

Portland State University

PDXScholar

OHSU-PSU School of Public Health Faculty
Publications and Presentations

OHSU-PSU School of Public Health

2018

Medicare Accountable Care Organizations Are Not Associated With Reductions in the Use of Low-Value Coronary Revascularization

John M. Hollingsworth

University of Michigan Medical School and School of Public Health

Brahmajee K. Nallamothu

Institute for Healthcare Policy and Innovation

Phyllis Yan

Dow Division of Health Services Research

Sarah Ward

Department of Cardiac Surgery

Sunny C. Lin

Portland State University, sunlin@pdx.edu

Follow this and additional works at: https://pdxscholar.library.pdx.edu/sph_facpub



See next page for additional authors
Part of the [Medicine and Health Sciences Commons](#)

Let us know how access to this document benefits you.

Citation Details

Hollingsworth, J. M., Nallamothu, B. K., Yan, P., Ward, S., Lin, S., Colla, C. H., ... & Ryan, A. M. (2018). Medicare Accountable Care Organizations are not associated with reductions in the use of low-value coronary revascularization. *Circulation: Cardiovascular Quality and Outcomes*, 11(6), e004492.

This Article is brought to you for free and open access. It has been accepted for inclusion in OHSU-PSU School of Public Health Faculty Publications and Presentations by an authorized administrator of PDXScholar. Please contact us if we can make this document more accessible: pdxscholar@pdx.edu.

Authors

John M. Hollingsworth, Brahmajee K. Nallamothu, Phyllis Yan, Sarah Ward, Sunny C. Lin, Carrie H. Colla, Valerie A. Lewis, and multiple additional authors

ORIGINAL ARTICLE



Medicare Accountable Care Organizations Are Not Associated With Reductions in the Use of Low-Value Coronary Revascularization

BACKGROUND: Because specialty care accounts for half of Medicare expenditures, improving its value is critical to the success of Medicare accountable care organizations (ACOs) in curbing spending growth. However, whether ACOs have reduced low-value specialty care without compromising use of high-value services remains unknown.

METHODS AND RESULTS: Using national Medicare data, we identified 2 cohorts: beneficiaries for whom the value of coronary revascularization is lower (those with ischemic heart disease without angina, congestive heart failure, or recent admission for acute myocardial infarction) and beneficiaries for whom its value is higher (those with recent acute myocardial infarction admission). We then determined the provider groups who cared for the cohorts, distinguishing between those participating (n=298) and those not participating in a Medicare ACO (1329). After measuring the provider groups' use of coronary artery bypass grafting and percutaneous coronary intervention among the 2 cohorts, we fit multivariable models to test the statistical significance of rates of change in low- and high-value revascularization after ACO participation. During the pre-ACO period, participating and nonparticipating provider groups had similar rates of low- and high-value revascularization. Our multivariable model results show that rates of change for low- and high-value coronary revascularization were not altered by a provider group's participation in a Medicare ACO (lower value: difference, -0.04 per year; 95% confidence interval, -0.11 to 0.03; higher value: difference, 0.96 per year; 95% confidence interval, -0.46 to 2.4).

CONCLUSIONS: We found no association between provider group participation in a Medicare ACO and use of low- or high-value coronary revascularization.

John M. Hollingsworth, MD, MS
Brahmajee K. Nallamothu, MD, MPH
Phyllis Yan, MS
Sarah Ward, MD
Sunny Lin, MS
Carrie H. Colla, PhD
Valerie A. Lewis, PhD
John Z. Ayanian, MD, MPP
Brent K. Hollenbeck, MD, MS
Andrew M. Ryan, PhD

Key Words: accountable care organizations ■ heart failure ■ Medicare ■ myocardial infarction ■ percutaneous coronary intervention

© 2018 American Heart Association, Inc.

<http://circoutcomes.ahajournals.org>

WHAT IS KNOWN

- Data on the early experience of Medicare accountable care organizations (ACOs) with specialty care are sparse.
- Studies on a commercial ACO pilot and the first-year performance of the Pioneer ACO Model Program suggest that they may decrease utilization of lower value procedural care.

WHAT THE STUDY ADDS

- Regardless of a procedure's value, its use was not altered by provider participation in a Medicare ACO.
- This suggests that the incentives of current Medicare ACO programs may be too weak to influence specialist physician behavior.

Given Medicare's projected increases in spending,¹ many hope that the expansion of accountable care organizations (ACOs) will help curb future spending growth. Accounting for nearly half of all Medicare expenditures,^{2,3} attention must be paid to expensive specialty care, particularly cardiovascular services, such as coronary revascularization, which make an outsize contribution to spending.⁴ Yet, when the leaders of Medicare ACOs were recently surveyed about their organizations' early strategic plans for achieving shared savings, conspicuously missing was any mention of specialty care.⁵

However, Medicare ACOs have the potential to influence specialty care substantially. A core premise of ACOs is shared accountability in patient management and coordination between primary and specialty care. Because participants are held to quality and spending targets for not only the services that they provide but also the care delivered by others, ACO primary care physicians may lead specialists to limit a procedure's use in situations where its value is low. They might also steer referrals toward specialists who provide higher value care. Furthermore, collective incentives may motivate specialists participating in ACOs to lower their costs by reducing procedures among marginal patients. On the contrary, ACO financial pressures may bluntly discourage use of all procedures, regardless of their value.

To better understand the effects of Medicare ACOs on specialty care, we analyzed national Medicare claims from beneficiaries with ischemic heart disease, who were candidates for coronary revascularization. Coronary revascularization is an ideal procedure to study given that its value to patients varies substantially from scenarios where it can be lifesaving (acute myocardial infarction [AMI]) to those where its value is less certain (asymptomatic ischemia). We deter-

mined the provider groups who cared for these beneficiaries, distinguishing between those participating and those not participating in a Medicare ACO. We then compared coronary revascularization use among these groups before and after ACO implementation to assess whether ACOs reduced population-based rates of low-value procedures without affecting high-value specialty care.

METHODS

Data Source and Study Population

Our analyses were based on national Medicare claims from a 20% random sample of beneficiaries, including data from the Carrier, Denominator, Medicare Provider Analysis and Review, and Outpatient research identifiable files, allowing us to capture both inpatient and outpatient cardiac services. Because of the sensitive nature of these files, requests to access them from qualified researchers trained in human subject confidentiality protocols may be sent to the Centers for Medicare & Medicaid Services. For each study year from 2008 to 2014, we included fee-for-service beneficiaries if they had continuous enrollment in Parts A and B in that year and the year prior (for purposes of comorbidity assessment). As in other studies,^{6,7} we also required that beneficiaries received at least 1 primary care service (Healthcare Common Procedure Coding System codes 99201 through 99215, 99304 through 99350, G0402, G0438, and G0439) in the study year furnished by an ACO professional.

For each study year, we used *International Classification of Diseases, Ninth Revision*, codes to identify 2 cohorts (code lists available in the Appendix in the [Data Supplement](#)). The first cohort included beneficiaries for whom the value of coronary revascularization is widely considered to be lower.⁸ It included beneficiaries with evidence of stable, asymptomatic ischemic heart disease without concomitant diagnoses of angina, congestive heart failure, or recent AMI hospitalization. For the second cohort, we identified beneficiaries for whom the value of coronary revascularization is generally regarded as higher.⁹ This consisted of those admitted in a given year with a primary diagnosis of AMI.

Assigning Beneficiaries to Provider Groups Who Cared for Them

Next, we used 2-step to assign beneficiaries to provider groups (defined as primary care physicians, specialists, and hospitals who care for common patients).¹⁰ First, we linked beneficiaries to their predominant ambulatory provider, defined as the primary care physician who furnished the most primary care services during a given year. For those who received no primary care services by any primary care physician, we assigned them to the specialist or nonphysician practitioner responsible for the most primary care services. Second, we linked all predominant ambulatory providers to the acute care hospital where they performed the plurality of their work during the year. Providers who did not bill for any inpatient care were linked to the hospital where most of their patients were referred that year.

Distinguishing Provider Groups Participating in a Medicare ACO

After determining the provider groups who cared for beneficiaries with ischemic heart disease, we used the Leavitt Partners ACO Database to distinguish those participating in a Medicare ACO. This validated database has been in existence since 2010 and contained 839 Medicare, Medicaid, and commercial ACOs at the time of our analysis.¹¹ Information on ACOs in the database is updated regularly from press releases, news articles, government announcements, conferences, personal and industry interviews, and other public records. We considered a provider group to be participating in a Medicare ACO if the hospital where the primary care physicians and specialists in it delivered the plurality of their inpatient care was identified as either being owned by or affiliated with the ACO.

Measuring Rates of Coronary Revascularization

Our unit of analysis was quarterly provider group-level rates of total coronary revascularization for both of our cohorts. Among the cohort with asymptomatic ischemia, the numerator for our rate calculation was the number of times in a study quarter that coronary artery bypass or percutaneous coronary intervention (PCI; code lists available in the Appendix in the [Data Supplement](#)) was performed on a given provider group's assigned beneficiaries. Of note, these procedures are largely done on an inpatient basis. The denominator corresponded to the number of the provider group's assigned beneficiaries, who had a diagnosis of asymptomatic ischemia that same quarter.

Among the cohort with hospitalization for AMI during the calendar year (for whom revascularization is high-value), the numerator for our rate calculation was the number of times in a study quarter that coronary artery bypass grafting or PCI was performed on a given provider group's assigned beneficiaries during hospitalization and up to 30 days after discharge. The denominator was the number of the provider group's assigned beneficiaries, who were hospitalized that same quarter for AMI. Using previously described methods,¹² we risk-adjusted all rates using beneficiary-level covariates for age, sex, race/ethnicity, coexisting medical conditions (based on hierarchical condition categories¹³), and socioeconomic status.¹⁴

Statistical Analysis

We first examined differences between ACO participating and nonparticipating provider groups with respect to the beneficiaries for whom they cared, using parametric and non-parametric tests where appropriate. We also linked data from the American Hospital Association Annual Survey to compare groups based on characteristics of the hospitals where they delivered inpatient care, including hospital size, urbanicity, for-profit and teaching status, and region.¹⁵ Because capability and capacity may influence intervention decisions, we limited our analysis to provider groups that performed at least 10 PCIs and coronary artery bypass grafting procedures annually.

For both cohorts, we then plotted adjusted rates of total coronary revascularization in ACO participating and

Table 1. Characteristics of ACO Participating and Nonparticipating Provider Groups

	Participating (n=298)	Nonparticipating (n=1329)	P Value
Characteristics of the provider group			
Contract start date			
2012	119 (39.9)	NA	NA
2013	99 (33.2)	NA	NA
2014	80 (26.9)	NA	NA
Organizational type			
Physician-hospital partnership	160 (53.7)	NA	NA
Hospital-led	103 (34.6)	NA	NA
Physician-led	35 (11.7)	NA	NA
Program type			
Medicare shared savings	272 (91.3)	NA	NA
Pioneer ACO program	26 (8.7)	NA	NA
Commercial ACO contract			
Yes	186 (62.4)	NA	NA
No	112 (37.6)	NA	NA
Medicaid ACO contract			
Yes	21 (7.1)	NA	NA
No	277 (93.0)	NA	NA
Characteristics of the hospitals where provider groups deliver inpatient care			
Hospital size			0.0265
Small	11 (3.7)	94 (7.1)	
Medium	63 (21.1)	328 (24.7)	
Large	224 (75.2)	907 (68.2)	
For-profit hospital			
Yes	30 (10.1)	327 (24.6)	<0.001
No	268 (89.9)	1,002 (75.4)	
Teaching hospital			
Yes	53 (17.8)	166 (12.5)	0.0155
No	245 (82.2)	1163 (87.5)	
Urban hospital			
Yes	298 (100.0)	1320 (99.3)	0.1543
No	0 (0.0)	9 (0.7)	
Geographic region			
Northeast	55 (18.5)	178 (13.4)	<0.001
Midwest	112 (37.6)	305 (22.9)	
South	72 (24.2)	573 (43.1)	
West	59 (19.8)	273 (20.5)	

Parentheses indicate percent. ACO indicates accountable care organization; and NA, not applicable.

nonparticipating provider groups by study year. To test the statistical significance of rates of change in revascularization after ACO participation, we fit multivariable linear regression

models (see Appendix in the [Data Supplement](#) for full model specification). We accounted for repeated measures by using generalized estimating equations with robust variance estimators,^{16,17} weighted by the number of beneficiaries assigned to a group per quarter. Our models included a time-varying indicator for the group (set to 1 the quarter when a group began Medicare ACO participation and 0 otherwise) and covariates for the hospital characteristics described above. To address temporal trends, we introduced quarter and year as fixed effects.

To test the robustness of our findings, we conducted a series of sensitivity analyses. To see whether ACO effects differed between early and late adopters, we constructed separate models for groups with contract start dates in 2012, 2013, and 2014. To examine whether a group's organizational structure, degree of financial risk assumed (based on its participation in the Pioneer ACO or Medicare Shared Savings Program), or its participation in a commercial or Medicaid ACO contract were effect modifiers, we added interaction terms to our primary models. Because practice patterns may change with increased experience, we also fit models that included year lags for Medicare ACO participation. Finally, we performed an exploratory analysis on provider groups in the Medicare Shared Savings Program to determine whether specialist participation (defined as the number of specialist physicians per 1000 beneficiaries in the ACO to which a given provider group belonged) modified ACO effects.

We performed all analyses using SAS Version 9.4 (Cary, NC). Tests were 2-tailed, and we set the probability of Type 1 error at 0.05. The Health Sciences Institutional Review Board at our institution deemed this study to be exempt from its oversight.

RESULTS

We identified 298 provider groups that participated in a Medicare ACO contract at some point during the study interval and 1329 nonparticipating groups. As shown in Table 1, 40% were early ACO model adopters (ie, they had a contract start date in 2012). The overwhelming majority (91%) participated in the Medicare Shared Savings Program (as opposed to the Pioneer ACO Program). Most participating provider groups (53.7%) included hospital partners. Sixty-two percent were concurrently in a commercial ACO, but only 7.1% also participated in a Medicaid ACO contract.

Table 2 compares beneficiaries cared for by ACO participating and nonparticipating provider groups during the precontract period. The distribution of asymptomatic ischemia was similar between groups, and differences in their beneficiaries' age, sex, race/ethnicity, and level of comorbid illness were not clinically meaningful. However, beneficiaries cared for by nonparticipating groups tended to come from lower socioeconomic strata ($P<0.01$). Participating groups tended to practice at larger, not-for-profit, and teaching hospitals (Table 1). Furthermore, their hospitals were concentrated disproportionately in the Northeast and Midwest.

Figure 1 displays adjusted rates (per 100 beneficiaries per year) of total coronary revascularization across participating and nonparticipating provider groups (the former are stratified by their Medicare ACO contract start date). During the precontract period, rates of revascularization among beneficiaries with asymptomatic ischemia

Table 2. Characteristics of the Beneficiaries With Ischemic Heart Disease Cared for by ACO Participating and Nonparticipating Groups During the Precontract Period

Beneficiary Characteristic	Precontract Period (2008 to 2011)		Difference Between Groups During Precontract Period	P Value
	Participating (n=444851)	Nonparticipating (n=1 715 606)		
IHD cohort, %				0.23
Stable ischemia	96.8	96.9	0.0	
Recent AMI	3.2	3.1	0.0	
Mean age±SD, y	77.2±7.2	77.1±7.2	-0.1	<0.01
Female, %	46.2	45.6	0.6	<0.01
Race/ethnicity, %				<0.01
White	89.4	89.9	-0.5	
Black	6.6	5.8	0.8	
Hispanic	1.1	1.5	-0.4	
Other	2.9	2.9	0.0	
Mean no. of HCCs±SD	1.9±1.7	1.9±1.7	0.0	0.81
SE stratum, %				<0.01
Low	25.0	33.6	-8.6	
Medium	32.7	33.6	-0.9	
High	42.3	32.8	9.5	

ACO indicates accountable care organization; AMI, acute myocardial infarction; HCCs, hierarchical condition categories; IHD, ischemic heart disease; and SE, socioeconomic.

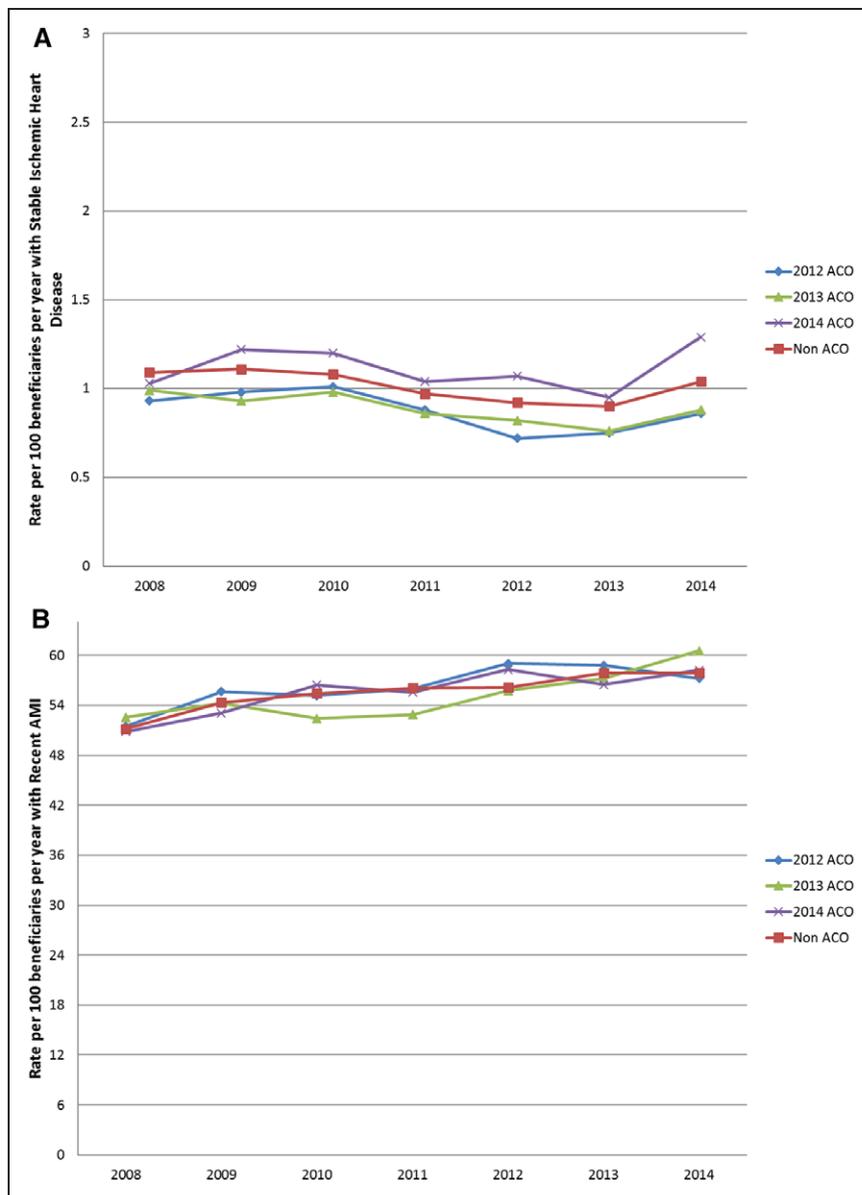


Figure 1. Rates of total coronary revascularization among accountable care organization (ACO) participating and nonparticipating provider groups over the study interval for low- (A) and high-value (B) scenarios. Participating provider groups are stratified by contract start date. AMI indicates acute myocardial infarction.

(panel A) and those among beneficiaries hospitalized for AMI (panel B) were similar between participating and nonparticipating provider groups (lower value, 1.0 versus 1.1, respectively; higher value, 53.9 versus 54.2, respectively). Over the study interval, although the rates of lower value revascularization remained relatively flat (from 1.0 in 2008 to 1.0 in 2014), rates of higher value revascularization rose, on average, by 13.5% (from 51.5 in 2008 to 58.5 in 2014). For both cohorts, there was no noticeable separation of rates in participating provider groups after the start of an ACO.

As displayed in Table 3, our multivariable model results show that rates of change for low- and high-value coronary revascularization were not altered by a provider group's participation in a Medicare ACO (lower value: difference, -0.04 per year; 95% confidence interval [CI], -0.11 to 0.03 ; higher value: difference, 0.96 per year; 95% CI, -0.46 to 2.4). When considered separately, we

noted similar findings when rates for coronary artery bypass grafting (lower value, difference, -0.01 per year; 95% CI, -0.04 to 0.01 ; higher value, difference, 0.01 per year; 95% CI, -0.9 to 0.9) and PCI (lower value, difference, -0.02 per year; 95% CI, -0.08 to 0.03 ; higher value, difference, 0.7 per year; 95% CI, -0.8 to 2.2).

Figure 2 illustrates findings from our sensitivity analyses. We observed no association between ACO participation and total coronary revascularization rates when we analyzed early and late model adopters separately. Group organizational structure, degree of financial risk, and commercial or Medicaid ACO participation did not modify Medicare ACO effects on rates of lower or higher value revascularization. When we examined organizational learning effects by including year lags for ACO participation in our models, we noted decreases in the rates of lower value total coronary revascularization and PCI in year 2 (total: difference, -0.1 ; 95% CI, -0.2

Table 3. Multivariable Model Examining the Relationship Between Provider Group Participation in a Medicare ACO and the Rate of Coronary Revascularization, Stratified by the Value of Intervention

Variable	Parameter Estimates for Percentage Change of Coronary Revascularization	
	Lower Value	Higher Value
	Coefficient (95% CI)	Coefficient (95% CI)
Year (referent 2008)		
2009	0.03 (−0.01 to 0.07)	3.10 (2.14 to 4.06)
2010	0.01 (−0.03 to 0.05)	4.01 (3.06 to 4.96)
2011	−0.11 (−0.15 to −0.07)	4.55 (3.59 to 5.52)
2012	−0.16 (−0.21 to −0.12)	5.17 (4.19 to 6.15)
2013	−0.18 (−0.23 to −0.14)	6.41 (5.40 to 7.42)
2014	−0.03 (−0.08 to 0.02)	6.30 (5.23 to 7.37)
Quarter (referent first)		
Second	−0.09 (−0.11 to −0.07)	−0.38 (−1.09 to 0.34)
Third	0.14 (0.10 to 0.17)	−1.14 (−1.85 to −0.42)
Fourth	0.15 (0.11 to 0.19)	−4.05 (−4.78 to −3.32)
Urban hospital (referent rural)		
Urban	0.31 (0.06 to 0.56)	0.83 (−2.16 to 3.83)
Teaching hospital (referent nonteaching)		
Teaching	−0.15 (−0.23 to −0.08)	0.89 (−0.18 to 1.95)
Nonprofit hospital (referent for-profit)		
Nonprofit	−0.02 (−0.10 to 0.06)	0.06 (−1.06 to 1.18)
Hospital region (referent Northeast)		
Midwest	0.45 (0.35 to 0.54)	5.20 (3.96 to 6.45)
South	0.29 (0.22 to 0.37)	3.01 (1.77 to 4.24)
West	0.30 (0.21 to 0.39)	4.13 (2.69 to 5.56)
Hospital size (referent small)		
Medium	−0.17 (−0.33 to −0.01)	−1.11 (−3.76 to 1.54)
Large	−0.21 (−0.36 to −0.06)	−0.07 (−2.63 to 2.49)
First year participating in ACO (referent nonparticipating)		
ACO	−0.04 (−0.11 to 0.03)	0.96 (−0.46 to 2.38)

ACO indicates accountable care organization; and CI, confidence interval.

to 0.0; PCI: difference, −0.1; 95% CI, −0.2 to −0.0]), but this effect was not maintained in year 3. Finally, on our exploratory analysis, we found evidence suggesting that provider groups with high specialist participation may decrease rates of lower value revascularization (difference, −0.10 per year; 95% CI, −0.27 to 0.07) and increase rates of higher value revascularization (difference, 1.62 per year; 95% CI, −1.70 to 4.93), although these effects were not statistically significant.

DISCUSSION

For both low- and high-value scenarios, we found that rates of change for total coronary revascularization, coronary artery bypass grafting, and PCI among beneficiaries treated by provider groups participating in a Medicare ACO contract were similar to those of

beneficiaries treated by nonparticipating groups. These findings indicate that the incentives of Medicare Shared Savings Program and Pioneer may be too weak to limit the growth in spending on cardiac specialty care, and that refinements of current alternative payment models and risk-bearing contracts are needed to influence provider behavior.¹⁸

Data on the early experience of ACOs with specialty care are sparse; only 2 studies have examined ACO effects on specialty care delivery. The first was of an ACO pilot, comparing use of cardiovascular imaging and procedures among participating groups before and after implementation.¹⁹ Consistent with our results, the study's authors found no evidence that the pilot had any effect on the use of lower value care.¹⁹ More recently, Schwartz and colleagues assessed the performance of Pioneer ACOs.²⁰ In contrast to our results, they demonstrated marginally significant but modest reductions in some lower value procedural care (eg, carotid endarterectomy for asymptomatic patients) during the program's first year.²⁰

One reason why we observed no effects of Medicare ACOs on lower value coronary revascularization procedures is that these procedures are already infrequently performed. As such, ACO leaders may have chosen instead to focus on higher prevalence, lower value activities where more room for improvement exists. An alternative explanation has to do with the fact that participating provider groups, and particularly specialists, have too little skin in the game. Specifically, most in our study were in 1-sided risk models that required no penalty for losses. Thus, the specialists participating in these ACOs may have limited incentive to alter their practice patterns. A second explanation pertains to a lack of specialist involvement. Half of Medicare ACOs have no formal arrangements with specialty practices.²¹ Given that ACO primary care physicians, by law, cannot restrict their beneficiaries' care choices,²² weakly connected specialists may fall outside the reach of ACOs.

Our study has limitations that merit discussion. First, working with medical claims, we do not know beneficiaries' burden of symptoms. Therefore, we cannot comment on whether a given coronary revascularization procedure was appropriate or not. Nevertheless, we can comment on the value of intervention. Indeed, other investigators have used frameworks similar to ours for estimating lower value PCI use with administrative data. Second, participation in a Medicare ACO is nonrandom and may be endogenous with organizational factors. Insofar as participating provider groups already had structures and processes in place before ACO implication to limit low-value procedure utilization among specialists, our results would be biased. That said, we would expect the direction of this bias to be positive toward finding an effect of ACOs.

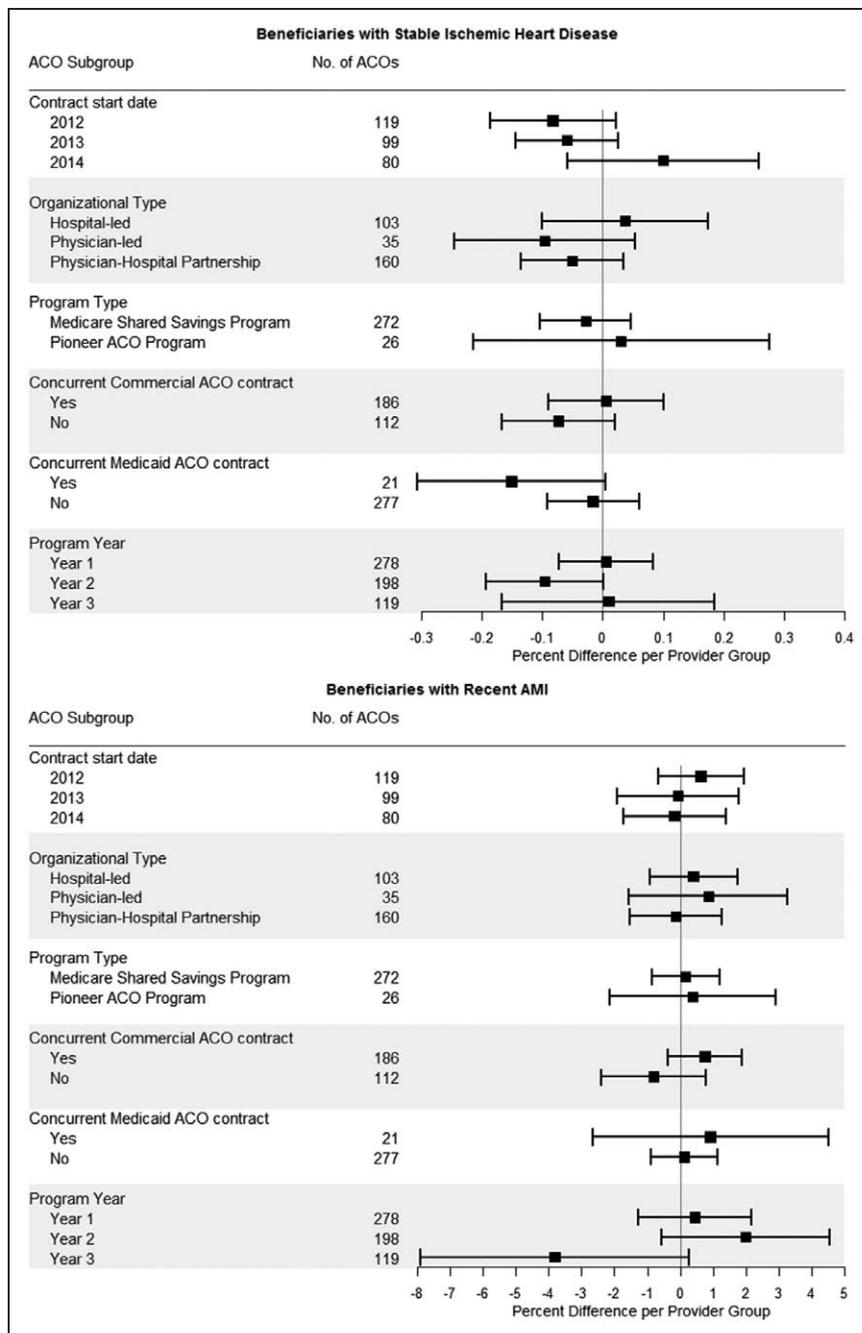


Figure 2. Differential changes in rates of coronary revascularization in low- and high-value scenarios based on accountable care organization (ACO) contract start date, organizational type, concurrent commercial or Medicaid contract, and experience. Error bars represent 95% confidence interval. AMI indicates acute myocardial infarction.

Third, we must acknowledge the possibility of misclassification bias from 2 sources. For one, we determined a provider group’s participation in a Medicare ACO based on where its primary care physicians and specialists delivered inpatient services. In addition, our method for categorizing the value of coronary revascularization depends, in part, on the accuracy of providers’ diagnosis coding. However, we have reasons to think that the risk of this bias is low. When we compared results from our group ACO participation algorithm with data from the Shared Saving Program ACO Provider-level research identifiable file, we observed that our assignment approached 90% accuracy. What is more,

the rates of lower value PCI, which we observed are similar to those published elsewhere.²³

Fourth, we concentrated on lower value procedures for ischemic heart disease only. We did so because these procedures are costly, accounting for \$6 billion annually in Medicare spending and involve a diverse group of specialists, but we acknowledge that findings on them may not be generalizable to lower value care for other conditions. Finally, it is unclear whether our findings apply to alternative ACO models, emphasizing greater financial risk for providers.

Notwithstanding these limitations, our findings have important implications for clinician leaders and policy-

makers. The focus of the initial iteration of Medicare ACOs has been on enhanced primary care for beneficiaries with multiple chronic medical conditions and complex medical needs. This narrow focus has produced, at best, slight savings for Medicare. As suggested by our exploratory analysis, new more comprehensive designs that better incorporate specialists may be necessary if ACOs are to reach their full potential. Without such changes, the current Medicare ACO programs may struggle to control specialist costs.

ARTICLE INFORMATION

Received December 8, 2017; accepted May 17, 2018.

Guest Editor for this article was Dennis T. Ko, MD, MSc.

The Data Supplement is available at <http://circoutcomes.ahajournals.org/lookup/suppl/doi:10.1161/CIRCOUTCOMES.117.004492/-/DC1>.

Correspondence

John M. Hollingsworth, MD, MS, N Campus Research Complex, 2800 Plymouth Rd, Bldg 16, 1st Floor, Room 112W, Ann Arbor, MI 48109-280. E-mail kinks@med.umich.edu

Affiliations

Dow Division of Health Services Research, Department of Urology (J.M.H., P.Y., B.K.H.), Institute for Healthcare Policy and Innovation (J.M.H., B.K.N., J.Z.A., B.K.H., A.M.R.), Division of Cardiovascular Medicine, Department of Internal Medicine (B.K.N.), Department of Cardiac Surgery (S.W.), and Division of General Medicine, Department of Internal Medicine (J.Z.A.), University of Michigan Medical School, Ann Arbor, MI. Center for Clinical Management and Research, Ann Arbor Veterans Affairs Healthcare System, Ann Arbor, MI (B.K.N.). Department of Health Management and Policy, University of Michigan School of Public Health, Ann Arbor, MI (S.L., A.M.R.). The Dartmouth Institute for Health Policy and Clinical Practice, Geisel School of Medicine, Hanover, NH (C.H.C., V.A.L.).

Sources of Funding

This study was supported by the Agency for Healthcare Research & Quality (1R01HS024525 01A1 and 1R01HS024728 01 to Dr Hollingsworth) and the National Institute on Aging (R01-AG-048071 to Dr Hollenbeck).

Disclosures

None.

REFERENCES

- Centers for Medicare & Medicaid Services. National Health Expenditure Projections 2016–2025. <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/proj2016.pdf>. Accessed May 9, 2017.
- Health Care Cost Institute. 2013 Health Care Cost and Utilization Report Appendix. 2014. <http://www.healthcostinstitute.org/files/2013%20HCCUR%20Appendix%2010-28-14.pdf>. Accessed February 7, 2015.
- The Organisation for Economic Co-operation and Development. Why Is Health Spending in the United States So High? 2011. <http://www.oecd.org/unitedstates/49084355.pdf>. Accessed February 7, 2015.
- Benjamin EJ, Blaha MJ, Chiuve SE, Cushman M, Das SR, Deo R, de Ferranti SD, Floyd J, Fornage M, Gillespie C, Isasi CR, Jiménez MC, Jordan LC, Judd SE, Lackland D, Lichtman JH, Lisabeth L, Liu S, Longenecker CT, Mackey RH, Matsushita K, Mozaffarian D, Mussolino ME, Nasir K, Neumar RW, Palaniappan L, Pandey DK, Thiagarajan RR, Reeves MJ, Ritchey M, Rodriguez CJ, Roth GA, Rosamond WD, Sasson C, Towfighi A, Tsao CW, Turner MB, Virani SS, Voeks JH, Willey JZ, Wilkins JT, Wu JH, Alger HM, Wong SS, Muntner P; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics—2017 Update: a report from the American Heart Association. *Circulation*. 2017;135:e146–e603. doi: 10.1161/CIR.0000000000000485.
- Dupree JM, Patel K, Singer SJ, West M, Wang R, Zinner MJ, Weissman JS. Attention to surgeons and surgical care is largely missing from early medicare accountable care organizations. *Health Aff (Millwood)*. 2014;33:972–979. doi: 10.1377/hlthaff.2013.1300.
- Colla CH, Lewis VA, Kao LS, O'Malley AJ, Chang CH, Fisher ES. Association between Medicare accountable care organization implementation and spending among clinically vulnerable beneficiaries. *JAMA Intern Med*. 2016;176:1167–1175. doi: 10.1001/jamainternmed.2016.2827.
- McWilliams JM, Hatfield LA, Cherner ME, Landon BE, Schwartz AL. Early performance of accountable care organizations in Medicare. *N Engl J Med*. 2016;374:2357–2366. doi: 10.1056/NEJMsa1600142.
- Stergiopoulos K, Boden WE, Hartigan P, Möbius-Winkler S, Hambrecht R, Hueb W, Hardison RM, Abbott JD, Brown DL. Percutaneous coronary intervention outcomes in patients with stable obstructive coronary artery disease and myocardial ischemia: a collaborative meta-analysis of contemporary randomized clinical trials. *JAMA Intern Med*. 2014;174:232–240. doi: 10.1001/jamainternmed.2013.12855.
- Keeley EC, Boura JA, Grines CL. Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials. *Lancet*. 2003;361:13–20. doi: 10.1016/S0140-6736(03)12113-7.
- Lewis VA, McClurg AB, Smith J, Fisher ES, Bynum JP. Attributing patients to accountable care organizations: performance year approach aligns stakeholders' interests. *Health Aff (Millwood)*. 2013;32:587–595. doi: 10.1377/hlthaff.2012.0489.
- Colla CH, Lewis VA, Tierney E, Muhlestein DB. Hospitals participating in ACOs tend to be large and urban, allowing access to capital and data. *Health Aff (Millwood)*. 2016;35:431–439. doi: 10.1377/hlthaff.2015.0919.
- Zuckerman RB, Sheingold SH, Orav EJ, Ruhter J, Epstein AM. Readmissions, observation, and the Hospital Readmissions Reduction Program. *N Engl J Med*. 2016;374:1543–1551. doi: 10.1056/NEJMsa1513024.
- Pope GC, Kautter J, Ingber MJ, Freeman S, Sekar R, Newhart C. Evaluation of the CMS-HCC risk adjustment model: Final report. CMS website. https://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/downloads/evaluation_risk_adj_model_2011.pdf. Accessed May 9, 2017.
- Diez Roux AV, Merkin SS, Arnett D, Chambless L, Massing M, Nieto FJ, Sorlie P, Szklo M, Tyroler HA, Watson RL. Neighborhood of residence and incidence of coronary heart disease. *N Engl J Med*. 2001;345:99–106. doi: 10.1056/NEJM200107123450205.
- Kralovec PD, Mullner R. The American Hospital Association's annual survey of hospitals: continuity and change. *Health Serv Res*. 1981;16:351–355.
- Liang KY, Zeger SL. Longitudinal data-analysis using generalized linear models. *Biometrika* 1986;73:13–22.
- White H. A heteroskedasticity-consistent covariance-matrix estimator and a direct test for heteroskedasticity. *Econometrica*. 1980;48:817–838.
- Frandsen B, Rebitzer JB. Structuring incentives within accountable care organizations. *J Law Econ Organ*. 2015;31:77–103.
- Colla CH, Goodney PP, Lewis VA, Nallamothu BK, Gottlieb DJ, Meara E. Implementation of a pilot accountable care organization payment model and the use of discretionary and nondiscretionary cardiovascular care. *Circulation*. 2014;130:1954–1961. doi: 10.1161/CIRCULATIONAHA.114.011470.
- Schwartz AL, Cherner 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;175:1815–1825. doi: 10.1001/jamainternmed.2015.4525.
- Colla CH, Lewis VA, Shortell SM, Fisher ES. First national survey of ACOs finds that physicians are playing strong leadership and ownership roles. *Health Aff (Millwood)*. 2014;33:964–971. doi: 10.1377/hlthaff.2013.1463.
- Centers for Medicare & Medicaid Services, HHS. Medicare program; Medicare shared savings program; accountable care organizations—revised benchmark rebasing methodology, facilitating transition to performance-based risk, and administrative finality of financial calculations. Final rule. *Fed Regist* 2016;81:37949–8017.
- Schwartz AL, Landon BE, Elshaug AG, Cherner ME, McWilliams JM. Measuring low-value care in Medicare. *JAMA Intern Med*. 2014;174:1067–1076. doi: 10.1001/jamainternmed.2014.1541.