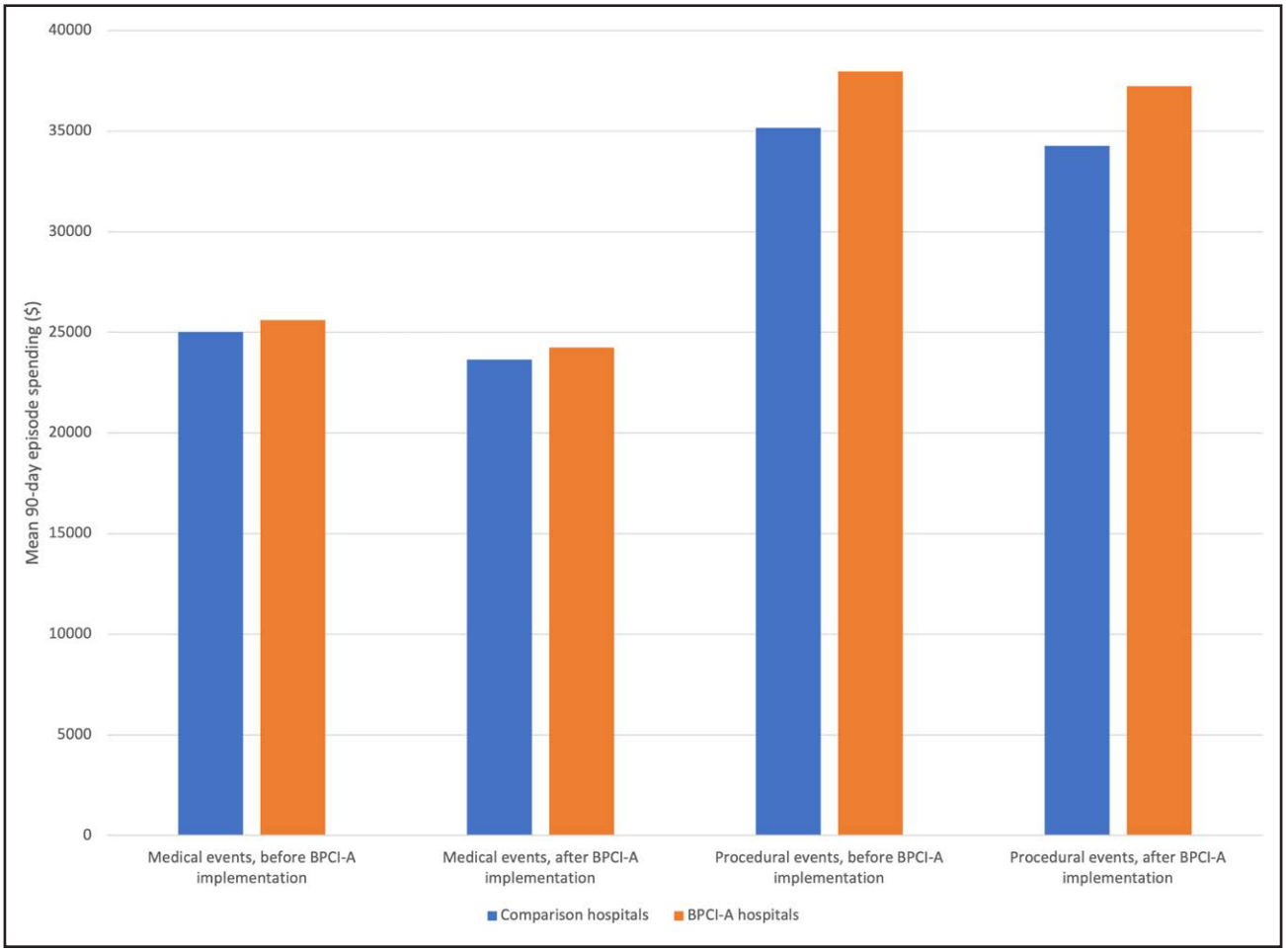

Figure. Mean spending for cardiovascular medical and procedures episodes at BPCI-A–participating and –nonparticipating control hospitals.
For the aggregate of cardiac medical bundles, the change in mean episode spending associated with implementation of BPCI-A (Bundled Payments for Care Improvement – Advanced) was −$1378 at control hospitals and −$1362 at BPCI-A hospitals. The differential change was thus $16 (95% CI, −$228 to $261; *P*=0.90). For the aggregate of cardiac procedural bundles, the change in mean episode spending associated with implementation of BPCI-A was −$909 at control hospitals and −$738 at BPCI-A hospitals. The differential change was thus $171 (95% CI, −$429 to $772; *P*=0.58).

Table 3. Changes in Cardiovascular Spending and Care Utilization Associated With Participation in BPCI-A

	Comparison			BPCI-A				
	Before period	After period	Difference	Before period	After period	Difference	DiD (95% CI)	*P* value
Cardiac medical bundles								
Total episode spending, $	25 026	23 648	−1378	25 606	24 245	−1362	16 (−228, 261)	0.90
With SNF stay, %	23.1	21.7	−1.4	23.9	22.5	−1.3	0.08 (−0.38, 0.53)	
SNF length of stay, d	6.82	6.14	−0.68	7.01	6.22	−0.79	−0.11 (−0.28, 0.07)	
SNF spending, $	3877	3531	−346	4044	3617	−427	−82 (−184, 21)	
AMI								
Total episode spending, $	27 504	26 111	−1393	27 500	26 802	−698	696 (−93, 1484)	
With SNF stay, %	24.0	22.6	−1.4	26.1	24.0	−2.0	−0.6 (−2.0, 0.8)	
SNF length of stay, d	7.19	6.29	−0.90	7.40	6.62	−0.78	0.12 (−0.43, 0.67)	
SNF spending	4092	3572	−520	4280	3856	−424	96 (−225, 418)	
Arrhythmia								
Total episode spending, $	19 092	18 662	−430	19 499	18 824	−674	−245 (−677, 188)	
With SNF stay, %	16.0	14.8	−1.2	16.3	15.6	−0.7	0.5 (−0.3, 1.3)	
SNF length of stay, d	4.80	4.32	−0.48	4.98	4.36	−0.63	−0.15 (−0.47, 0.17)	
SNF spending, $	2736	2491	−248	2898	2545	−353	−106 (−294, 82)	
CHF								
Total episode spending, $	27 579	26 003	−1576	28 594	27 005	−1589	−14 (−328, 301)	
With SNF stay, %	27.5	26.1	−1.4	28.5	27.2	−1.4	0.0 (−0.6, 0.6)	
SNF length of stay, d	8.10	7.41	−0.69	8.38	7.55	−0.83	−0.14 (−0.38, 0.10)	
SNF spending, $	4602	4264	−338	4818	4374	−444	−106 (−245, 33)	
Cardiac procedural bundles								
Total episode spending, $	35 178	34 269	−909	37 961	37 223	−738	171 (−429, 772)	0.58
With SNF stay, %	21.7	20.7	−1.0	22.1	21.1	−1.1	−0.06 (−1.17, 1.05)	
SNF length of stay, d	5.88	5.59	−0.28	6.06	5.71	−0.35	−0.07 (−0.50, 0.36)	
SNF spending, $	3408	3224	−184	3537	3336	−202	−18 (−271, 235)	
Cardiac defibrillator								
Total episode spending, $	55 227	54 361	−867	56 241	52 163	−4078	−3211 (−7,961, 1538)	
With SNF stay, %	15.5	18.5	3.0	16.5	14.4	−2.1	−5.2 (−13.4, 3.0)	
SNF length of stay, d	3.29	5.22	1.93	4.54	4.38	−0.16	−2.09 (−4.96, 0.79)	
SNF spending, $	1939	2769	830	2756	2679	−78	−908 (−2651, 835)	
Cardiac valve								
Total episode spending, $	60 147	57 571	−2576	58 665	56 907	−1758	818 (−2342, 3978)	
Percentage with SNF stay, %	39.7	27.7	−12.0	17.8	15.4	−2.4	9.5 (3.9, 15.1)	
SNF length of stay, d	7.83	5.69	−2.14	4.49	3.55	−0.95	1.19 (−0.55, 2.94)	
SNF spending, $	4610	3551	−1059	2627	2071	−556	502 (−550, 1555)	
CABG								
Total episode spending, $	48 024	48 124	100	47 325	46 481	−844	−944 (−2486, 598)	
Percent with SNF stay, %	24.6	22.4	−2.3	18.6	16.7	−1.8	0.4 (−2.7, 3.6)	
SNF length of stay, d	5.08	4.30	−0.78	4.06	3.39	−0.67	0.10 (−0.80, 1.01)	
SNF spending, $	3028	2586	−442	2445	2093	−352	90 (−478, 657)	
Pacemaker								
Total episode spending, $	29 994	29 182	−812	30 695	29 393	−1302	−490 (−1906, 1150)	
Percent with SNF stay, %	21.2	20.6	−0.7	21.7	20.9	−0.8	−0.2 (−2.8, 2.5)	

(*Continued*)

Table 3. Continued

	Comparison			BPCI-A				
	Before period	After period	Difference	Before period	After period	Difference	DiD (95% CI)	*P* value
SNF length of stay, d	6.17	6.23	0.07	6.18	5.78	−0.40	−0.47 (−1.50, 0.57)	
SNF spending, $	3621	3603	−19	3664	3484	−180	−161 (−787, 464)	
PCI								
Total episode spending $	26 582	25 758	−824	26 556	26 028	−527	296 (−335, 927)	
Percent with SNF stay, %	8.2	8.1	−0.1	8.8	7.9	−0.9	−0.8 (−1.8, 0.2)	
SNF length of stay, d	2.26	2.09	−0.17	2.36	2.16	−0.19	−0.02 (−0.58, 0.33)	
SNF spending, $	1323	1207	−116	1400	1266	−135	−19 (−232, 194)	

AMI indicates acute myocardial infarction; BPCI-A, Bundled Payments for Care Improvement – Advanced; CABG, coronary artery bypass grafting; CHF, congestive heart failure; DiD, difference in differences; PCI, percutaneous coronary intervention; and SNF, skilled nursing facility.

spending (differential change, $29 [95% CI, $7–$50]; Table S8). There were no other observable changes in care utilization for the aggregate of medical conditions. Furthermore, there was no meaningful change in episode spending for any of the medical conditions when analyzed individually (Table 3).

For the aggregate of cardiac procedural bundles, the differential change in episode spending associated with BPCI-A was $171 (95% CI, −$429 to $772; *P*=0.58). There were no changes in the individual payment components comprising episode spending except a small increase in outpatient spending (differential change, $216 [95% CI, $109–$323]). There was no change in episode spending or care utilization for any of the procedures when analyzed individually (Table 3).

Changes in Clinical Outcomes

There was no differential change in 90-day readmission or mortality rates for BPCI-A compared with non–BPCI-A patients before versus after implementation of BPCI-A (Table 4). This was true both for the aggregates of the cardiac medical and procedural bundles and for each of the 8 conditions when analyzed individually. For example, the differential change in 90-day mortality rates among patients with acute myocardial infarction at BPCI-A versus non-BPCI-A hospitals was 0.13% (95% CI, −1.06% to 1.33%). Similarly, among both medical and procedural bundles, there was no differential change, before versus after implementation of BPCI-A in the number of healthy days spent at home.

DISCUSSION

We found that participation in BPCI-A was not associated with meaningful changes in spending, utilization, or clinical outcomes for the cardiovascular medical events or procedures included in the model. In addition, we did not find evidence that hospitals participating in these cardiac bundles selectively avoided vulnerable, high-cost patients in order to reduce spending and meet cost reduction targets. Our findings, which are consistent with work on the BPCI-A precursor,[6–10] have several clinical and policy implications.

First, we found that participation in BPCI-A was not associated with changes in episode spending for any of the cardiac bundles. Several factors may underlie this finding. Providers in bundled payments have generally focused on reducing episode spending by reducing utilization of PAC, such as skilled nursing facilities and inpatient rehabilitation facilities, because PAC accounts for significant variation in episode spending and may be one of the few settings in which spending cuts are feasible (conversely, hospitalization costs are mostly fixed due to the diagnosis-related group system).[4,8,9,30–33] Indeed, bundled payments have found the most success with conditions for which PAC is responsible for nearly all variation in episode spending, such as orthopedic surgeries.[8,9,34–37] In contrast, for cardiovascular care, PAC contributes less to variation in episode spending, and hospitalizations, which are less amenable to spending reductions, contribute more.[9,10,32,37,38]

Furthermore, each cardiac bundle covers hospitalizations that range from elective admissions to life-threatening decompensations. This heterogeneity could lead to substantial variation in within-bundle care processes that resists “one-size-fits-all” efforts to reduce spending, such as blanket decreases in PAC use.[39,40] Patients initiating cardiac bundles are also likely sicker and may have more unavoidable PAC needs compared with clinically optimized patients undergoing elective orthopedic surgeries. Indeed, although we did observe a small reduction in PAC spending for cardiac medical bundles, this reduction was much lower than that seen among orthopedic bundles and was insufficient to affect overall episode spending.[34–36] For these reasons, as long as PAC remains the primary target for reducing spending in bundled payment models, cardiovascular care may not see success under these programs.

Second, there were no meaningful changes in 90-day mortality, readmissions, or healthy days at home for the cardiac bundles. This finding is not surprising, given the minimal change in care patterns observed, and is

Table 4. Changes in Clinical Outcomes Associated With Participation in BPCI-A

	Comparison			BPCI-A			
	Before period	After period	Difference	Before period	After period	Difference	DiD (95% CI)
Cardiac medical bundles							
90-d readmission, %	37.4	37.1	−0.4	37.7	37.6	−0.1	0.27 (−0.25, 0.80)
90-d mortality, %	14.4	13.6	−0.8	14.0	13.1	−0.9	−0.14 (−0.50, 0.23)
Healthy days at home	71.9	73.2	1.29	71.7	73.1	1.43	0.14 (−0.14, 0.43)
AMI							
90-d readmission, %	34.2	34.0	−0.3	34.7	35.6	0.9	1.18 (−0.40, 2.77)
90-d mortality, %	16.1	15.6	−0.5	16.0	15.7	−0.4	0.13 (−1.06, 1.33)
Healthy days at home	70.4	71.8	1.38	70.0	71.1	1.07	−0.31 (−1.22, 0.60)
Arrhythmia							
90-d readmission, %	29.2	28.8	−0.4	29.4	28.9	−0.5	−0.06 (−1.10, 0.98)
90-d mortality, %	7.9	7.7	−0.3	7.4	7.0	−0.3	−0.07 (−0.66, 0.53)
Healthy days at home	78.5	79.3	0.81	78.5	79.5	0.99	0.18 (−0.31, 0.68)
CHF							
90-d readmission, %	42.6	42.4	−0.2	43.1	43.2	0.1	0.29 (−0.39, 0.97)
90-d mortality, %	17.7	16.7	−1.0	17.4	16.1	−1.3	−0.22 (−0.74, 0.29)
Healthy days at home	68.2	69.6	1.43	67.9	69.5	1.62	0.20 (−0.19, 0.59)
Cardiac procedural bundles							
90-d readmission, %	28.7	28.2	−0.5	28.8	28.7	−0.2	0.31 (−0.98, 1.60)
90-d mortality, %	8.0	8.0	0.0	7.8	7.4	−0.3	−0.36 (−1.25, 0.54)
Healthy days at home	77.1	77.4	0.33	76.9	77.5	0.60	0.27 (−0.43, 0.96)
Cardiac defibrillator							
90-d readmission, %	32.6	34.4	1.8	30.7	29.8	−0.9	−2.66 (−13.21, 7.89)
90-d mortality, %	7.6	4.0	−3.5	5.4	5.5	0.1	3.64 (−1.71, 8.99)
Healthy days at home	80.3	79.1	−1.19	79.7	80.0	0.30	1.49 (−3.02, 6.00)
Cardiac valve							
90-d readmission, %	26.6	25.0	−1.6	23.6	25.6	2.0	3.54 (−2.62, 9.70)
90-d mortality, %	2.5	1.9	−0.5	1.9	1.5	−0.5	0.05 (−1.95, 2.05)
Healthy days at home	77.9	80.1	2.25	81.6	82.7	1.06	−1.19 (−3.62, 1.24)
CABG							
90-d readmission, %	19.1	19.3	0.2	19.8	20.8	1.1	0.87 (−2.41, 4.14)
90-d mortality, %	1.8	2.1	0.3	1.2	1.5	0.3	−0.05 (−1.08, 0.97)
Healthy days at home	81.4	81.6	0.21	82.9	83.8	0.83	0.61 (−0.66, 1.88)
Pacemaker							
90-d readmission, %	21.2	21.0	−0.1	22.4	22.2	−0.2	−0.05 (−2.88, 2.79)
90-d mortality, %	3.3	4.0	0.7	4.2	4.4	0.1	−0.53 (−1.89, 0.82)
Healthy days at home	80.5	80.3	−0.17	79.6	80.0	0.40	0.57 (−0.79, 1.93)
PCI							
90-d readmission, %	23.3	22.7	−0.7	22.6	22.3	−0.3	0.35 (−1.17, 1.88)
90-d mortality, %	3.2	3.3	0.1	3.2	2.8	−0.4	−0.53 (−1.18, 0.11)
Healthy days at home	84.1	84.4	0.26	84.1	84.5	0.44	0.18 (−0.39, 0.76)

AMI indicates acute myocardial infarction; BPCI-A, Bundled Payments for Care Improvement – Advanced; CABG, coronary artery bypass grafting; CHF, congestive heart failure; DiD, difference-in-differences; PCI, percutaneous coronary intervention; and SNF, skilled nursing facility.

consistent with work demonstrating little to no changes in clinical outcomes for the aggregate of all bundles offered in BPCI-A.[4] On one hand, it is reassuring that the incentives for hospitals to decrease utilization were not associated with worsened quality of care. On the other hand, BPCI-A is expected to cost CMS billions of dollars.[24,25]

Despite this investment, we did not observe beneficial changes in the form of spending reductions or quality improvements for an important set of bundles offered.

Our findings have implications for equity as well. Several stakeholders and policymakers have raised concerns that high-cost patients with cardiovascular disease might face adverse selection under BPCI-A given the financial incentives to cut costs.[39,41–43] However, we did not find evidence that hospitals restricted access to care for medically or socially complex patients. This is consistent internally with the minimal change in care patterns observed and is also consistent with work on the BPCI-A precursor, which did not observe adverse selection against vulnerable patients.[44,45] More follow-up will be important to ensure that BPCI-A continues to maintain access to care for high-need, high-cost patients.

This study has several limitations. First, participation in BPCI-A was voluntary, and hospitals that chose to participate differed in important ways from nonparticipants.[46] Our results may thus not generalize to all hospitals or to further iterations of BPCI-A. Second, our results pertain only to hospitals and may differ for the physician group practices that joined BPCI-A, which represent an important area for future work. Third, we are unable to measure changes in other costs and overhead that hospitals may have experienced in preparation for participation in BPCI-A.[47] Fourth, we captured clinical outcomes using claims data, which are somewhat blunt, as they do not contain the granularity that could provide a more accurate picture of patient-specific clinical characteristics and illness severity. Fifth, we were able to evaluate only the first year of BPCI-A. It is possible that hospitals need time to redesign care patterns and to learn how to succeed in bundled payments, such that spending reductions might start to be seen only in longer-term evaluations. However, analyses of the BPCI-A precursor failed to demonstrate this learning effect for cardiovascular bundles despite several years of extended follow-up.[6,48,49] Furthermore, BPCI-A was effectively paused in 2020 due to the COVID-19 pandemic. When it was restarted, it set more accurate target prices for participants and shifted to a service line–based model rather than one focused on individual conditions. Whether these new incentives are properly calibrated to motivate spending reductions or quality improvements will require further study.

Conclusions

We found that participation in BPCI-A, an expensive Medicare value-based payment model, was not associated with meaningful changes in spending, care utilization, or clinical outcomes for any of the cardiovascular medical or procedural bundles offered in the model. Policymakers should consider different approaches to incentivize spending reductions and quality improvements for cardiovascular care.

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Supplemental Material

Tables S1–S8
Figures S1 and S2

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