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Bundled Payments For Care Improvement Advanced: Effects On Hospital And CMS Spending, 2018–21

DOI: 10.1377/hlthaff.2025.00459
HEALTH AFFAIRS 45, NO. 2 (2026): 121–128

ABSTRACT The Bundled Payments for Care Improvement Advanced Model (BPCI-A) aims to reduce hospital spending and generate savings for the Centers for Medicare and Medicaid Services (CMS). The design of BPCI-A evolved across four model years; however, previous analyses have not examined its impact on hospital and CMS spending throughout this period. We conducted a synthetic difference-in-differences analysis with a 100 percent sample of Medicare fee-for-service beneficiary data from the period April 2014 through December 2021 to evaluate spending changes across 883 participating hospitals and 1,772 nonparticipating hospitals. BPCI-A led to an average $324 reduction in hospitals' ninety-day episode spending, with larger reductions in model years 3 and 4. The largest spending reductions were for orthopedics and neurological care. Yet large incentive payments to hospitals led to net CMS losses of $171 million during the study period, despite net savings in model year 4. BPCI-A reduced payments to skilled nursing facilities during the study period. Thus, BPCI-A had minimal impact on the CMS budget while shifting payments to hospitals and away from skilled nursing facilities. Our results suggest that voluntary bundled payment is unlikely to generate meaningful savings for CMS.

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Launched in 2018, the Bundled Payments for Care Improvement Advanced Model (BPCI-A) introduced financial incentives to increase efficiency and reduce Medicare spending per episode of hospital care. Under BPCI-A, which is voluntary, participating hospitals are assigned an episode spending target for their selected clinical conditions. Subject to quality performance, hospitals receive bonuses if their spending is below the target or pay penalties if their spending exceeds the target. Although both hospitals and physician groups can choose to participate, most participants have been hospitals.[1]

BPCI-A's design has evolved across several model years. A previous study of model years 1 and 2 (October 2018–December 2019) found that the program led to small reductions in episode spending, resulting in gross savings to the Centers for Medicare and Medicaid Services (CMS).[2] However, program evaluations found that bonus payments to participants offset these gross savings, leading to net CMS losses.[2–4] In response, CMS made substantial changes to the program in model year 4; notably, hospitals could no longer participate in the program for individual conditions but instead had to select entire service lines of clinically related conditions.[5] This change reduced hospitals' ability to cherry-pick individual conditions for which they were likely to succeed. In addition, CMS introduced retrospective adjustment to financial targets, to more accurately reflect national spend-

ing patterns.[5] Reforms in model year 4 may have limited hospitals' strategic participation and mitigated high bonus payments attributable to overly generous targets. However, by reducing opportunities for financial gains, these changes may have depressed participation, potentially attenuating program impact.

The impact of changes in BPCI-A model year 4 and the long-term impact of bundled payment on savings to CMS are unknown. We used national Medicare claims, combined with data on incentive payments, to evaluate the impact of hospital participation in the BPCI-A on gross and net savings to CMS during model years 1–4, between October 2018 and December 2021.

Study Data And Methods

DATA We used data from the CMS Virtual Research Data Center to create ninety-day episodes of eligible conditions during the period April 1, 2014, through December 31, 2021. Data included all medical claims associated with the episode, including information from inpatient, carrier, outpatient, skilled nursing facility, home health, hospice, and durable medical equipment files. We conducted a Freedom of Information Act request to identify the clinical conditions selected by participating hospitals during the study period and validated the data with participant information from the CMS Innovation Center Model Data Sharing initiative. We linked the clinical conditions data to data on hospital characteristics from the CMS inpatient prospective payment system impact file and the American Hospital Association Annual Survey.

INCLUSION AND EXCLUSION CRITERIA Following BPCI-A rules,[6] we included acute care hospitals participating in the inpatient prospective payment system and excluded hospitals from Maryland and US territories. We excluded one hospital that began participating in BPCI-A in July 2019, one that began in July 2020, and one that began in July 2021 because these hospitals did not participate across the entirety of the model year in which they entered.

We included episodes on the basis of qualifying inpatient diagnosis-related groups or outpatient Healthcare Common Procedure Coding System codes for included conditions (online appendix exhibit A1).[7] We followed CMS rules for episode exclusions, with minor variations to ensure comparability with nonparticipating hospitals (appendix Methods).[7] We excluded hospitals without at least ten observations across any of the thirty-three eligible conditions in each quarter of the study period, as the synthetic difference-in-differences estimator used in our analysis required a balanced panel. No further exclusions were made among potential control hospitals. A total of 883 acute care hospitals participating in BPCI-A for at least one condition ("treated" hospitals) had 5,265,163 eligible episodes ending during the period April 1, 2014, through December 31, 2021. Of the 1,773 hospitals that did not participate in BPCI-A for any condition ("control" hospitals), 1,772 were included (had nonzero weights) in the synthetic difference-in-differences analysis, with 14,173,923 eligible episodes ending during this period (appendix exhibit A2).[7]

For treated hospitals, we included only conditions for which hospitals participated at some point during the study period with at least ten observations per quarter. For control hospitals, we included all conditions with at least ten observations per quarter.

OUTCOMES The primary outcome of our statistical analysis was Medicare spending for ninety-day episodes, adjusted to 2021 dollars. We decomposed ninety-day episode spending across several categories (skilled nursing facility, inpatient rehabilitation, index hospitalization, rehospitalization, and home health). When calculating this spending, we did not adjust prices to account for administratively determined differences in payments (such as indirect medical education and disproportionate share hospital payments) or regional adjustments, to facilitate comparisons between changes in episode spending and incentive payments from CMS. In a sensitivity analysis to assess the robustness of our results, we examined ninety-day episode spending with prices that were adjusted for administrative differences.

The secondary outcome was ninety-day mortality. Per our synthetic difference-in-differences estimator, we aggregated outcomes across all clinical conditions to the hospital-quarter level.

Before aggregation, we adjusted for differences in mean spending across clinical conditions by dividing by the mean level for that condition across the study period. We then calculated hospital-quarter-level means, weighted by episode volume, both overall and separately for BPCI-A service lines. This procedure allowed us to generate average estimates of the impact of BPCI-A across conditions.

DESIGN AND STATISTICAL ANALYSES We used the synthetic difference-in-differences estimator[8] to assess the effect of BPCI-A on per episode spending and mortality. The estimator created a comparison group from a weighted combination of untreated control units that was optimized to match the pretreatment outcome trends of the treated group. The estimation approach also incorporated time weights to give more influence to periods in which treated and control units

exhibited similar pretreatment trends.[9] The synthetic control approach is more robust than a standard difference-in-differences approach to bias from violations to the parallel trends assumption and bias from time-varying treatment effects occurring with staggered entry.[10–12] We display results as an event study, showing the difference in outcomes between treated and synthetic control hospitals for each entry cohort, normalized to zero in the period immediately preceding treatment.

We classified participating hospitals into three entry cohorts: 638 hospitals beginning in model years 1 and 2 (October 2018), 203 hospitals beginning in model year 3 (January 2020), and forty-two hospitals beginning in model year 4 (January 2021). Entry cohorts were defined on the basis of a hospital's earliest entry into BPCI-A for any condition. We performed an intention-to-treat analysis that maintained hospitals' treatment status if they exited the program. We created separate synthetic controls, consisting of a weighted combination of hospitals that never participated in BPCI-A, for each entry cohort. We generated estimates overall for each entry cohort, model year, and clinical service line and for separate spending categories (skilled nursing facility, inpatient rehabilitation, index hospitalization, rehospitalization, and home health).

Using data on incentive payments per episode and the number of eligible participant episodes in each model year, we then compared gross savings, measured as changes in hospitals' average ninety-day episode spending, with CMS's total incentive payments to calculate the net financial impact on CMS. The number of episodes included in the gross savings analysis was greater than that for the incentive payment analysis. This difference reflects the fact that our econometric analysis of gross savings used an intention-to-treat approach that maintained hospital participation after drop-out and assigned participation for all conditions that a hospital ultimately selected for participation to its earliest start date.

Our approach (see the appendix Methods)[7] differed from that previously used by a CMS contractor to evaluate the impact of BPCI-A.[3,4,13] For instance, the contractor's evaluation did not explicitly account for potential violations to parallel trends; performed matching to balance treated and control hospitals on hospital and market characteristics; standardized prices; and used somewhat different inclusion and exclusion criteria. We replicated the contractor's approach, performed a visual inspection of parallel trends, generated alternative estimates of the impact of BPCI-A, and identified the methodological decisions that were responsible for differences in effect magnitudes.

We conducted three sensitivity analyses. The first examined the robustness of the synthetic difference-in-differences approach by reestimating the treatment effect while excluding a single control hospital in each iteration.[14] Second, to evaluate heterogeneous effects across clinical conditions, we estimated additional synthetic control models for each of the five conditions with the highest episode volume. We also calculated CMS net savings for these conditions. Finally, we reestimated treatment effects using standard (nonsynthetic) difference-in-differences to compare results across alternative approaches.

We conducted all analyses using Stata MP, version 18.0. Standard errors were based on 500 bootstrap replications. We considered a two-tailed $p < 0.05$ to be statistically significant without adjustment for multiple comparisons. Brown University's Institutional Review Board approved this study and waived requirements for informed consent.

LIMITATIONS This study had several limitations. First, participation in BPCI-A was voluntary, and participation was likely influenced by whether hospitals expected to earn bonuses.[15] Hospitals that chose not to participate may have had lower capacity for clinical and operational changes, potentially inflating our estimates of the impact of BPCI-A. Yet this concern is mitigated by other research findings indicating that the impact of bundled payment has been similar among hospitals participating in voluntary and mandatory models.[16–18] Second, treated hospitals differed from synthetic control hospitals across a number of characteristics. However, these differences were consistent across the study period, suggesting that they were unlikely to introduce bias. Third, our synthetic difference-in-differences analysis used an intention-to-treat approach and assumed that participation for all conditions that a hospital ultimately selected began at hospitals' earliest start date. However, our replication of the contractor's analysis suggested that these specification decisions did not have a major impact on our estimates.

Fourth, our results might not generalize across the population of US hospitals, including those that have not participated in bundled payment programs. Fifth, we did not investigate the impact of BPCI-A among physician group practices, and our results might not generalize to these participants, although contractor evaluations suggest similar effects of BPCI-A among hospitals and physician groups.[3,4,13]

Finally, our study period included the COVID-19 pandemic. During this time, BPCI-A contin-

ued, but CMS excluded hospitalizations with a COVID-19 diagnosis and gave hospitals the option to forgo bonuses and penalties.[19] The pandemic also altered patterns of postacute care[20,21] that are relevant to episode spending under bundled payment. However, both treated and synthetic control hospitals were subject to these effects; the regional distributions of treated and synthetic control hospitals were similar (mitigating concerns of regional variation in the effects of the pandemic);[22] and shocks to spending after the pandemic were empirically similar between treated and synthetic control hospitals. As a result, although the pandemic likely inflated hospital bonus payments during 2020, we believe that it was unlikely to have affected the study findings.

EXHIBIT 1

Baseline characteristics of hospitals participating in the Bundled Payments for Care Improvement Advanced Model (BPCI-A) and nonparticipating (control) hospitals and their patients, model years 1 and 2 entry cohort, 2017

Characteristics	Model years 1 and 2 entry cohort (treated)	Synthetic controls
HOSPITAL CHARACTERISTICS		
Unique hospitals, no.	638	1,771
Episodes, no.	560,307	1,966,456
No. of beds, mean	291	184
Medicare share, mean %	37	39
Case-mix index, mean	1.68	1.57
Disproportionate share hospital index, mean	0.31	0.30
For-profit hospital, %	28	20
Teaching hospital, %	13	7
Region, %		
Northeast	18	17
Midwest	24	24
South	37	40
West	20	19
PATIENT CHARACTERISTICS		
Age, mean years	76	75
Female, %	56	55
Race, %		
Non-Hispanic White	79	84
Non-Hispanic Black	11	8
Hispanic	7	5
Dual eligibility,[a] %	27	25
Elixhauser comorbidities count, %		
0	6	8
1	21	23
2	30	30
3	24	22
4 or more	19	17

SOURCE Authors' analysis of a 100% sample of Medicare fee-for-service beneficiary data from the Centers for Medicare and Medicaid Services (CMS) Virtual Research Data Center, 2017; CMS inpatient prospective payment system impact file; and the American Hospital Association Annual Survey, 2017. **NOTES** The model years 1 and 2 cohort of hospitals began entering BPCI-A in October 2018. Characteristics of synthetic control hospitals and their patients are adjusted by the hospital-specific weight from the synthetic difference-in-differences model for overall spending in model years 1 and 2. [a]Both Medicare and Medicaid.

Study Results

Before the start of BPCI-A and compared with synthetic control hospitals (adjusted by model weights), hospitals in the model years 1 and 2 entry cohort were larger (average of 291 beds versus 184), had a somewhat lower share of Medicare discharges (37 percent versus 39 percent), had a similar disproportionate share hospital index (average of 0.31 versus 0.30), and had a greater share of teaching hospitals (13 percent versus 7 percent) (exhibit 1). These differences between treated and synthetic control hospitals were similar before and after treatment and across the entry cohorts, suggesting that differences in characteristics should not have introduced bias into effect estimates (appendix exhibits A3 and A4).[7] Patient characteristics were similar among treated and synthetic control hospitals (exhibit 1 and appendix exhibits A3–A5).[7] The most commonly selected conditions during the study period were sepsis (74 percent of participating hospitals, 353,980 episodes); simple pneumonia and respiratory infections (69 percent of participating hospitals, 142,501 episodes); and chronic obstructive pulmonary disease, bronchitis, and asthma (67 percent of participating hospitals, 95,709 episodes) (appendix exhibit A6).[7]

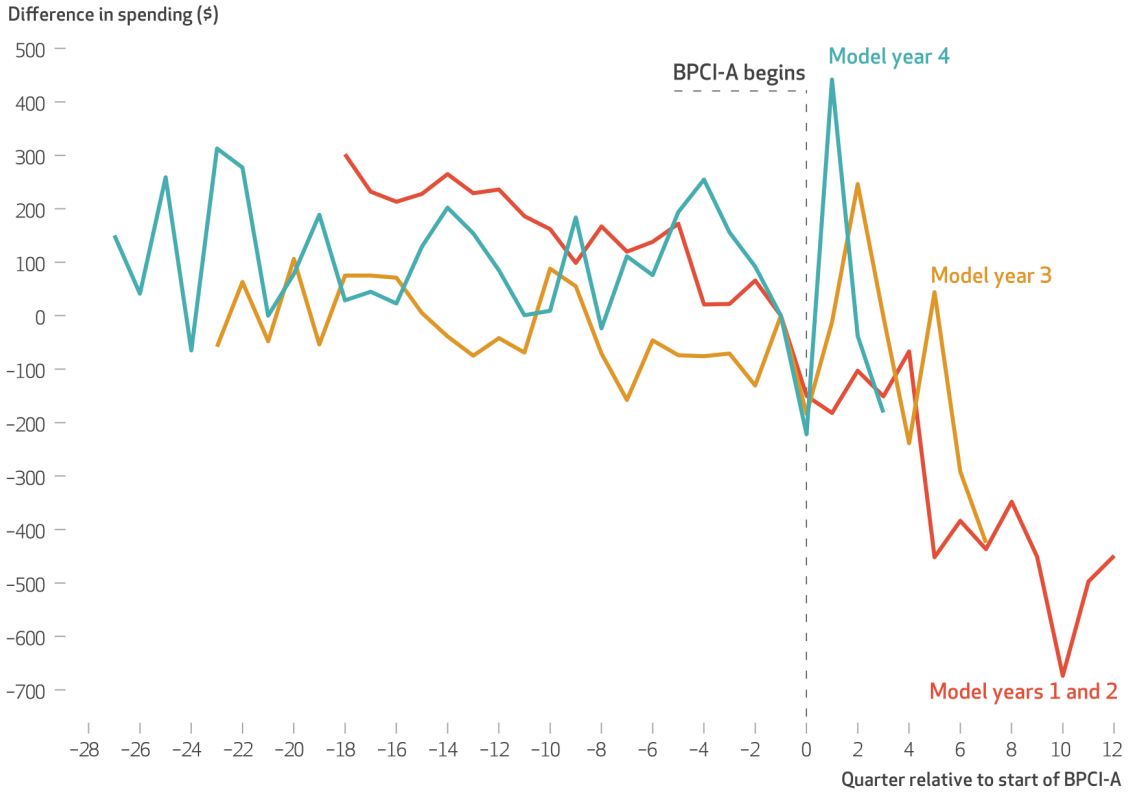
Preintervention trends in ninety-day episode spending were largely parallel between treated and synthetic control hospitals for each entry cohort (exhibit 2), supporting the validity of the synthetic difference-in-differences approach. Although there was some evidence of nonparallel trends for the model years 1 and 2 entry cohort, this was addressed in the synthetic control analysis by applying greater weight to the preintervention periods immediately preceding the program start (appendix exhibit A7, panels A–C).[7]

For the model years 1 and 2 entry cohort, participating hospitals had initially higher ninety-day episode spending than synthetic control hospitals before the start of BPCI-A (appendix exhibit A7, panel A).[7] This difference declined after the start of the program, suggesting that BPCI-A reduced episode spending (exhibit 2). For the model year 3 and model year 4 entry cohorts, there were no apparent changes in ninety-day episode spending after the start of BPCI-A (exhibit 2 and appendix exhibit A7, panels B and C).[7]

Across all clinical service lines and model years, we estimated that BPCI-A led to a $324 average reduction in ninety-day Medicare spending per episode (95% confidence interval: −459, −189) (exhibit 3). The largest reductions in ninety-day episode spending were for the orthopedics (−$797 per episode) and neurological care (−$767 per episode) service lines (exhibit 3).

EXHIBIT 2

Difference in average 90-day Medicare spending per episode among hospitals participating in the Bundled Payments for Care Improvement Advanced Model (BPCI-A) and nonparticipating (control) hospitals, 2018–21



SOURCE Authors' analysis of a 100% sample of Medicare fee-for-service beneficiary data from the Centers for Medicare and Medicaid Services Virtual Research Data Center, 2014–21. **NOTES** Model years 1 and 2: October 1, 2018–December 31, 2019; model year 3: January 1, 2020–December 31, 2020; and model year 4: January 1, 2021–December 31, 2021. Results are displayed as an event study showing the difference in average 90-day spending per episode between participating (treated) hospitals and synthetic controls for each model year entry cohort, normalized to equal 0 in the period immediately preceding the program start. Outcomes were aggregated to the hospital-quarter level and adjusted to 2021 dollars.

When the effects of BPCI-A were decomposed across spending categories, we found that by far the greatest CMS average spending reductions occurred for skilled nursing facility care (–$338; 95% CI: –412, –264) (appendix exhibit A8).[7]

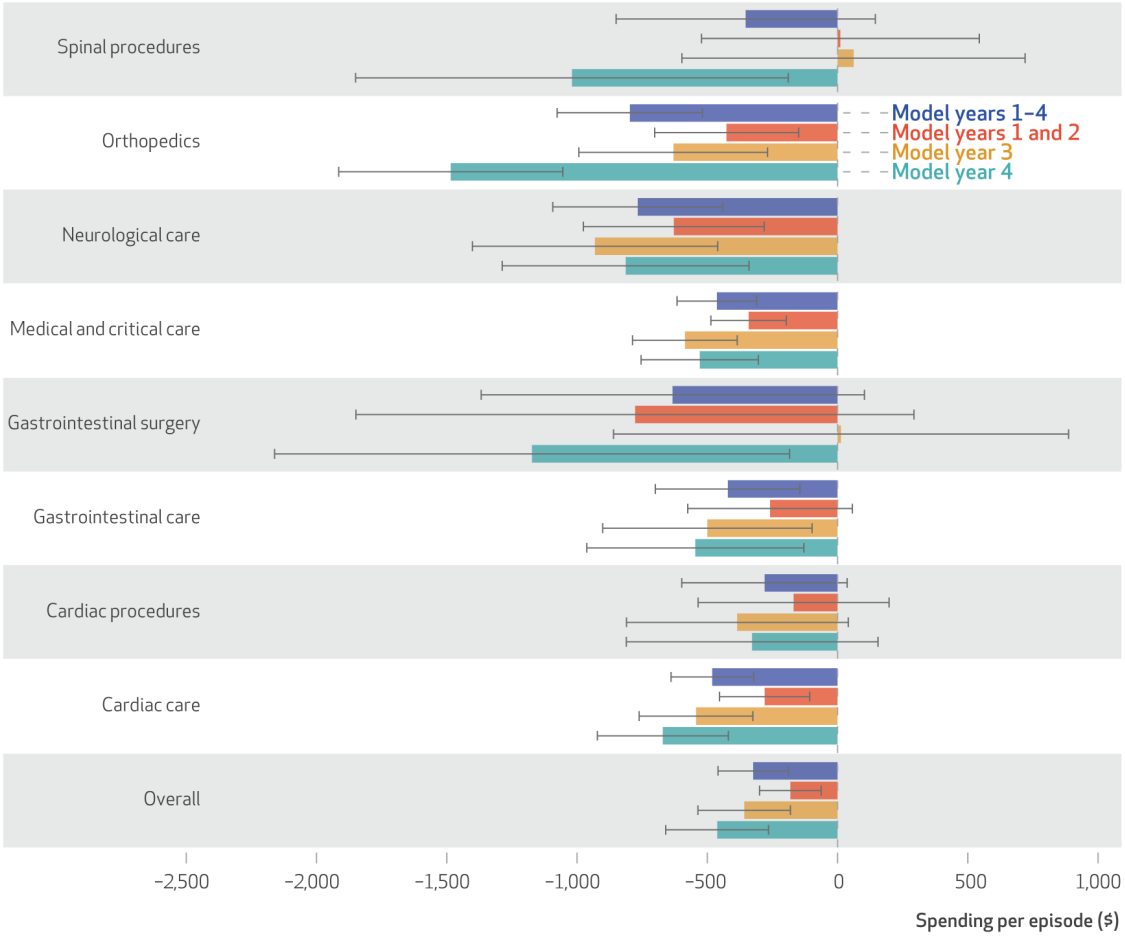
The magnitude of reductions in CMS average spending per ninety-day episode grew over the model years (–$181 per episode in model years 1 and 2, –$358 in model year 3, and –$462 in model year 4) (exhibit 4). Results indicate that the increasing magnitude of spending reductions across model years was attributable to increases in treatment effects over time among the model years 1 and 2 entry cohort, as treatment effects for hospital entrants in model year 3 and model year 4 were far smaller (appendix exhibit A7).[7] Sensitivity analyses found that standardized Medicare prices resulted in directionally consistent but smaller estimates (appendix exhibit A7).[7] Hospitals' participation in BPCI-A was associated with a nonsignificant 0.008-percentage-point (95% CI: –0.195, 0.212) increase in patient mortality per ninety-day episode (appendix exhibits A9 and A10).[7]

CMS hospital incentive payments per episode averaged $1,443 in model years 1 and 2, $2,006 in model year 3, –$112 in model year 4, and $1,119 overall (exhibit 4). When accounting for our estimates of gross savings to CMS, we found that BPCI-A generated net losses to CMS of $278 million in model years 1 and 2, net losses of $151 million in model year 3, and net savings of $246 million in model year 4. Together, this resulted in net losses of $171 million for CMS in model years 1–4.

Sensitivity analysis showed that the synthetic difference-in-differences estimator was robust across changes across the pool of control hospitals (appendix exhibit A11).[7] Estimates from the sensitivity analysis on the five conditions with the highest episode volume found that although gross savings per episode tended to be larger in these models, net losses were observed for four

EXHIBIT 3

Effect of the Bundled Payments for Care Improvement Advanced Model on average 90-day Medicare spending per episode, overall and across model years and clinical service lines, 2018–21



SOURCE Authors' analysis of a 100% sample of Medicare fee-for-service beneficiary data from the Centers for Medicare and Medicaid Services Virtual Research Data Center, 2014–21. **NOTES** Outcomes were aggregated to the hospital-quarter level and adjusted to 2021 dollars. Model years are defined in the exhibit 2 notes.

EXHIBIT 4

Centers for Medicare and Medicaid Services (CMS) gross and net savings and losses from the Bundled Payments for Care Improvement Advanced Model (BPCI-A), 2018–21

	Incentive payments			Gross savings			Net savings or losses
Model years	No. of episodes eligible for incentive	Incentive payments per episode	Total incentive payments, millions	No. of episodes in treated hospitals	Gross savings per episode	Total gross savings, millions	Total, millions
1 and 2	277,998	$1,443	$401	682,749	−$181	−$124	$278
3	176,075	2,006	353	564,979	−358	−202	151
4	200,120	−112	−22	484,568	−462	−224	−246
All	654,193	1,119	732	1,732,296	−324	−561	171

SOURCE Authors' analysis of a 100% sample of Medicare fee-for-service beneficiary data from the CMS Virtual Research Data Center, 2014–21; and Freedom of Information Act request data on BPCI-A incentive payments, 2018–21. **NOTES** Incentive payments per year were calculated as the sum of total incentive payments across all participating hospitals in each model year divided by the total number of eligible episodes. Per CMS accounting conventions, positive numbers represent additional expenditures (losses) and negative numbers represent lower expenditures (savings). Model years are defined in the exhibit 2 notes.

of the five conditions (appendix exhibits A11–A13).[7] Standard difference-in-differences estimates of the impact of BPCI-A on ninety-day gross spending per episode were larger than those reported in our main analysis (appendix exhibits A14 and A15).[7]

Our estimates from replication of the contractor's evaluations were also substantially larger than those found in our main analysis, but they were similar to those in the contractor's evaluation reports (appendix exhibit A17).[7] For instance, in model year 4, we estimated overall gross CMS savings of $462 per episode, compared with $800 per episode (weighted across medical and surgical episodes) in the contractor's evaluation. Following the methods described by the contractor, we were able to closely replicate the estimates to those appearing in evaluation reports (appendix exhibit A17).[7] In doing so, we found visible evidence of nonparallel trends (appendix exhibit A18).[7]

Discussion

We estimated that BPCI-A led to small reductions (approximately 1.2 percent) in ninety-day hospital episode spending over the course of its first four model years (2018–21). CMS gross spending reductions were largely attributable to the cohort of hospitals entering in model years 1 and 2 and were greatest for the orthopedics service line. Reduced spending related to skilled nursing facilities accounted for the greatest share of averted expenditures across spending categories. After we accounted for bonus payments to hospitals, BPCI-A generated losses to CMS in model years 1–3 but net CMS savings in model year 4. Overall, BPCI-A led to losses of $171 million for CMS over the course of the first four model years. CMS spending on skilled nursing facilities was reduced by approximately $585 million.

Our findings suggest that BPCI-A has resulted in additional transfers from CMS to hospitals, largely at the expense of skilled nursing facilities. It is possible that the program provided benefits to Medicare beneficiaries related to better-coordinated, higher-quality care. Yet survey research suggests that the only hospital strategy that differed statistically between BPCI-A participating and nonparticipating hospitals was related to reducing institutional postacute care.[23] BPCI-A was also associated with small reductions in beneficiaries' functional status and a reduction in beneficiaries' perception that the hospital staff honored their preferences for postacute care.[4,24–26] These findings did not provide evidence that hospitals engaged in strategies that improved beneficiaries' welfare under BPCI-A.

To our knowledge, ours was the first peer-reviewed study to evaluate the impact of the BPCI-A on savings to CMS in model years 3 and 4 and to document net savings in any of BPCI-A's model years. Ours was also the first to show variation in treatment effects across hospital entry cohorts in BPCI-A. Our results are consistent with evidence that BPCI-A resulted in net losses to CMS in model years 1–3[2–4] and net savings in model year 4.[13] However, the contractor's evaluations found substantially larger gross savings for CMS.[3,4,13] Because differences between our analysis and the contractor's analysis with respect to model specifications had a minor impact on treatment effects in our replication analysis, we believe that larger treatment effect estimates reported from the contractor's analysis relative to our findings are best explained by a failure to account for nonparallel preintervention trends.

Despite overall financial losses over its first four model years, design changes to BPCI-A in model year 4—including requiring participating hospitals to select entire service lines rather than individual episodes and making retrospective adjustments to spending targets—led to CMS savings. This result provides a proof of concept that CMS can generate savings through voluntary episode payment models. Yet prior research suggests that hospital losses in voluntary payment models are associated with hospital disenrollment,[27] and hospitals' participation in BPCI-A declined in model year 5.[28,29] As a result, savings to CMS in voluntary payment models may have a short shelf life, as participants sustaining losses will exit.

Conclusion

Our study provides evidence that voluntary bundled payment is unlikely to generate meaningful or sustained savings for CMS. CMS can likely increase savings by transitioning to mandatory bundled payment, as it has through the new Transforming Episode Accountability Model.[30] ■

The authors acknowledge grant support for this work from National Institute on Aging, National Institutes of Health (Grant Nos. R01AG047932 and R01HL160588, to Andrew Ryan, Yan Lin, and Jason Buxbaum). Ryan and Peter Hull report receiving grant support from Arnold Ventures. Sukruth Shashikumar reports receiving grant support from the Sarnoff Cardiovascular Research Foundation. To access the authors' disclosures, click on the Details tab of the article online.

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