

Spending Variation Among ACOs in the Medicare Shared Savings Program

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Variation in healthcare spending and utilization exists at every level of the healthcare system, ranging from states to individual physicians within a given practice.¹ Yet most of the research characterizing variation in healthcare spending has been focused at the geographic level, as exemplified by the Dartmouth Atlas. Results of geographic analyses argue convincingly that a great deal of spending variation across areas is not connected to patient morbidity or outcomes.¹ However, considerable differences in spending exist even within geographic areas,² and geographic areas are not a natural unit for actionable interventions to reduce spending variation.^{1,3,4} The National Academy of Medicine's 2013 report on spending variation emphasized the importance of extending analyses of practice pattern variation to "the unit of decision-making," such as individual providers or provider systems.¹

Evidence characterizing organizational variation remains relatively limited. Studies of organizational variation in Medicare spending typically focus on a specific clinical context, like outpatient cardiology or oncology practices, or examinations of specific services, like low-value care.⁵⁻⁹ Evidence from the commercial sector focuses on variation in price, rather than total spending, and generally looks at variation across hospitals rather than organizations such as accountable care organizations (ACOs) that are responsible for population-level spending.^{1,10} As in the geographic variation literature, research examining practice pattern variation in provider organizations reveals large and unexplained differences, but none of that work examines variation in total spending at the population level.¹¹⁻¹⁴

ACOs are provider groups that agree to take accountability for spending and quality of care for patients in the ACO contract. ACOs represent an important unit of observation because they are CMS' most important alternative payment model and the foundation of many current efforts to reduce wasteful medical spending. Little research exists on spending variation in ACOs: One early study reported considerable variation in ACO spending, even after controlling for regional variation and case mix, but did not delve into sources of variation.¹⁵ Breaking down sources of

ABSTRACT

OBJECTIVES: Understanding variation in spending across organizations, rather than across geographic areas, is important because care is delivered by organizations and interventions increasingly focus on organizations. Accountable care organizations (ACOs) are particularly important to study given their incentives to reduce spending. Analyzing spending differences across ACOs may help identify cost savings opportunities.

STUDY DESIGN: Cross-sectional analysis of Medicare claims.

METHODS: We stratified ACOs into quartiles based on the deviation between each ACO's risk-adjusted spending and average risk-adjusted fee-for-service spending in the same market (hospital referral region). We compared spending between top- and bottom-quartile ACOs on each of 7 major service categories and 10 clinical condition groups to identify areas of potential savings. We simulated spending reductions if ACOs with high adjusted spending reduced spending to the levels of lower-spending ACOs.

RESULTS: In 2016, geographically adjusted and risk-adjusted total per-beneficiary spending for the highest-spending quartile of ACOs was 14% higher than for ACOs in the lowest quartile. Variation between high- and low-spending ACOs was greatest, at 27%, in the use of skilled nursing facilities—a service category in which ACOs have reduced spending by the greatest percentage. Inpatient care was the largest driver of absolute dollar differences in spending, however, accounting for 37% of the total spread. If spending in ACOs above median adjusted spending were brought down to the median, savings would be 3% to 4%.

CONCLUSIONS: By extending the variations literature to focus on ACOs, we illustrated that meaningful further savings opportunities exist both within and across markets.

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spending variation among ACOs could inform where organizations might intervene to reduce avoidable spending.

METHODS

We examined the deviation between each 2016 ACO's risk-adjusted spending and average risk-adjusted spending in its market, then stratified ACOs into quartiles based on these deviations. We defined top-quartile ACOs—those with the largest positive deviations, in dollars, from adjusted local market fee-for-service (FFS) spending—as high spending (quartile 4 [Q4]). We defined bottom-quartile ACOs—those with the largest negative deviations—as low spending (quartile 1 [Q1]). We compared spending between Q1 and Q4 ACOs on each of 7 major service categories and 10 clinical condition groups to identify areas of potential savings. Finally, we simulated spending reductions if ACOs with high adjusted spending (within their market or nationally) reduced spending to the levels of lower-spending ACOs.

Study Population

We analyzed a 100% sample of FFS Medicare beneficiaries, refined to include only beneficiaries continuously enrolled in parts A and B for the full year (or until death) and continuously enrolled in the prior year. We further limited the sample to beneficiaries potentially eligible for enrollment in an ACO: individuals with at least 1 qualifying ambulatory evaluation and management visit in the year of interest.¹

We analyzed ACOs participating in the Medicare Shared Savings Program (MSSP), the largest of Medicare's ACO initiatives. We assigned beneficiaries to ACOs using the provider identifiers (taxpayer identification numbers [TINs] and CMS Certification Numbers [CCNs]) defining each ACO in the ACO SSP Provider-Level Research Identifiable File for that year. We assigned beneficiaries to an ACO if it accounted for a larger share of qualifying office visits with a primary care physician than any other ACO or non-ACO TIN/CCN during the year (see [eAppendix](#) [available at [ajmc.com](#)]). Patients assigned to non-ACO TINs served as FFS controls. As in the MSSP, we used retrospective assignment, assigning patients to ACOs based on utilization in the year of interest.

Our sample included 432 ACOs in 2016. (There were 220 in 2013, 333 in 2014, and 387 in 2015, and 145 ACOs were present all 4 years.) For ACOs present in multiple years, the composition of TINs or CCNs included in the ACO may have changed over time, which we addressed in sensitivity analyses.

Spending Variables

Our outcomes of interest were total annual per-beneficiary Part A and Part B Medicare spending and annual per-beneficiary Medicare spending by service subcategory.

TAKEAWAY POINTS

- ▶ There was a 14% difference in risk-adjusted total spending between accountable care organizations (ACOs) in the highest and lowest quartiles of spending relative to local fee-for-service Medicare spending, suggesting meaningful opportunities for savings even after 4 years of the ACO program.
- ▶ If spending in ACOs with above-median adjusted spending were brought down to the median, savings would be 3% to 4%.
- ▶ Spending variation by service category suggests savings opportunities in inpatient, postacute, and home health care. Variation in spending for patients by select condition categories indicates substantial savings opportunities in aggregate for prevalent chronic conditions, but the magnitude of variation in dollars per patient is small, suggesting that interventions must be low-cost on a per-beneficiary basis to achieve net savings.

Covariates

In all analyses, we controlled for beneficiary age, sex, race/ethnicity, Medicaid status, disability as the reason for enrollment, and end-stage renal disease. We controlled for comorbidities using prospective hierarchical condition category (HCC) diagnoses and risk scores using CMS 2014 version 12 software for all 4 years, using CMS' *International Classification of Diseases, Tenth Revision, Clinical Modification* to *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* crosswalk to convert diagnoses to ICD-9-CM. We identified whether beneficiaries had ever had 1 of 27 chronic conditions identified in the Chronic Conditions Warehouse (CCW). We assigned beneficiaries to a hospital referral region (HRR) based on their residential zip code.

Ranking ACOs by Adjusted Spending Deviations From Their Markets

To rank ACOs by total adjusted spending, we estimated a linear mixed-effects regression model predicting total per-beneficiary spending (eAppendix) as a function of the covariates described previously: HRR fixed effects and ACO random effects. Estimated random effects represent an adjusted mean spending deviation from local market FFS spending for each ACO. In contrast to fixed-effects models, the random-effects model accounts for within-ACO variation in spending in the estimation of the between-ACO variance; without this correction (eg, in a fixed-effects model), the ACO-level variance would be overestimated. We defined an ACO's market as the HRRs that it serves. ACOs can serve multiple HRRs, so an ACO beneficiary's spending relative to other FFS beneficiaries in its market is implicitly estimated as a weighted average of the beneficiaries in each HRR served by the ACO. We were thus able to measure each ACO's spending deviation relative to other ACOs and non-ACO FFS beneficiaries in the ACO's market.

We grouped ACOs into quartiles based on their risk-adjusted spending deviation from average FFS spending in their market. We used ACOs' total spending quartile rank in all analyses, including condition or service subcategory analyses.

Estimation of Total Spending Deviation

We ran a linear regression model with Q1 and Q4 quartile dummies and covariates for beneficiary demographic characteristics, case mix

TABLE 1. Differences in Adjusted Spending Deviations Relative to Local FFS Between Highest- and Lowest-Quartile ACOs and Shares of Gap in Total Spending Differences, by Service Category in 2016^a

Spending Category	Q1 (\$)	Q4 (\$)	Q4 - Q1 (\$)	Mean (\$)	(Q4 - Q1)/Mean (%)	Share of Total Gap (%)
Total spending	-896	513	1409	10,241	14	
Inpatient	-325	198	523	3399	15	37
Outpatient	-273	183	456	2096	22	32
Carrier	-69	50	119	3023	4	8
SNF	-151	52	203	740	27	14
Hospice	3	12	9	179	5	1
HHA	-66	11	77	561	14	5
DME	-15	7	22	244	9	2

ACO indicates accountable care organization; DME, durable medical equipment; FFS, fee-for-service; HHA, home health agency, Q, quartile; SNF, skilled nursing facility.

^aQ1 represents low-spending ACOs; Q4 represents high-spending ACOs. (Q4 - Q1)/mean is the percentage difference in mean geographically adjusted and risk-adjusted Medicare spending between Q4 and Q1 for each service category, calculated by dividing the difference in Q4 and Q1 adjusted spending deviations (in dollars) for each service category by mean adjusted spending for that category. Share of total gap is the percentage share of the difference in total adjusted spending between Q4 and Q1 attributable to each service category.

Source: Authors' analysis of Medicare claims.

(HCC), and market (HRR). We subtracted the Q4 coefficient (spending attributed to high-spending ACOs) from the Q1 coefficient (spending attributed to low-spending ACOs) to calculate the spread in total spending. We focused on this “spending gap” between the Q1 and Q4 means as a useful summary of the range of the spending deviations.

Spending Deviation by Service Category

We repeated the same total spending per beneficiary model described previously for each service category, changing only the dependent variable to subcategory spending rather than total spending. Additionally, we calculated the percentage share of the total spending gap between quartiles attributable to each service category.

Spending Deviation by Clinical Condition

We estimated deviations for patient populations with specific conditions, using the 27 CCW conditions to create 10 CCW condition groups (eAppendix). We restricted some conditions, such as hip fracture, to diagnoses within the last year to better isolate spending associated with that diagnosis. We included chronic conditions if the patient had ever received a diagnosis. Using linear regression models with quartile dummies, condition dummies, and interactions between quartiles and conditions, we computed spread in total spending and service category spending between Q1 and Q4 ACOs. We determined the prevalence of conditions in Q4 ACOs to estimate potential savings in aggregate associated with each condition; prevalence was approximately evenly distributed across ACO quartiles and other FFS beneficiaries.

Simulation of Potential Spending Reductions

We simulated cumulative spending reductions in 3 scenarios to crudely measure ACO savings potential. We estimated change in

total spending if all ACOs with above-median adjusted spending were able to reduce spending to the level of the median (50th percentile) ACO. We repeated this analysis for thresholds at the 25th and 10th percentiles.

Sensitivity Analyses

Our primary analyses focused on 2016. We repeated the analyses for 2013 to 2015, as well as for ACOs present in all 4 years. We replicated the service and clinical area analyses (both quartile rankings and spending category variation models) for each year, with and without controlling for geography (HRR). We also simulated savings without HRR controls.

RESULTS

Our sample included approximately 26.6 million eligible beneficiaries in 2016, with 8.3 million beneficiaries attributed to ACOs. Mean ACO membership was 19,179. Adjusted mean total per-beneficiary spending in 2016 was \$10,212 for low-spending ACOs and \$10,850 for high-spending ACOs. Results for 2013 to 2015 are reported in the eAppendix.

Spending Deviation by Service Category

In 2016, mean total risk-adjusted spending was 14% higher for ACOs in the highest quartile relative to those in the lowest (Table 1). Although the relative percentage difference between high and low spending quartiles for inpatient care was only 15%, inpatient spending was the largest service category in dollars; consequently, it accounted for 37% of the absolute spread in total spending (ie, in dollars per beneficiary). Outpatient spending in the upper quartile was 22% greater than that in the lowest quartile, and, because of its large spending share, it was the second largest driver of the overall spending gap, accounting for 32% of the spread in total spending.

In all years, variation on a percentage basis between Q1 and Q4 ACOs was greatest in skilled nursing facility (SNF) and home health. However, because SNF and home health spending accounted for a smaller share of spending than inpatient and outpatient spending, they account for a smaller share of the overall gap in spending.

Spending Deviation by Clinical Condition

Table 2 summarizes spending and prevalence by condition group for high- and low-spending ACOs. Taking patients with chronic kidney disease (CKD) as an example, the mean risk-adjusted difference in spending for Q4 is \$1372 higher than spending for Q1 ACOs. Prevalence of CKD in Q4 ACOs was 22%. If Q4 ACOs reduced incremental spending for patients with CKD to that of Q1 ACOs, Q4 ACOs could achieve cost savings of \$302 per beneficiary across the entire ACO population (ie, including people with and without CKD).

TABLE 2. Variation in Adjusted Spending by CCW Condition Group in 2016^a

CCW Group	CCW Group (\$) ^b	Difference Q4 – Q1 (\$) ^c	Difference Q4 – Q1 (%) ^d	Prevalence of Condition, Q4 (%) ^e	Overall Potential Per-Beneficiary Savings (\$) ^f
Chronic conditions^g					
CKD	6054	1372	23	22	302
Chronic CVD	1019	267	24	76	202
Diabetes	1832	355	19	27	129
Pulmonary	3799	484	13	24	120
Depression	2376	351	15	30	105
Dementia	3697	657	18	9	59
Acute/new-onset conditions^h					
Stroke	14,008	1800	13	3	54
Cancer	14,254	1373	10	3	47
AMI	23,775	2672	11	1	32
Hip fracture	27,070	1888	7	1	19

ACO indicates accountable care organization; AMI, acute myocardial infarction; CCW, Chronic Conditions Warehouse; CKD, chronic kidney disease; CVD, cardiovascular disease; Q, quartile.

^aMean geographically adjusted and risk-adjusted Medicare spending. Q1 represents low-spending ACOs; Q4 represents high-spending ACOs.

^bCCW group coefficient, which is the portion of overall adjusted spending attributed to the CCW condition group.

^cInteraction between quartile CCW group dummy variables, subtracting the Q1*CCW group interaction from the Q4*CCW group interaction (Q4*CCW – Q1*CCW).

^dInteraction between quartile CCW group dummy variables, subtracting the Q1*CCW group interaction from the Q4*CCW group interaction, divided by the CCW group coefficient [(Q4*CCW – Q1*CCW)/CCW coefficient].

^ePrevalence of the CCW group in Q4; prevalence does not vary significantly by Q.

^fPotential per-beneficiary savings if Q4 adjusted spending for this condition were brought to Q1 level of spending.

^gEver diagnosed.

^hDiagnosed in last year.

Source: Authors' analysis of Medicare claims.

We observed substantial spending variation across all condition groups. In general, acute or newly diagnosed CCW condition groups tended to have a high dollar difference, driven by higher mean spending, in per-beneficiary spending between Q1 and Q4 ACOs, but low prevalence. Chronic condition groups tended to have smaller per-beneficiary dollar differences in spending for patients with those diagnoses but high prevalence, and thus they were responsible for greater absolute spending differences between high- and low-performing ACOs when considered over the full ACO population.

Simulated Savings

If all beneficiaries in ACOs with geographically adjusted and risk-adjusted spending higher than the median ACO were brought down to that threshold, savings would be 3.6% (Table 3).

Sensitivity Analysis

Without adjusting for HRR, the between-quartile spread in total risk-adjusted spending deviations for the top and bottom quartiles of ACOs nationally was 10 percentage points larger than the models adjusting for HRR (eAppendix). Our primary analysis is thus conservative in that it assumes that ACOs are more readily able to reduce spending relative to their markets than relative to national benchmarks. On a national basis, if beneficiaries in ACOs above median national ACO spending (adjusted for case mix but not geography) were brought down to that threshold, savings would be 9.2%.

Our results were largely insensitive to the year of analysis (eAppendix): The gap between Q1 and Q4 ACOs in 2016 was \$1409 (14% of mean per-beneficiary spending). The analogous figures for 2013, 2014, and 2015 were \$1328 (14%), \$1364 (14%), and \$1475 (15%), respectively. The services contributing to this variation were largely unchanged. ACO quartile rankings were largely stable over time; only 6 ACOs had a year in the highest quartile and a year in the lowest.

DISCUSSION

This analysis suggests meaningful variation in ACO spending within markets and overall. Despite widespread recognition that high spending in the United States, particularly in the commercial sector, reflects high prices, our savings estimates largely measure variation in utilization because Medicare prices are set administratively and vary much less than commercial prices.¹ Thus, our analysis can broadly identify areas of savings opportunity related to utilization. Adjusted within-market spread between Q1 and Q4 ACOs was 14% in 2016, suggesting meaningful opportunities for savings even after 4 years of ACO adoption.

Our analysis suggests that key savings opportunities exist in the inpatient, SNF, and home health care settings, consistent with ACO evaluations reporting spending reductions in these areas.^{16,17} ACOs may find savings by changing the site of care (eg, shifting from hospital outpatient department to office settings), which is consistent with observed evidence on ACO savings.¹⁸

TABLE 3. Simulated Savings if All ACOs Above Percentile Threshold Brought Spending Down to Level of ACOs at That Threshold, 2016

	Simulated Spending Threshold ^a	% Reduction in Spending ^b
Within HRR	50th	3.6
	25th	4.8
	10th	8.6
No HRR controls	50th	9.2
	25th	10.0
	10th	13.0

ACO indicates accountable care organization; HRR, hospital referral region.
^aSavings if all ACOs above threshold are brought down to threshold spending
^bPercent reduction = (risk-adjusted spending – risk-adjusted spending at threshold)/risk-adjusted spending.

Source: Authors’ analysis of Medicare claims.

Research involving ACO executives suggests that they have adopted strategies including strengthened primary care, greater care management, and reductions in avoidable ED use—all with an emphasis on high-risk patients.¹⁹ However, care management strategies do not appear to be how ACOs, on average, have found savings. Prior research indicates that ACOs have not differentially reduced admissions for ambulatory care–sensitive conditions, nor have reductions in hospitalizations and spending been disproportionately concentrated among high-risk patients.²⁰ ACOs increasingly report focusing on standardizing and systematizing clinical processes.²¹ And, as ACOs have discovered the savings opportunities in postacute care, they have initiated strategies such as preferred SNF networks.²²

Spending variation in clinical groups suggests considerable aggregate savings potential among patients with high-prevalence chronic conditions, but the magnitude of spending variation per beneficiary in dollars is small, meaning that interventions aiming for net savings would need to be highly efficient on a per-patient basis. Incremental spending differences between Q1 and Q4 ACOs for people with newly diagnosed and acute conditions are sizeable in dollars per beneficiary, but these conditions are low in prevalence, meaning that aggregate savings would be modest in condition-specific efforts to control costs.

Targeted interventions to improve chronic conditions may not provide a return on investment for ACOs in the short term because per-beneficiary cost savings are modest and the costs of many interventions, such as case management, are high. Further, returns to chronic disease management may be realized in future years, and beneficiary attribution to an ACO is not guaranteed from year to year. Many popular clinical interventions may be cost-effective but not cost-saving.^{23,24} The most proximate savings may lie in interventions to reduce utilization of low-value services; this requires developing effective interventions, as existing tools to measure low-value care capture only a small fraction of it.⁸ Because low-value care is not necessarily confined to the high-risk group, interventions almost certainly need to be broad.^{20,25}

Our estimates of spending variation contextualize the magnitude of ACO savings estimated in existing evaluations of the MSSP.

Current evidence suggests that ACOs reduce spending, relative to local trends, by an average of 1% to 2%, with physician-group ACOs achieving 3% to 5% reductions after 3 years of participation, and ACOs with high spending also achieving greater savings.¹⁸ These amounts are roughly comparable with the 3% to 4% potential savings if all ACOs with adjusted spending above the median came down to that threshold. The simulated savings are conservative because opportunities for savings exist even in low-spending ACOs, although research indicates that savings to date have been greater among ACOs with high spending.^{8,9,26}

Although many have been disappointed in ACO savings,^{27,28} partly because the savings to Medicare are shared with the providers, the underlying effects are not small when judged against overall variation in spending. But considerable savings opportunities remain that may be unlocked with modifications to program parameters that increase incentives to save and with greater experience. The benchmarking formula and the shared savings rate are 2 important levers for adjusting provider incentives.

Current MSSP benchmarks for determining ACO eligibility for shared savings are based on a blend of historical performance and spending relative to the regional average, aiming to mitigate the disincentives in these targets individually.²⁹ Benchmarks based on historical performance, which were in place during the study period, ratchet down future savings targets if the ACO saves money in the current performance year. The addition of regional benchmarking softens the ratchet effect but gives high-spending organizations weaker incentives to become ACOs because they begin at a relative disadvantage in being able to make a return on investment.

Limitations

This work shares many of the limitations that arise in analyses of geographic spending variation. Although our unit of observation is the ACO, which is closer to healthcare decision making than geographic areas, our analyses cannot be used to make causal inferences about the factors contributing to spending variation across ACOs. Our biggest concern is that variation in case mix in ways we cannot measure could be confounding the results. Although our analyses are case mix–adjusted, those adjustments are imperfect and variation likely exists in the intensity of coding of diagnoses across healthcare organizations. We used both HCCs and CCWs in our analyses, and these classifications may vary differentially across organizations depending on coding practices. Prior research found that patient characteristics from survey data accounted for additional variation in ACO spending, but residual variation remained large, suggesting that variation in ACO efficiency likely contributes substantially to the variation we analyzed in this study.¹⁵ This analysis does not address the relationship between spending variation and quality. The existing literature on geographic spending variation finds little evidence of a relationship between utilization and quality.¹

We measured variation after any reduction in spending attributable to ACO activities, which may be greater in ACOs with higher

spending prior to joining the ACO program.²⁶ This observation is important because it illustrates that despite the effects of ACOs on spending, which have been modest, considerable variation persists and thus additional cost savings opportunities likely remain as well. Savings opportunities may be understated because there are surely savings opportunities in low-spending ACOs.^{8,9}

CONCLUSIONS

The literature on geographic variation in healthcare spending has been among the most impactful areas of health services research over the past half century. By extending the variations literature to focus on ACOs, we illustrate that meaningful further savings opportunities exist both within and across markets. Designing benchmarks and shared savings incentives to motivate program participation and savings behavior among participating ACOs is key to capturing available savings opportunities. ■

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REFERENCES

1. Institute of Medicine. *Variation in Health Care Spending: Target Decision Making, Not Geography*. Washington, DC: National Academies Press; 2013.
2. Zhang Y, Baik SH, Fendrick AM, Baicker K. Comparing local and regional variation in health care spending. *N Engl J Med*. 2012;367(18):1724-1731. doi: 10.1056/NEJMsa1203980.
3. Song Y, Skinner J, Bynum J, Sutherland J, Wennberg JE, Fisher ES. Regional variations in diagnostic practices [erratum in *N Engl J Med*. 2010;363(2):198. doi: 10.1056/NEJMx100034]. *N Engl J Med*. 2010;363(1):45-53. doi: 10.1056/NEJMsa0910881.

4. Finkelstein A, Gentzkow M, Williams H. Sources of geographic variation in health care: evidence from patient migration. *Q J Econ*. 2016;131(4):1681-1726. doi: 10.1093/qje/qjw023.
5. Clough JD, Patel K, Riley GF, Rajkumar R, Conway PH, Bach PB. Wide variation in payments for Medicare beneficiary oncology services suggests room for practice-level improvement. *Health Aff (Millwood)*. 2015;34(4):601-608. doi: 10.1377/hlthaff.2014.0964.
6. Clough JD, Rajkumar R, Crim MT, et al. Practice-level variation in outpatient cardiac care and association with outcomes. *J Am Heart Assoc*. 2016;5(2). pii: e002594. doi: 10.1161/JAHA.115.002594.
7. Safavi KC, Li SX, Dharmarajan K, et al. Hospital variation in the use of noninvasive cardiac imaging and its association with downstream testing, interventions, and outcomes. *JAMA Intern Med*. 2014;174(4):546-553. doi: 10.1001/jamainternmed.2013.14407.
8. Schwartz AL, Chernew ME, Landon BE, McWilliams JM. Changes in low-value services in year 1 of the Medicare Pioneer accountable care organization program. *JAMA Intern Med*. 2015;175(11):1815-1825. doi: 10.1001/jamainternmed.2015.4525.
9. Schwartz AL, Zaslavsky AM, Landon BE, Chernew ME, McWilliams JM. Low-value service use in provider organizations. *Health Serv Res*. 2018;53(1):87-119. doi: 10.1111/1475-6773.12597.
10. Cooper Z, Craig SV, Gaynor M, Van Reenen J. The price ain't right? hospital prices and health spending on the privately insured. *D J Econ*. 2019;134(1):51-107. doi: 10.1093/qje/qjy020.
11. Tsugawa Y, Jha AK, Newhouse JP, Zaslavsky AM, Jena AB. Variation in physician spending and association with patient outcomes. *JAMA Intern Med*. 2017;177(5):675-682. doi: 10.1001/jamainternmed.2017.0059.
12. Chen CL, Lin GA, Bardach NS, et al. Preoperative medical testing in Medicare patients undergoing cataract surgery. *N Engl J Med*. 2015;372(16):1530-1538. doi: 10.1056/NEJMsa1410846.
13. Obermeyer Z, Powers BW, Makar M, Keating NL, Cutler DM. Physician characteristics strongly predict patient enrollment in hospice. *Health Aff (Millwood)*. 2015;34(6):993-1000. doi: 10.1377/hlthaff.2014.1055.
14. Cutler D, Skinner J, Stern AD, Wennberg D. Physician beliefs and patient preferences: a new look at regional variation in health care spending. *Am Econ J Econ Policy*. 2019;11(1):192-221. doi: 10.1257/pol.20150421.
15. Rose S, Zaslavsky AM, McWilliams JM. Variation in accountable care organization spending and sensitivity to risk adjustment: implications for benchmarking. *Health Aff (Millwood)*. 2016;35(3):440-448. doi: 10.1377/hlthaff.2015.1026.
16. McWilliams JM, Gilstrap LG, Stevenson DG, Chernew ME, Huskamp HA, Grabowski DC. Changes in post-acute care in the Medicare Shared Savings Program. *JAMA Intern Med*. 2017;177(4):518-526. doi: 10.1001/jamainternmed.2016.9115.
17. Dummit L, Marruffo G, Marshall J, et al. CMS Bundled Payments for Care Improvement Initiative models 2-3: year 5 evaluation & monitoring annual report. CMS website. [downloads.cms.gov/files/cmim/bpci-models2-4-yr5evalrpt.pdf](https://www.cms.gov/files/cmim/bpci-models2-4-yr5evalrpt.pdf). Published October 2018. Accessed November 25, 2018.
18. McWilliams JM, Hatfield LA, Landon BE, Hamed P, Chernew ME. Medicare spending after 3 years of the Medicare Shared Savings Program. *N Engl J Med*. 2018;379(12):1139-1149. doi: 10.1056/NEJMsa1803388.
19. Lewis VA, Schoenher K, Fraze T, Cunningham A. Clinical coordination in accountable care organizations: a qualitative study. *Health Care Manage Rev*. 2019;44(2):127-136. doi: 10.1097/HMR.0000000000000141.
20. McWilliams JM, Chernew ME, Landon BE. Medicare ACO program savings not tied to preventable hospitalizations or concentrated among high-risk patients. *Health Aff (Millwood)*. 2017;36(12):2085-2093. doi: 10.1377/hlthaff.2017.0814.
21. Lewis VA, Schoenher K, Fraze T, Cunningham A. Clinical coordination in accountable care organizations: a qualitative study. *Health Care Manage Rev*. 2019;44(2):127-136. doi: 10.1097/HMR.0000000000000141.
22. Kennedy G, Lewis VA, Kundu S, Mousques J, Colla CH. Accountable care organizations and post-acute care: a focus on preferred SNF networks [published online July 1, 2018]. *Med Care Res Rev*. doi: 10.1177/1077558718781117.
23. Neumann PJ, Cohen JT. Cost savings and cost-effectiveness of clinical preventive care. *Synth Proj Res Synth Rep*. 2009;(18). pii: 48508.
24. Cohen JT, Neumann PJ, Weinstein MC. Does preventive care save money? health economics and the presidential candidates. *N Engl J Med*. 2008;358(7):661-663. doi: 10.1056/NEJMpo0708558.
25. McWilliams JM, Schwartz AL. Focusing on high-cost patients: the key to addressing high costs? *N Engl J Med*. 2017;376(9):807-809. doi: 10.1056/NEJMj1612779.
26. McWilliams JM, Hatfield LA, Chernew ME, Landon BE, Schwartz AL. Early performance of accountable care organizations in Medicare. *N Engl J Med*. 2016;374(24):2357-2366. doi: 10.1056/NEJMsa1600142.
27. Ayala C. MedPAC disappointed in ACO performance. The Hill website. [thehill.com/extra-site/policy/299724-medpac-disappointed-in-aco-performance](https://www.thehill.com/extra-site/policy/299724-medpac-disappointed-in-aco-performance). Published October 7, 2016. Accessed January 25, 2019.
28. Was the Medicare Shared Savings Program successful in 2017? Center for Healthcare Quality and Payment Reform website. [chqpr.org/blog/index.php/2018/08/was-the-medicare-shared-savings-program-successful-in-2017](https://www.chqpr.org/blog/index.php/2018/08/was-the-medicare-shared-savings-program-successful-in-2017). Published August 30, 2018. Accessed January 25, 2019.
29. Medicare Shared Savings Program: shared savings and losses and assignment methodology: specifications. CMS website. [cms.gov/Medicare/Medicare-Fee-for-Service-Payment/sharedsavingsprogram/Downloads/Shared-Savings-Losses-Assignment-Spec-V7.pdf](https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/sharedsavingsprogram/Downloads/Shared-Savings-Losses-Assignment-Spec-V7.pdf). Accessed April 26, 2019.

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eAppendix

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A1. ACO Attribution

Our definition of eligibility for enrollment and approach to ACO attribution follow algorithms previously developed by members of the research team.¹ We designated providers as ACOs by matching TINs/CCNs in the claims files to the list of participants in the ACO SSP Provider file. MSSP ACOs are defined as collections of Tax Identification Numbers (TINs) or CMS Certification Numbers (CCNs) representing the provider practices included in the ACO contract with CMS. The set of providers in any given ACO may change over time. We assigned beneficiaries to ACOs based on where they received the plurality of primary care during the year. We used retrospective assignment, matching patients to ACOs based on utilization in the analysis year.

1. We used the CMS ACO SSP Provider file to determine which providers were part of an ACO. We used the CMS Medicare Data on Provider Practice and Specialty (MD-PPAS) files to find provider specialty and flagged claims as delivered by a primary care or specialist physician, which we then linked to ACO membership TINs, or CMS Certification Numbers (CCN).
2. We assigned beneficiaries to ACOs based on the TINs/CCNs where they received the plurality of their allowed charges for qualifying outpatient services delivered by a primary care physician in the analysis year. We defined qualifying primary care services as the following HCPCS/CPT codes:
 - a. Outpatient office visits 99201-99215, G0602, G0438, G0439, G0463
 - b. FQHC & RHC primary care revenue center codes 0521-0525
3. For the purposes of attribution, we excluded Skilled Nursing Facility (SNF) and home visits 99304-99318, 99324-99496.
4. Patients without qualifying services were excluded from the analysis, including:
 - a. Patients who didn't use care, e.g., they had zero E&M visits during the year;
 - b. Patients without Parts A & B coverage;
 - c. Patients residing in an institution, e.g., nursing home residents;
 - d. Patients whose primary insurance was not Medicare, e.g., they had Medicare Secondary Payer (MSP) status;
 - e. Patients enrolled in Medicare Advantage, for any part of the year.

Construction of Sample

	2013	2014	2015	2016
100% sample of Medicare claims	55,206,238	56,767,788	58,294,195	59,818,481
Eligible beneficiaries*	26,353,074	26,364,777	26,410,787	26,637,987
Beneficiaries attributed to ACOs	3,248,093	5,289,917	6,679,423	8,285,541
Number of ACOs	220	333	387	432
Mean members per ACO	14,764	15,886	17,259	19.179

*Includes FFS-only beneficiaries attributed to a TIN/CCN with at least one full year of enrollment, and at least one visit for primary care services in an ambulatory setting during the analysis year.

A2. Quartile ranks

For each year (2013-2016) we ran a regression, below, with total per beneficiary spending as the outcome variable. We controlled for patient characteristics, including age, sex, race, Medicaid status, disability, ESRD, and HCC fixed effects. We controlled for geographic variation using HRR fixed effects. We estimated ACO random effects (U_a) to determine how much each ACOs deviated from contemporaneous local market FFS spending, adjusting for patient characteristics. We used the ACO random effects to rank ACOs from low to high-spending. For each year, we grouped ACOs into quartiles based on random effects. Quartile 1 (Q1) consisted of the lowest spending ACOs and quartile 4 (Q4) included the highest spending ACOs.

Adjusted ACO spending

$$Total_Spend_{i,j,a} = \alpha + \beta_1 demo_i + \beta_2 HRR_j + \beta_3 HCC_i + U_a$$

Adjusted mean total per-beneficiary spending ranged from \$9,179 in 2013 to \$10,212 in 2016 for low-spending ACOs (Q1), and \$10,295-\$10,850 in high-spending ACOs (Q4).

A3. Spending deviations by service category

We estimated variation by spending category using the Model 2 equation below. The outcome variable was spending (total or a subcategory). The regression includes patient demographics (age, sex, race, ESRD, disability, Medicaid), HCC fixed effects, HRR fixed effects, and fixed effects for Q1 (beneficiaries assigned to a low-spending ACO) or Q4 (beneficiaries assigned to a

high-spending ACO). We subtracted $\hat{\beta}_5$ from $\hat{\beta}_4$ to get the difference between Q1 and Q4 ACOs for each category of spending we modeled.

Spending variation by service category

$$Spend_{i,j} = \alpha + \beta_1 demo_i + \beta_2 HRR_j + \beta_3 HCC_i + \beta_4 Q1 + \beta_5 Q4$$

Exhibit 1 in the manuscript reports spending deviations by service category for 2016; the exhibit below reports the same information for all years. Note that the cohort of ACOs in each year was distinct. The number of participating ACOs increased each year, in addition to compositional changes in the ACO cohort itself given new entrants and exits in each year. In addition, within ACOs, there could be changes in participating TINs/CCNs. Note that deviations are net of savings behavior undertaken by ACOs.

Percent difference in spending deviations between highest- and lowest-quartile ACOs, and share of gap in total spending difference, by service category for all years

2013						
	Q1	Q4	Q4-Q1	mean	Q4-Q1/mean	share of total gap (%)
Total spend	-822	506	1328	9565	0.14	
Inpatient	-262	168	430	3187	0.13	0.32
Outpatient	-229	48	277	1776	0.16	0.21
Carrier	-64	146	210	2846	0.07	0.16
SNF	-124	51	175	743	0.24	0.13
Hospice	-6	28	34	176	0.19	0.03
HHA	-119	59	178	564	0.32	0.13
DME	-19	5	24	274	0.09	0.02
2014						
	Q1	Q4	Q4-Q1	mean	Q4-Q1/mean	share of total gap (%)
Total spend	-863	501	1364	9864	0.14	
Inpatient	-289	245	534	3347	0.16	0.39
Outpatient	-290	101	391	1904	0.21	0.29
Carrier	-39	61	100	2890	0.03	0.07
SNF	-122	37	159	756	0.21	0.12
Hospice	7	12	5	168	0.03	0.00
HHA	-110	42	152	552	0.28	0.11
DME	-19	4	23	249	0.09	0.02
2015						
	Q1	Q4	Q4-Q1	mean	Q4-Q1/mean	share of total gap (%)
Total spend	-912	563	1475	10119	0.15	
Inpatient	-325	219	544	3360	0.16	0.37

Outpatient	-241	149	390	1998	0.20	0.26
Carrier	-94	67	161	2993	0.05	0.11
SNF	-148	74	222	769	0.29	0.15
Hospice	5	17	12	170	0.07	0.01
HHA	-92	28	120	569	0.21	0.08
DME	-16	8	24	260	0.09	0.02
2016						
	Q1	Q4	Q4-Q1	mean	Q4-Q1/mean	share of total gap (%)
Total spend	-896	513	1409	10241	0.14	
Inpatient	-325	198	523	3399	0.15	0.37
Outpatient	-273	183	456	2096	0.22	0.32
Carrier	-69	50	119	3023	0.04	0.08
SNF	-151	52	203	740	0.27	0.14
Hospice	3	12	9	179	0.05	0.01
HHA	-66	11	77	561	0.14	0.05
DME	-15	7	22	244	0.09	0.02

Source: Authors' analysis of Medicare claims

Note: Q1 represents low-spending ACOs, while Q4 represents high-spending ACOs. Q4-Q1/mean is the percent difference in spending between Q4 and Q1 for each service category, calculated by dividing the difference in Q4 and Q1 spending deviations (in dollars) for each service category by mean spending for that category. Share of total gap is the percent share of the difference in total spending between Q4 and Q1 attributable to each service category.

A4. Spending deviations by CCW groups

The table below describes how we grouped the 27 CCW conditions into condition groups.

CCW Condition Groups

CCW Condition Groups	CCW Conditions	Inclusion criteria
Hip fracture		In last year
Stroke		In last year
Cancer	Breast	In last year
	Colorectal	In last year
	Endometrial	In last year
	Prostate	In last year
	Lung	In last year
AMI	Acute myocardial infarction	In last year
Chronic cardiovascular	Congestive heart failure	Ever diagnosed
	Ischemic heart disease	Ever diagnosed

	Atrial fibrillation	Ever diagnosed
	Hypertension	Ever diagnosed
Dementia	Alzheimer's	Ever diagnosed
	Dementia	Ever diagnosed
Diabetes		Ever diagnosed
Depression		Ever diagnosed
Chronic Kidney Disease	Chronic kidney disease	Ever diagnosed
Pulmonary	Asthma	Ever diagnosed
	COPD	Ever diagnosed
Eye Diseases	Cataracts	<i>Excluded</i>
	Glaucoma	<i>Excluded</i>
Endocrine Disorders	Hyperlipidemia	<i>Excluded</i>
	Thyroid	<i>Excluded</i>
	Anemia	<i>Excluded</i>
	Benign prostatic hyperplasia	<i>Excluded</i>
Rheumatology	Osteoporosis	<i>Excluded</i>
	Rheumatoid or osteoarthritis	<i>Excluded</i>

For total spending and each service categories, we ran linear regressions with patient characteristics, HRR fixed effects, and Q1 and Q4 fixed effects.. We dropped HCC fixed effects, added fixed effects for the CCW clinical group variables, and interacted each CCW clinical group variable with the Q1 (lowest-spending quartile ACOs) and Q4 (highest-spending quartile ACOs) variables.

Below is the CCW condition group regression model.

Spending variation by CCW group

$$Spend_{i,j} = \alpha + \beta_1 demo_{i,t} + \beta_2 HRR_j + \beta_3 Q1 + \beta_4 Q4 + \beta_5 CCW + \beta_6 Q1 * CCW + \beta_7 Q4 * CCW$$

Exhibit 2 in the manuscript reports spending deviations by CCW group for 2016; the exhibit below reports that information for all years. As with the service category analysis, we note that the number of participating ACOs and composition of the ACO cohort changed in each year. Additionally, within ACOs there could be changes in participating TINs/CCNs from year to year. Note that deviations are net of savings behavior undertaken by ACOs.

Percent difference in spending deviations between highest- and lowest-quartile ACOs, and share of gap in total spending difference, by CCW condition group, for all years

2013

CCW group	CCW group (\$) ^b	Difference, Q4-Q1 (%) ^c	Difference Q4-Q1 (\$) ^d	Prevalence of condition, Q4 (%) ^e	Overall potential per beneficiary savings (\$) ^f
CKD	6,078	22	1,356	0.187	254
Chronic CVD	979	25	244	0.757	185
Diabetes	2,006	20	404	0.326	132
Pulmonary	3,656	5	187	0.26	49
Depression	2,335	6	140	0.276	39
Dementia	3240	18	573	0.09	52
Stroke	12,800	13	1,670	0.033	55
Cancer	13,289	5	689	0.036	25
AMI	21,092	6	1,210	0.012	15
Hip fracture	26,113	5	1,305	0.01	13
2014					
CCW group	CCW group (\$) ^b	Difference, Q4-Q1 (%) ^c	Difference Q4-Q1 (\$) ^d	Prevalence of condition, Q4 (%) ^e	Overall potential per beneficiary savings (\$) ^f
CKD	6,150	23	1,421	0.199	283
Chronic CVD	1,036	1	12	0.758	9
Diabetes	2,023	17	352	0.34	120
Pulmonary	3,747	10	382	0.26	99
Depression	2,382	12	292	0.28	82
Dementia	3,361	3	356	0.09	32
Stroke	13,479	8	1,070	0.033	35
Cancer	13,748	9	1,303	0.036	47
AMI	22,028	5	1,001	0.012	12
Hip fracture	27,116	7	2,011	0.01	20
2015					
CCW group	CCW group (\$) ^b	Difference, Q4-Q1 (%) ^c	Difference Q4-Q1 (\$) ^d	Prevalence of condition, Q4 (%) ^e	Overall potential per beneficiary savings (\$) ^f
CKD	6,147	24	1,478	0.2	310
Chronic CVD	1,061	14	146	0.8	111
Diabetes	2,010	18	367	0.3	125
Pulmonary	3,819	9	359	0.3	97
Depression	2,402	6	133	0.3	39
Dementia	3,487	-1	-32	0.1	-3
Stroke	13,795	16	2,146	0.0	69
Cancer	14,028	11	1,603	0.0	56
AMI	22,695	12	2,738	0.0	33
Hip fracture	27,446	4	987	0.0	10

2016					
CCW group	CCW group (\$) ^b	Difference, Q4-Q1 (%) ^c	Difference Q4-Q1 (\$) ^d	Prevalence of condition, Q4 (%) ^e	Overall potential per beneficiary savings (\$) ^f
CKD	6,054	23	1,372	22	302
Chronic CVD	1,019	24	267	76	202
Diabetes	1,832	19	355	24	120
Pulmonary	3,799	13	484	27	129
Depression	2,376	15	351	30	105
Dementia	3,697	18	657	9	59
Stroke	14,008	13	1,800	3	54
Cancer	14,254	10	1,373	3	47
AMI	23,775	11	2,672	1	32
Hip fracture	27,070	7	1,888	1	19

Source: Authors' analysis of Medicare claims. Notes: CKD stands for chronic kidney disease; Chronic CVD stands for chronic cardiovascular disease; AMI stands for acute myocardial infarction.

^a Q1 represents low-spending ACOs, Q4 represents high-spending ACOs

^b CCW group coefficient, which is portion of overall spending attributed to the CCW condition group

^c $Q4*CCW - Q1*CCW / CCW$ coefficient

^d $Q4*CCW - Q1*CCW$

^e Prevalence of the CCW group in Q4; prevalence does not vary significantly by quartile

^f Potential per-beneficiary savings if Q4 spending for this condition brought to Q1 level of spend

^g Ever diagnosed

^h Diagnosed in last year

A5. Simulated savings

Simulated savings if all ACOs above percentile threshold brought spending down to level of ACOs at that threshold

	Simulated spending threshold ^a	% Reduction in spending ^b			
		2013	2014	2015	2016
Within HRR	50 th	3.2	3.2	3.6	3.6
	25 th	5.4	4.5	5.0	4.8
	10 th	8.1	8.4	8.2	8.6
No HRR Controls	50 th	7.8	3.7	7.7	9.2
	25 th	10.8	7.5	9.2	10.0
	10 th	13.7	11.4	12.2	13.0

Source: Authors' analysis of Medicare claims

^a Savings if all ACOs above threshold are brought down to threshold spending

^b Percent reduction = (risk-adjusted spending – risk-adjusted spending at threshold) / risk-adjusted spending

A6. Spending without geographic adjustment

As a sensitivity analysis, we compare local market and national spending variation. To do this, we repeated several of our analyses without HRR fixed effects, that is with and without adjusting for HRR.

First, we re-estimated the model used to rank ACOs without adjusting for HRR. We then estimated a random effect for each ACO, which represented the deviation in dollar spending from the national FFS Medicare average. We assigned new quartile rankings based on these unadjusted random effects.

Spending deviations by service category, without HRR

	2013		2014		2015		2016	
	Q4-Q1/ Mean (%)	Share of total gap (%)	Q4- Q1/ Mean (%)	Share of total gap (%)	Q4-Q1/ Mean (%)	Share of total gap (%)	Q4-Q1/ Mean (%)	Share of total gap (%)
Total Spending	25		24		24		25	
Inpatient	29	38	28	40	30	41	31	41
Outpatient	15	11	17	14	14	11	13	11
Carrier	28	33	22	27	28	35	28	33
SNF	41	13	35	11	40	13	39	11
Hospice	(15)	(1)	(21)	(2)	(15)	(1)	(10)	(1)
Home Health	31	7	34	8	22	5	22	5
DME	(6)	(1)	(4)	0	(5)	(5)	(6)	(1)

Source: Authors' analysis of Medicare claims

Note: Q1 represents low-spending ACOs, while Q4 represents high-spending ACOs. Q4-Q1/mean is the percent difference in spending between Q4 and Q1 for each service category, calculated by dividing the difference in Q4 and Q1 spending deviations (in dollars) for each service category by mean spending for that category. Share of total gap is the percent share of the difference in total spending between Q4 and Q1 attributable to each service category.

A7. Spending variation by spending category, ACOs present in all four years only

The table below repeats the analysis of spending deviations by service category only for the cohort of 145 ACOs present in all four years. Note that we re-estimated the quartile ranks in each year. And, there could be changes to participating TINs/CCNs within ACOs from year to year. Note that deviations are net of savings behavior undertaken by ACOs.

2013						
category	Q1(\$)	Q4 (\$)	Q4-Q1 (\$)	Mean (\$)	Q4-Q1/mean (%)	Share of gap (%)
Total spend	-822	516	1338	9563	0.14	
Inpatient	-229	155	384	3186	0.12	0.29
Outpatient	-289	106	395	1777	0.22	0.30
Carrier	-28	142	170	2845	0.06	0.13
SNF	-128	35	163	742	0.22	0.12
Hospice	-2	15	17	175	0.10	0.01
HHA	-128	56	184	563	0.33	0.14
DME	-19	7	26	274	0.09	0.02
2014						
category	Q1(\$)	Q4 (\$)	Q4-Q1 (\$)	Mean (\$)	Q4-Q1/mean (%)	Share of gap (%)
Total spend	-897	475	1372	9863	0.14	
Inpatient	-305	199	504	3343	0.15	0.37
Outpatient	-329	110	439	1906	0.23	0.32
Carrier	42	66	24	2887	0.01	0.02
SNF	-129	55	184	758	0.24	0.13
Hospice	-7	9	16	167	0.10	0.01
HHA	-154	32	186	552	0.34	0.14
DME	-14	3	17	249	0.07	0.01
2015						
category	Q1(\$)	Q4 (\$)	Q4-Q1 (\$)	Mean (\$)	Q4-Q1/mean (%)	Share of gap (%)
Total spend	-986	509	1495	10111	0.15	
Inpatient	-326	190	516	3356	0.15	0.35
Outpatient	-302	113	415	2003	0.21	0.28
Carrier	-58	101	159	2985	0.05	0.11
SNF	-134	78	212	771	0.27	0.14
Hospice	-9	10	19	169	0.11	0.01
HHA	-139	14	153	567	0.27	0.10
DME	-18	2	20	260	0.08	0.01
2016						
category	Q1(\$)	Q4 (\$)	Q4-Q1 (\$)	Mean (\$)	Q4-Q1/mean (%)	Share of gap (%)
Total spend	-913	388	1301	10237	0.13	
Inpatient	-266	153	419	3393	0.12	0.32
Outpatient	-329	142	471	2093	0.23	0.36

Carrier	-23	60	83	3031	0.03	0.06
SNF	-145	16	161	743	0.22	0.12
Hospice	-11	10	21	178	0.12	0.02
HHA	-124	-4	120	556	0.22	0.09
DME	-15	12	27	243	0.11	0.02

A8. Spending persistence over time

For the 145 ACOs present in all four years, we correlated the adjusted spending deviations (ACO random effects) across years to determine how consistent ACOs' spending performance was over time. We used adjusted Pearson correlations to examine how ACO spending deviations and quartile rankings changed over time. Spending deviations for the 145 ACOs present in all four years were correlated over time. Year to year adjusted correlations are around .85-.90; across 4 years the correlation weakens to about .74. Only six (4%) of the ACOs had at least one year in the top, high-spending, quartile and at least one year in the bottom, low-spending, quartile.

Since rankings were based on ACO random effects, we adjusted Pearson correlation coefficients using post-estimation reliability estimates to account for bias towards the null introduced by shrinkage from estimating each year separately. In addition, we looked at changes in quartile rank from year to year.

Adjusted Pearson correlations of ACO random effects (including HRR)

	2013	2014	2015	2016
2013	1			
2014	0.903	1		
2015	0.814	0.887	1	
2016	0.738	0.836	0.849	1

Source: Authors' analysis of Medicare claims