

Small Practice Participation and Performance in Medicare Accountable Care Organizations

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The Patient Protection and Affordable Care Act placed a greater emphasis on models of reimbursing physicians and hospitals that hold them accountable for both quality and cost of care, an approach commonly referred to as value-based purchasing (VBP).¹ The accountable care model is a particular VBP approach that has expanded rapidly. Within a Medicare Shared Savings Program (MSSP) accountable care organization (ACO), physician group practices, hospitals, and health systems can receive payments known as “shared savings” for meeting care quality and spending benchmarks.² Study findings have shown that ACOs improve care quality but only modestly reduce annual beneficiary spending.³⁻⁹ However, evidence suggests that spending reductions are heterogeneous across organizational characteristics of the ACO.¹⁰⁻¹⁶ Further exploration of ACO features associated with spending reductions may help identify pathways for ACOs to control costs.^{17,18}

One group that has faced challenges in VBP programs is the small physician practice.¹⁹⁻²¹ For small practices, participating in an ACO offers a potential opportunity to gain the benefits of provider networks that can overcome the burdensome requirements for VBP participation. Small practices face obstacles when joining and participating in VBP due to their lack of infrastructure (eg, health information technology), administrative and business expertise, and capital.¹⁹ Small practices may help ACOs obtain shared savings payments by limiting high-cost inpatient and specialty care and forming strong bonds with patients, thus increasing treatment adherence.²² Patients in small practices are also less likely to have avoidable hospital stays²³ and readmissions.²⁴ Further, small practices are nimbler when adjusting care to meet ACO quality and spending benchmarks.²⁵ Therefore, we hypothesized that there would be greater reductions in spending for patients attributed to small practices in ACOs relative to large practices.

METHODS

Study Design

We evaluated the relative performance of small practices (≤ 15 providers) and large practices (> 15 providers) participating

ABSTRACT

OBJECTIVES: Alternative payment models (APMs) encouraging provider collaboration may help small practices overcome the participation challenges that they face in APMs. We aimed to determine whether small practices in accountable care organizations (ACOs) reduced their beneficiaries' spending more than large practices in ACOs.

STUDY DESIGN: Retrospective cohort study of Medicare patients attributed to ACOs and non-ACOs.

METHODS: We conducted a modified difference-in-differences analysis that allowed us to compare large vs small practices before and after the Medicare Shared Savings Program (MSSP) ACO started, between 2010 and 2016. Our sample included Medicare fee-for-service beneficiaries with 12 months of Medicare Part A and Part B (unless death) who were attributed to small (≤ 15 providers) and large (> 15 providers) practices participating in ACOs and non-ACOs. The outcome was patient annual spending based on CMS' total per capita costs.

RESULTS: Patients attributed to small practices in ACOs had annual Medicare spending decreases of \$269 [95% CI, \$213-\$325; $P < .001$] more than patients attributed to large practices in ACOs. Small ACO practices reduced spending more than large practices by \$165 for physician services [95% CI, \$140-\$190; $P < .001$], \$113 for hospital/acute care [95% CI, \$65-\$162; $P < .001$], and \$52 for other services [95% CI, \$27-\$77; $P < .001$]. Small practices in ACOs spent \$253 more on average at baseline than small practices in non-ACOs. ACOs with a higher proportion of small practices were more likely to receive shared savings payments.

CONCLUSIONS: Small practices in ACOs controlled costs more so than large practices. Small practice participation may generate higher savings for ACOs.

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TAKEAWAY POINTS

Are small practices in accountable care organizations (ACOs) more likely to achieve Medicare savings than large practices in ACOs?

- ▶ We find that small practices in ACOs reduced spending relative to large practices in ACOs, and we show that ACOs having a higher proportion of small practices than large received more shared savings payments.
- ▶ Historically, small practices struggle in pay-for-performance models, but they appear to achieve success in the ACO model. ACOs may be able to improve their performance by contracting with more small practices.

(HCC) scores as a comorbidity measure, as well as patient disability and end-stage renal disease status. We also restricted patient matching to within hospital referral region (HRR) and year to address temporal and geographic variation in both attribution and health care resources. After matching, our analytic sample consisted of 2,788,240 unique ACO-attributed beneficiaries and 3,943,174 unique non-ACO-attributed beneficiaries between 2010 and 2016 (see [Appendix B Table](#)).

in an MSSP ACO in reducing annual Medicare expenditures of attributed beneficiaries between 2010 and 2016 using a modified difference-in-differences analysis. Beneficiary spending in small and large practices in ACOs was compared with spending in small and large non-ACO practices before and after ACO entry. Then, the difference between the small and large practice differences was calculated, which causally estimated how small practices in ACOs affected spending relative to large practices in ACOs.

The primary outcome, annual spending, was measured by aggregating Medicare spending for each beneficiary each year (Medicare Provider Analysis and Review [MedPAR], Outpatient, and Carrier files; 2010-2016). The independent variables included physician practice and patient characteristics from the Medicare Data on Provider Practice and Specialty (MD-PPAS; 2010-2016), the Medicare Beneficiary Summary File (MBSF; 2010-2016), and Medicare claims files. The ACO attribution and ACO entry dates were derived using the ACO Provider Research Identifiable File (RIF) for 2016. Shared savings payment information for 2016 was obtained from the Shared Savings Program ACO Public Use File and linked to our ACO practice composition data.

Study Population

The study population includes Medicare beneficiaries with parts A and B and no Medicare Advantage plan coverage for each year between 2010 and 2016 or until death. Note that 2016 was selected as the final year of the study due to data availability, whereas the other restrictions prevented potentially unobserved spending and diagnoses from biasing model estimates. Beneficiaries were then assigned to either an ACO or a non-ACO based on the CMS Shared Savings and Losses and Assignment Methodology Version 4 (see [eAppendix A](#) [eAppendices available at [ajmc.com](#)]).²⁶ Characteristics of ACO-attributed and non-ACO-attributed beneficiaries were obtained from the MBSF, and beneficiary medical histories were determined using diagnosis codes included in the Medicare Carrier, Outpatient, and MedPAR files.

We used propensity score matching as a technique for quasirandomization.²⁷ Demographics in the matching model included race and ethnicity (ie, Black, Asian, Native American, White, Hispanic, and other/unknown race), Medicaid dual-eligible status, gender, and age. We also incorporated CMS Hierarchical Categorical Condition

Identifying Practices and Characteristics

We identified physician practices using federal Taxpayer Identification Numbers (TINs). Whether a practice was participating as an ACO provider was then determined using the ACO provider files. Special payment models in underserved areas (eg, federally qualified health centers) do not use TINs for billing in the Outpatient file and account for a small percentage of beneficiaries, so we excluded them due to the difficulty in accurately measuring their sizes.²⁶

The primary independent variable was practice size. We defined a small practice as any practice with 15 or fewer practicing physicians, which is the exact definition used by CMS' Merit-based Incentive Payment System program.²⁸ To characterize by practice size, we calculated the number of National Provider Identifiers (NPIs) participating in each TIN each year using MD-PPAS files.

We also included a variable that indicated whether physician practices were part of a vertically integrated system. Organizational incentives differ for vertically integrated practices, and these incentives may affect a practice's ability to constrain costs.²⁹ Prior work by McWilliams et al showed that physician vs hospital ownership of the ACO, a measure of vertical integration, was associated with ACO spending.¹¹ We identified vertical integration using Neprash and colleagues' methods,³⁰ which use the proportion of spending accrued by NPIs in hospital outpatient departments to assign TINs to vertically integrated systems (see [eAppendix C](#)).

Outcome Variable: Annual Patient Expenditures

The primary outcome was annual patient spending based on CMS' total per capita costs (TPCC).²⁶ Our annual spending measure included TPCC components of MedPAR, Carrier, Hospice, Home Health, and Outpatient claims. Durable medical equipment, a small proportion of total spending, was excluded due to data availability. Spending above the 1% threshold in each year was also censored to the 1% level to smooth highly irregular payments (see [eAppendix D](#) for additional details).

Statistical Analysis

To determine the difference in spending between small and large practices in ACOs, we *separately* compared their spending with small and large practices in non-ACOs from before and after ACO entry and took the difference of these differences. Applying this

methodology, referred to as difference-in-difference-in-differences,³¹ provided an estimate of the relative reduction in spending between small and large ACO practices. Specifically, our model had the following specification:

$$TPCC_{ikt} = \beta_0 + \beta_1 Small_k + \beta_2 Post_{kt} + \beta_3 Post_{kt} \times Small_k + \beta_4 Year_t + \delta X_{it} + \alpha_1 ACO_{ikt} + \alpha_2 ACO_{ikt} \times Post_{kt} + \alpha_3 ACO_{ikt} \times Small_k + \alpha_4 ACO_{ikt} \times Small_k \times Post_{kt} + \epsilon_{ikt}$$

The outcome, $TPCC_{ikt}$, is the TPCC of patient i assigned to TIN k in year t ; ACO_{ikt} is an indicator for whether or not a patient is attributed to an ACO; X_{it} is a set of patient-level covariates (ie, gender, race/ethnicity, age [< 65 , $65-74$, $75-80$, and > 80 years], and the 72 HCC indicators used in CMS' risk adjustment model) with δ defined as a vector of corresponding coefficients; $Year_t$ is a normalized time trend (ie, 0, 1, 2, 3, 4, 5, 6); $Post_{kt}$ is an indicator for whether or not TIN k is in its post period (ie, after ACO launch date if the patient was ACO attributed and after the matched pair's ACO launch date if the patient was attributed to a non-ACO); β_0 is the intercept; and ϵ_{ikt} is the independent and identically distributed error term. The variable of interest, $Small_k$, is an indicator of whether or not TIN k was defined as a small practice in a given year. The "treatment effect" in our model is the coefficient on the triple interaction term (α_4), which represents the mean difference in spending between patients attributed to small practices in ACOs relative to large. Our full specification, which separately specifies ACO attribution by ACO entry cohort (with April 2012 being the first cohort), is provided in [eAppendix E](#). Note that we identify 6 ACO cohorts based on their unique start dates provided in the ACO provider RIF. Therefore, we model 6 ACO cohort effects, which we weigh by the total beneficiaries in each cohort to obtain a single estimate of the ACO effect on spending.

Secondary Analysis

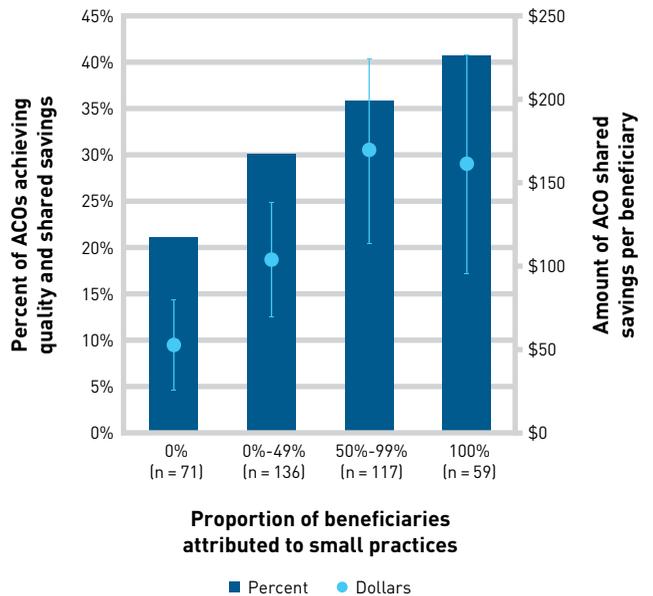
To achieve savings, ACOs had to meet both quality and savings benchmarks. We illustrate ACO achievement of shared savings and the dollars per attributed beneficiary by the percentage of attributed beneficiaries assigned to a small practice ([Figure](#)).

RESULTS

Practice and Beneficiary Characteristics of ACOs vs Non-ACOs Before and After Matching

Before the 1:1 propensity score matching was applied, ACO practices differed from non-ACO practices on both practice and patient characteristics in 2016 ([Table 1](#)). ACO practices were more likely to be primary care physician (PCP) only (56.8% vs 39.9%; $P < .001$) and mixed PCPs and specialists (23.9% vs 16.4%; $P < .001$) as opposed to specialist only (19.2% vs 43.7%; $P < .001$). Practices participating in ACOs were primarily located in the Northeast (24.8% vs 20.1%; $P < .001$) and Midwest (17.3% vs 15.9%; $P < .001$). Although they represented only 15% of total practices, ACO practices were responsible for the care of roughly a quarter of all patients. Patients in ACOs were younger and less likely to be disabled or dually eligible.

FIGURE. Percent of ACOs Receiving Shared Savings Payments and Mean Savings per Beneficiary by the Proportion of Beneficiaries Attributed to Small Practices in the ACOs



ACO, accountable care organization.
Source: Shared Savings Program ACO Public Use File 2016.

After matching, patient characteristics were well balanced between ACOs and non-ACOs. Practice characteristic differences were also reduced after patient matching. This is likely a consequence of matching patients within HRR where practice characteristics are likely homogenous.

Characteristics of Small and Large Practices in ACOs vs Non-ACOs after Patient Matching

[Table 2](#) shows the comparison of small and large practices in ACOs and non-ACOs in our postmatching sample in 2016. This comparison demonstrates the key features that distinguish small and large practices and their attributed patients not related to ACO participation. Small practices in ACOs were more likely to have dual-eligible patients (19.4% vs 14.5%; $P < .001$), less likely to be vertically integrated (3.0% vs 7.2%; $P = .049$), and more likely to be PCP only (61.2% vs 0.2%; $P < .001$). Further, small practices represented nearly 10 times the total number of practices as large practices in ACOs yet cared for 40% fewer patients.

Observed differences between small and large practices were similar across ACO status. However, there were differences between ACO and non-ACO practices. ACO practices were more likely to be vertically integrated, be composed of specialty physicians, and have more patients attributed to large practices. Further, large practices made up a more significant proportion of practices in ACOs than they did in non-ACOs, with a ratio of small to large practices in ACOs of 10:1 compared with 12:1 in non-ACOs. Propensity score

TABLE 1. Characteristics of Beneficiaries Attributed vs Not Attributed to MSSP ACOs Before and After Propensity Score Matching, 2016

Characteristics	Prematching			Post matching		
	MSSP	Non-MSSP	P	MSSP	Non-MSSP	P
Practice characteristics						
Total practices	12,039	66,397		10,485	46,343	
Median No. of physicians per practice	1	1		1	1	
Range of physicians per practice	1-3416	1-7980		1-3416	1-7980	
Mean No. of physicians	13.37	8.57		14.18	9.78	
Practice type						
PCP	56.8%	39.9%	<.001	55.6%	44.4%	<.001
Specialist	19.2%	43.7%		18.9%	37.5%	
Mixed	23.9%	16.4%		25.5%	18.1%	
Physician gender mix						
Female	33.3%	37.2%	<.001	33.7%	36.7%	<.001
Male	66.7%	62.8%		66.3%	63.3%	
Region						
Northeast	24.8%	20.1%	<.001	26.5%	22.9%	<.001
West	16.8%	22.2%		17.2%	19.8%	
Midwest	17.3%	15.9%		17.8%	15.9%	
South	35.9%	39.4%		38.6%	41.4%	
Metropolitan vs micropolitan						
Metropolitan	93.4%	87.4%	<.001	93.2%	88.2%	<.001
Micropolitan	6.6%	12.6%		6.8%	11.8%	
Vertical integration rate	3.2%	3.8%	.290	3.3%	3.8%	.349
Patient characteristics						
Total patients	1,247,572	3,824,616		1,093,182	1,093,182	
Gender						
Female	57.7%	57.2%	<.001	57.8%	57.9%	.079
Male	42.3%	42.8%		42.2%	42.1%	
Age cohort in years						
< 65	10.5%	13.3%	<.001	10.8%	11.0%	<.001
65-74	43.0%	41.6%		42.8%	42.7%	
75-79	20.4%	19.4%		20.4%	20.0%	
≥ 80	26.1%	25.7%		26.0%	26.3%	
Race						
White	84.9%	83.8%	<.001	84.1%	84.0%	<.001
Black	8.6%	9.1%		9.1%	9.3%	
Other race	6.5%	7.1%		6.7%	6.7%	
Dual-eligible status						
Dual eligible	15.7%	20.1%	<.001	16.3%	17.0%	<.001
Non-dual eligible	84.3%	79.9%		83.7%	83.0%	
Original entitlement reason						
Aged ≥ 65 years	80.5%	76.6%	<.001	79.93%	79.72%	<.001
Disability	18.9%	22.6%		19.37%	19.58%	
ESRD	0.7%	0.8%		0.71%	0.70%	

ACO, accountable care organization; ESRD, end-stage renal disease; MSSP, Medicare Shared Savings Program; PCP, primary care physician.

matching created a balanced covariate distribution between beneficiaries attributed to ACOs vs non-ACOs. This balance was unperturbed after stratifying by practice size (Tables 1 and 2).

We also examined whether being vertically integrated would be perfectly colinear with practice size. Large practices were more frequently vertically integrated and hospital owned. However, adequate proportions of small practices were in each category to include the integration variable (eAppendix F).

Differences in Marginal Predicted Payments by Payment Category

Table 3 shows the model-predicted payments stratified by practice size and ACO attribution status for 4 different spending categories: total, hospital/acute care, physician, and all other spending. There was a modest reduction in beneficiaries' spending attributed to small ACO practices in all payment categories. Being attributed to a small ACO practice led to an additional spending reduction of \$269 relative to large ACO practices, representing a 3% decline in baseline spending. Spending for beneficiaries attributed to small ACO practices declined \$113 for hospitals/acute care (~3.4%), \$165 for physician services (~5.0% and \$52 for all other service types (~2.2%). The parallel trends assumption was confirmed visually (see eAppendix G Figure).

Differences in baseline spending may drive more significant spending reductions in small practices. Small practices in ACOs spent \$253 more on average in the pre-ACO period than did small practices in non-ACOs. The higher mean costs before ACO entry for small practices decreased to non-ACO levels after entry. In contrast, large practices in ACOs had lower spending than did large practices in non-ACOs at baseline—\$88 less on average in the pre-ACO period—and did not reduce spending substantially after ACO entry.

Association of Practice Size Within ACO With Receiving MSSP Rewards

The Figure shows the fraction of ACOs receiving shared savings stratified by their practice size composition. The likelihood of achieving shared savings and the per-beneficiary payment amounts were higher for ACOs that had a greater proportion of their beneficiaries attributed to small practices.

DISCUSSION

Within the MSSP payment model, small ACO practices decreased annual Medicare spending by \$269 per patient more than large ACO practices. Multiplying this by the 408,837 patients in all small practices in ACOs yields an approximation of savings to Medicare of roughly \$110 million. More generally, ACOs with a higher proportion of small practices were more likely to meet their quality and spending benchmarks and to achieve shared savings back to the ACO. Small practices in ACOs had higher costs before participating, suggesting lower baseline efficiency but more potential for improvement.

Small practice success in the ACO model may be surprising due to the cited burdens that small practices face when participating in pay-for-performance programs.²¹ Small practice attitudes toward pay-for-performance programs have been described in the literature as “unmotivated” due to the additional labor burden and the program-related implementation costs.¹⁹ These attitudes may explain why, in some cases, small practice performance in national programs is no different or worse than large practice performance.³²⁻³⁵ However, a study by Wang and colleagues evaluated small practice performance and found that the most considerable improvements were for small practices in the Patient-Centered Medical Home (PCMH) program.³⁶ Although PCMH lacks a formal pay-for-performance component, it emphasizes care coordination and sharing resources across participating practices, just like the ACO model. More generally, small practices have a greater incentive to reduce spending if more care is delivered outside the organization. For example, they are more likely to reduce costly hospitalizations than hospital-led organizations.

In the context of other studies of ACO performance, the reduction in total spending among ACO-attributed patients (when averaged over our large and small practice savings, \$26 and \$295, respectively) is similar to overall ACO findings presented by McWilliams and colleagues.¹⁰ They observed a beneficiary spending reduction of \$144 for patients attributed to the 2012 ACO cohort. Our analysis, however, includes several of the more recent ACO cohorts with additional

TABLE 2. Characteristics of Beneficiaries Attributed vs Not Attributed to MSSP ACOs, Stratified by Practice Size, After Propensity Score Matching, 2016

Characteristics	MSSP			Non-MSSP		
	Small practice	Large practice	P	Small practice	Large practice	P
Practice characteristics						
Total practices	9525	960		42,908	3435	
Median No. of physicians per practice	1	16		1	16	
Range of physicians per practice	1-15	16-3416		1-15	16-7980	
Mean No. of physicians	2.38	131.19		2.4	102.50	
Practice type						
PCP	61.2%	0.2%	<.001	47.9%	0.2%	<.001
Specialist	18.8%	19.9%		37.8%	33.5%	
Mixed	20.0%	79.9%		14.3%	66.3%	
Physician gender mix						
Female	32.3%	47.0%	<.001	35.7%	50.3%	<.001
Male	67.7%	53.0%		64.3%	49.7%	
Region						
Northeast	26.2%	28.8%	<.001	22.9%	22.7%	<.001
West	17.6%	12.7%		20.0%	16.8%	
Midwest	17.1%	24.2%		15.4%	22.4%	
South	39.0%	34.4%		41.6%	38.1%	
Metropolitan vs micropolitan						
Metropolitan	93.2%	93.1%	.496	88.3%	87.1%	.026
Micropolitan	6.8%	6.9%		11.7%	12.9%	
Vertical integration rate	3.0%	7.2%	.049	2.8%	15.8%	<.001
Patient characteristics						
Total patients	408,837	684,345		632,541	460,641	
Gender						
Female	57.7%	57.8%	.192	57.6%	58.2%	<.001
Male	42.3%	42.2%		42.4%	41.8%	
Age cohort in years						
< 65	10.7%	10.9%	<.001	10.4%	11.9%	<.001
65-74	41.5%	43.6%		42.1%	43.5%	
75-79	20.7%	20.3%		20.5%	19.5%	
≥ 80	27.2%	25.3%		27.1%	25.1%	
Race*						
White	81.1%	85.9%	<.001	82.9%	85.4%	<.001
Black	9.5%	8.9%		9.4%	9.3%	
Other race/ethnicity	9.4%	5.2%		7.7%	5.3%	
Dual-eligible status						
Dual eligible	19.4%	14.5%	<.001	17.6%	16.0%	<.001
Non-dual eligible	80.6%	85.5%		82.4%	84.0%	
Original entitlement reason						
Aged ≥ 65 years	79.5%	80.2%	<.001	80.2%	79.1%	<.001
Disability	19.8%	19.1%		19.2%	20.1%	
ESRD	0.7%	0.7%		0.6%	0.8%	

ACO, accountable care organization; ESRD, end-stage renal disease; MSSP, Medicare Shared Savings Program; PCP, primary care physician.

*The Research Triangle Institute race category provided in the Medicare Beneficiary Summary Files and used to identify beneficiary race and ethnicity does not explicitly categorize multiracial beneficiaries. The “other race/ethnicity” category includes Asian, Native American, Hispanic, and unknown/unspecified race beneficiaries.

TABLE 3. Differences in Marginal Predicted Payments by MSSP and ACO Participation

Payment category	Marginal predicted payments			Preperiod difference	Post period difference	Small practice DID	Large practice DID	Difference between small and large DID	95% CI
	Practice size	Pre-ACO	Post ACO						
Total	Small ACO	\$9324	\$9391	\$253	-\$42	-\$295	-\$26	-\$269	-\$325 to -\$213
Total	Large ACO	\$8985	\$9204						
Total	Small control	\$9071	\$9433	-\$88	-\$114	-\$163	-\$50	-\$113	-\$162 to -\$65
Total	Large control	\$9073	\$9318						
Physician	Small ACO	\$3347	\$3391	\$135	\$5	-\$130	\$35	-\$165	-\$190 to -\$140
Physician	Large ACO	\$3040	\$3131						
Physician	Small control	\$3212	\$3386	\$59	\$94	-\$64	-\$12	-\$52	-\$77 to -\$27
Physician	Large control	\$2981	\$3037						
Hospital/acute care	Small ACO	\$4167	\$4231	\$143	-\$20	-\$64	-\$12	-\$52	-\$77 to -\$27
Hospital/acute care	Large ACO	\$4035	\$4111						
Hospital/acute care	Small control	\$4024	\$4251	-\$56	-\$106	-\$64	-\$12	-\$52	-\$77 to -\$27
Hospital/acute care	Large control	\$4091	\$4217						
Other ^a	Small ACO	\$2287	\$2249	-\$4	-\$68	-\$64	-\$12	-\$52	-\$77 to -\$27
Other ^a	Large ACO	\$2337	\$2433						
Other ^a	Small control	\$2291	\$2317	-\$129	-\$141	-\$64	-\$12	-\$52	-\$77 to -\$27
Other ^a	Large control	\$2466	\$2574						

ACO, accountable care organization; DID, difference-in-differences; MSSP, Medicare Shared Savings Program.

^aThe “other” payment category reflects all sources of spending from Medicare’s Medicare Provider Analysis and Review, Carrier, Outpatient, Home Health, and Hospice claims data except for physician and hospital/acute care.

years of data for the early entrants. Consequently, we find that ACOs have maintained consistency in their ability to control costs over time and across cohorts. We also build on the findings of prior ACO studies that suggest that heterogeneity of ACO organizational features can determine ACO success.

Limitations

Despite statistically significant findings suggesting that the participation of small practices in ACOs reduced patient spending, several limitations remain to be considered. The first is potential residual confounding due to beneficiary selection into ACOs.³⁷⁻³⁹ To mitigate this issue, we propensity score matched ACO-attributed and non-ACO-attributed beneficiaries by their ACO attribution probabilities, and we found that balance was maintained when we categorized attributed practice by size. Because our comparison is between large and small practices in ACOs, any residual unobserved patient selection issues should be addressed by using a difference-in-differences framework. In addition to patient selection, selection bias in which practices enter and leave ACOs may exist. Specifically, there is some evidence that ACOs selectively move practices in and out of the ACO based on their performance and patient case mix. This form of selection may be easier to do with small rather than large practices. However, in examining ACO dropout between small and large practices, we did not find any differences large enough to support any considerable bias.

Another limitation is that our definition of a “small” practice is somewhat arbitrary even though it is based on that of another VBP program. As a sensitivity analysis, we reestimated the model using different small practice cut points, including solo practitioners, 5 providers, 10 providers, 25 providers, and 50 providers. Results from the sensitivity analysis were consistent with our findings; increasing the small practice cut point above 15 reduced the difference in spending (ie, smaller savings for small practices than the main model) whereas decreasing the cut point below 15 increased the spending difference (ie, greater savings for small practices than the main model). Another concern regarding practice size is that MD-PPAS files, which we used to determine practice size, may underestimate practice size. Some large practices bill under more than 1 TIN, which would bias toward an underestimate of actual spending reduction.

Finally, we do not consider nuances surrounding the expansion of the ACO program during our study period, such as the introduction of Pathways to Success and the ACO investment model in 2016. Although we do not believe these issues would affect our findings given that our study period ended in 2016 and most ACOs selected 1-sided risk, changes to the ACO model in 2016 and beyond are essential to consider in the context of our results. In particular, small practices may face more significant challenges taking on 2-sided risk contracts, especially in rural areas where there may be a lack of experience with these contracts and a greater density of small practices. Future research on this topic should carefully

consider how the development of the ACO model may affect small practice performance.

CONCLUSIONS

Annual Medicare spending for beneficiaries attributed to small ACO practices was \$269 less on average than for large ACO practices. Spending reductions were the largest in physician services (\$165), followed by hospital/acute care (\$113). These findings appear to be driven by high baseline spending among beneficiaries attributed to small practices in ACOs, which was reduced to the level of small practices in non-ACOs following ACO entry. This finding may be explained by efficiency gains accruing to small practices when participating in ACOs. The substantial savings in small practices may also warrant policies that strengthen incentives for small practice participation in ACOs and VBP. ■

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eAppendix A. Patient Attribution Methodology

According to CMS Shared Savings and Losses and Assignment Methodology (Version #4 for Performance Years 2015-2016), a patient is attributed retrospectively to an ACO if the plurality of their total allowed charges for primary care in a given year were from an ACO as opposed to a non-ACO. This is determined using a two-step assignment process. First, patients' total charges from primary care services delivered by primary care physicians (PCP) and practitioners are used to attribute them to an ACO or non-ACO. Suppose no assignment can be made due to, for example, no utilization of primary care services with PCPs. In that case, patients are attributed to practices using primary care claims delivered by physician specialists.

Relevant claims are initially selected using designated primary care HCPCS codes, and HFASPCCL specialty codes in the Medicare claims data.¹ Charges are then aggregated to the TIN level for care delivered at non-ACOs, and the ACO level for care delivered at ACOs. Note that patients can receive care at multiple TINs within an ACO, which is why CMS aggregates to the ACO level for primary care delivered by ACOs. For example, if a patient receives 60% of their primary care split evenly at TINs A and B that participate in an ACO, and 40% in TIN C that does not participate in an ACO, the patient should logically be assigned to an ACO since the plurality of their charges fell at an ACO. If the ACO assignment were based on charges at the TIN level, then beneficiaries in the previous example would have been assigned to non-ACO TIN C.

After the initial two-step attribution process, to make practice/TIN level comparisons between ACO's and non-ACOs, we take an additional step to assign patients to a specific TIN within an ACO. This subsequent assignment is done based on the plurality of primary care charges across TINs in the ACO where they were initially assigned. Although rare, assignment ties lead to the TIN in the ACO where the most recent service was provided. This process is also used as the tie-breaker method in the initial two-step attribution methodology.

Since specialty facilities like CAH, FQHC, RHC, and ETA deliver primary care, they also were considered during the attribution process. Their total organizational charges are obtained separately using claims in the Medicare outpatient file and linked to ACOs through

¹ See Tables 2-4 in CMS Shared Savings and Losses and Assignment Methodology (Version #4)

their CCN.² During the attribution process, they are considered simultaneously; only primary care delivered by PCPs is considered separately from Specialists. However, if a beneficiary is assigned to one of these facilities, they are dropped because the practice size cannot be ascertained.

One other methodological adjustment is that we chose to only use the ACO provider file from 2016 to identify our sample of ACOs to remove bias created by the transition of ACOs to Next-Generation ACOs in 2015, which performed better than average. Since TINs are not stable over time due to, for example, practice mergers and acquisitions, we created TIN crosswalks for each year for TINs in ACOs using 2015, 2014, and 2013 ACO provider files. Doing so ensured a full accounting of ACO participants in 2016 for prior years in our analysis, where their TIN may have been different.

² See Table 5 in CMS Shared Savings and Losses and Assignment Methodology (Version #4) for details regarding identifying FQHC, RHC, ETA, and CAH claims.

eAppendix B. Patient Frequencies by Sample Restriction by Year

#. Description/Year	2010	2011	2012	2013	2014	2015	2016
1. 20% FFS Medicare beneficiaries aged 21+	9,531,312	9,747,683	10,007,071	10,331,622	10,717,786	11,209,016	11,550,386
2. Exclude No Part A&B	7,310,056	7,483,406	7,663,680	7,909,219	8,096,812	8,383,085	8,829,258
3. No Medicare Part C/ No HMO	5,387,477	5,374,392	5,355,155	5,509,697	5,544,229	5,592,975	5,665,482
4. Propensity Score Matching	1,760,104	1,882,166	1,996,212	2,111,186	2,133,660	2,034,872	2,273,482

Source: Medicare claims data files 2010-2016.

eAppendix C. Identifying Vertically Integrated TINs

We identified vertically integrated practices based on detailed instructions in Neprash, Chernew, and McWilliams (2017).³ To summarize, a TIN was vertically integrated if A) it had ten or more NPIs with at least 50% of NPIs billing 90% or more of their outpatient services in the hospital outpatient department (HOPD) setting or B) a TIN was identified as a hospital.

Before determining the relevant set of TINs from A), we first had to reclassify some Medicare Carrier claims due to a billing exploit used by doctors to obtain additional Medicare reimbursement. Specifically, a carrier claim was deemed to have occurred in the hospital outpatient setting if it could be matched to a claim in the Medicare Outpatient file with a setting code indicating hospital outpatient (facility type = 1 and type of service = 3). A match was made if the following was the same across Medicare carrier and outpatient files: I) beneficiary ID, service date, and procedure code, and/or II) beneficiary ID, service date +/- seven days.

To obtain a unique list of NPIs in hospital TINs as in B), we created a list of TINs with nine or more NPIs and five or more office visits total in the Carrier file for any given year. This list was then merged onto the Medicare Data on Physician Practice and Specialty dataset, including the specific organization names associated with each TIN. Like Neprash and colleagues, we considered a TIN to be a hospital if the name had at least one of the following: hospital, medical center, or system.

³ Neprash HT, Chernew ME, McWilliams JM. Little evidence exists to support the expectation that providers would consolidate to enter new payment models. *Health Aff (Millwood)*. 2017;36(2). See Supplementary Appendix.

eAppendix D. Methods for Generating a Measure of Patient Spending

Our measure of patient spending was derived based on total per capita costs.⁴ Its creation involved aggregating spending across Medicare Carrier, Outpatient, MedPAR, Hospice, and Home Health Agency (HHA) claims files and censoring payment outliers using CMS guidelines.⁵ The key differences were that 1) we did not rollup spending from the patient level to the ACO/TIN level, 2) we did not include DME, and 3) we required that each patient in the sample maintain full 12 months Part A&B coverage unless they died in the year of analysis. We also excluded any patients with Medicare Part C whose medical claims data is not included in MedPAR, Outpatient, or Carrier files as their spending is unobserved. We obtained raw paid amounts by claim line for all years between 2010-2016 and combined them into a single dataset for the remaining patients.

Once the aggregated annual spending file had been constructed, we followed CMS guidelines to censor extreme and irregular payments. Specifically, we truncated negative values for paid amounts to 0, which occurs when Medicare "overpays" due to pending patient deductible payments. We also found high-cost patient outliers, such as ESRD patients, that would otherwise impose bias in our estimates. We censored annual spending for these patients by setting their paid amounts equal to the 99% threshold in that year.

⁴ See Section 4 in CMS Shared Savings and Losses and Assignment Methodology (Version #4)

⁵ See Table 6 in CMS Shared Savings and Losses and Assignment Methodology (Version #4)

eAppendix E. Full Description of Statistical Analysis

Following McWilliams and colleagues (2016), we chose to separately specify ACO cohorts to adjust for potential differences between early and late adopters that could affect their ability to control costs. This was accomplished by creating six separate ACO cohort indicators and interacting them with a post-ACO entry period indicator and the small practice indicator. In addition to controlling for selection on observables, the propensity score matching provided a practical way to assign post-periods to the control group. Each non-ACO attributed patient simply subsumed the specific post-period of the ACO attributed patient that they matched with. This leads to the following updated specification of the model described in the text:

$$\text{TPCC}_{ikt} = \beta_0 + \beta_1 \text{Small}_k + \beta_2 \text{Post}_{kt} + \beta_3 \text{Post}_k \times \text{Small}_k + \beta_4 \text{Year}_t + \delta X_{it} + \zeta_k + \sum_{j=1}^6 [\alpha_{1,j} \text{ACO}_{ikt,j} + \alpha_{2,j} \text{ACO}_{ikt,j} \times \text{Post}_k + \alpha_{3,j} \text{ACO}_{ikt,j} \times \text{Small}_k + \alpha_{4,j} \text{ACO}_{ikt,j} \times \text{Small}_k \times \text{Post}_k] + \varepsilon_{ikt}$$

The summation term in equation 2 reflects the fact that we have attribution indicators and

interactions for each of the six ACO cohorts with specific starting dates of April 2012, July 2012, January 2013, January 2014, January 2015, and January 2016. Again, the treatment effect from model [1], α_4 , was estimated separately for each one of the six ACO cohorts

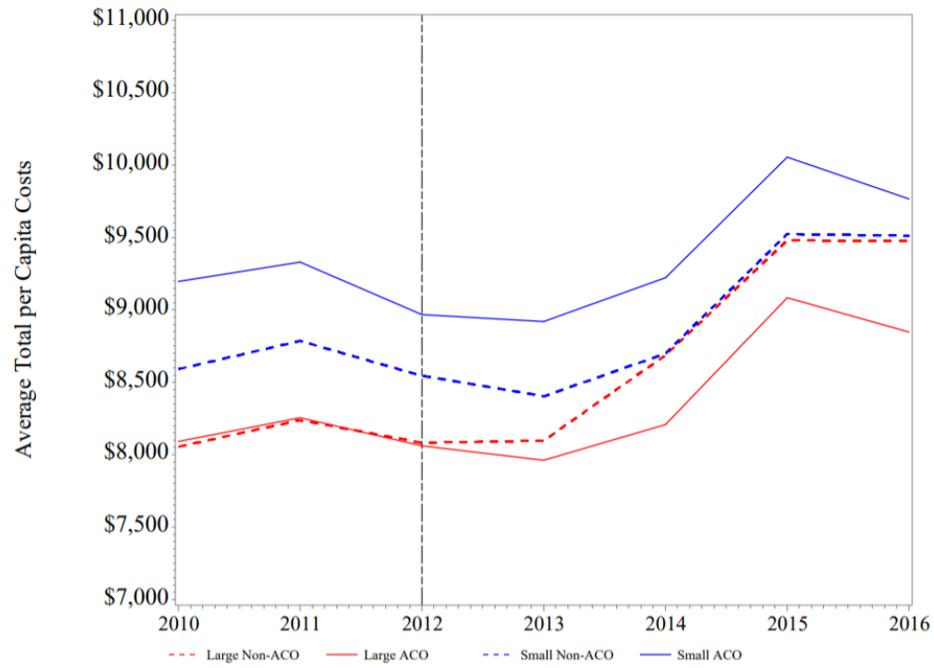
(i. e. $\alpha_{4,1}, \alpha_{4,2}, \alpha_{4,3}, \alpha_{4,4}, \alpha_{4,5}, \alpha_{4,6}$).

eAppendix F. Comparison of Small and Large Practices in ACOs vs. Non-ACOs by Ownership and Baseline Spending

Description	ACO		Non-ACO	
	Small	Large	Small	Large
<i>Total Practices</i>	9,525	960	42,908	3,435
<i>Vertically integrated</i>	281	69	1,201	544
	3.0%	7.2%	2.8%	15.8%
<i>Hospital Owned</i>	1,061	207	-	-
	11.1%	21.6%	-	-
<i>Physician Owned</i>	3,029	199	-	-
	31.8%	20.7%	-	-
<i>Baseline Total Spending per beneficiary</i>	\$9,324	\$8,985	\$9,071	\$9,073

Source: Medicare Claims data 2010-2016 & Accountable Care Organization Provider Level Research Identifiable Files 2013-2016.

eAppendix G. Trends in Patient Spending by ACO Attribution Status and Practice Size



Source:
Medicare Claims Data 2010-2016.