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Risk adjustment in Medicare ACO program deters coding increases but may lead ACOs to drop high-risk beneficiaries

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Abstract

The Medicare Shared Savings Program (MSSP) adjusts savings benchmarks by beneficiaries' baseline risk scores. To discourage increased coding intensity, the benchmark is not adjusted upward if beneficiaries' risk scores rise while in the MSSP. As a result, accountable care organizations (ACOs) face an incentive to avoid increasingly sick or expensive beneficiaries. We examined whether beneficiary exposure to the MSSP was associated with within-beneficiary changes in risk score and whether risk score was associated with entry and exit in the MSSP. We found that the MSSP was not associated with consistent changes in within-beneficiary risk score. Conversely, the highest-risk beneficiaries (99th percentile of risk score) had a 25.1% chance of exiting the MSSP compared to a 16.0% chance among median risk beneficiaries (50th percentile). The decision to not upwardly adjust risk score in the MSSP has successfully deterred coding increases but may have led ACOs to avoid high-risk beneficiaries.

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Keywords

Health Care Reform; Health Care Costs; Quality of Health Care; Medicare; Accountable Care Organizations

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Introduction

Encouraging organizations to care for high-risk beneficiaries while holding them accountable for spending and health outcomes is a central tension of payment reform.¹ In the Medicare Shared Savings Program (MSSP), accountable care organizations (ACOs) are eligible to receive shared savings bonuses if they lower spending below a financial benchmark based on the historical spending of the beneficiaries attributed to the ACO. To avoid penalizing ACOs that care for beneficiaries with greater medical complexity and predicted spending, an ACO's financial benchmark is adjusted using each beneficiary's Hierarchical Condition Category (HCC) risk score. To minimize ACOs' incentives to raise benchmarks by increased diagnostic coding, the benchmark is not adjusted upward if the risk score rises while the beneficiary is in the MSSP.^{2–4} If the risk score falls, however, the benchmark is adjusted downward.

It is unknown if the Centers for Medicare and Medicaid Services (CMS) approach to risk adjustment has appropriately balanced incentives for ACOs to care for high-risk beneficiaries against incentives to avoid increased coding intensity in the MSSP. Because CMS' approach does not capture growth in risk score over time, many commenters expressed concern during rulemaking that ACOs retain an incentive to avoid chronically or acutely ill beneficiaries.^{2–4} For instance, ACOs may deliberately drop clinicians with high-risk beneficiary panels.⁵ ACOs may also prevent high-risk beneficiaries from being attributed to their ACO by submitting claims that cannot lead to attribution, submitting claims from a provider ineligible for participation in the MSSP (e.g., urologists), or billing under a provider group not included in the ACO's Provider Participant List.

At the same time, ACOs face an incentive to maintain their current levels of coding intensity. Consider a beneficiary with diabetes and depression and average total Medicare spending of \$10,986.⁶ If the ACO documents both conditions (diabetes without complication and major depressive, bipolar, and paranoid disorders) in the baseline year the beneficiary's risk score would be 0.847 (slightly below the average risk of 1). If the ACO then fails to document depression in the subsequent year, the beneficiary's risk score would fall to 0.524.⁷ As a result, the spending benchmark for the beneficiary would fall by \$3,342 ($\$10,348 \times (0.524 - 0.847)$) and the ACO could forego up to \$1,671 in shared savings (50% of \$3,342).

To evaluate the impact of this risk adjustment policy, we used national Medicare data from 2008 through 2014 to examine the relationship between beneficiary "exposure" to the MSSP (beneficiary attribution to an MSSP ACO) and beneficiary risk profiles for the years 2012–2014. We assessed changes in coding intensity by evaluating whether beneficiary exposure to the MSSP was associated with within-beneficiary changes in risk score over time. A positive association would imply that the MSSP was associated with greater coding intensity. We assessed favorable risk selection by evaluating whether beneficiary risk score

and risk growth was associated with entry and exit of beneficiaries and clinicians to and from the MSSP. A positive association would indicate that beneficiaries with greater severity were more likely to enter or exit the MSSP.

Methods

Data Sources and Study Population.

We used national claims data from 2008 through 2014 for a random 20 percent sample of beneficiaries in Fee-for-Service (FFS) Medicare. To ensure accurate designation of MSSP participation, we attributed beneficiaries and clinicians to MSSP ACOs using CMS' Provider- and Beneficiary-level Shared Savings Program files (2012–2014). The MSSP program began in 2012.

We constructed a cohort of Medicare beneficiaries who were continuously enrolled in FFS Medicare from 2008–2014. Following MSSP specifications, we excluded beneficiaries enrolled in Medicare Advantage or not enrolled in Medicare Parts A and B.⁸ In order to ensure consistent identification of within-beneficiary risk score changes over time, we excluded beneficiaries who died or had missing risk scores in any year of the study. This also ensured that MSSP exit was not an artifact of beneficiary death. To improve comparability between MSSP and non-MSSP beneficiaries, we excluded beneficiaries who resided outside of a hospital referral region or lacked any eligible primary care claims required for MSSP attribution in any year of the study (Exhibit A1 in the Online Appendix⁹).

Measures.

CMS derives a single HCC risk score for each Medicare beneficiary to predict spending in the subsequent year.¹⁰ The risk score incorporates both diagnostic information in claims data (subsequently classified into HCCs) and demographic information (including age, sex, Medicaid dual eligibility, and disability). CMS adjusts MSSP beneficiary risk scores retrospectively, meaning, for example, that a risk score used to adjust 2014 payment is based on a beneficiary's 2013 claims data. In this study, we based risk scores on same-year data to capture contemporaneous changes in risk score associated with MSSP exposure.

We defined exposure to the MSSP using a time-varying indicator for cumulative time attributed to an MSSP ACO. This captured ACOs' staggered entry into MSSP contracts (April 2012, July 2012, January 2013, January 2014) and the ability of beneficiaries to enter and exit MSSP ACOs each year. We used the CMS Master Beneficiary Summary File to define beneficiary age, sex, race/ethnicity (white, black, Hispanic, or other/unknown), original reason for Medicare entitlement (aged, disability, end-stage renal disease), and dual-eligibility for Medicaid (months of enrollment). Due to reports that risk scores have increased more among beneficiaries in Medicare Advantage than in FFS Medicare,^{11–14} we adjusted for average county-level Medicare Advantage penetration (share of Medicare beneficiaries). We used American Community Survey data to define area-level poverty and education. We used the Shared Savings Program Public-Use File to define whether the ACO earned shared savings (yes/no) and the Leavitt Partners ACO Database to define ACO

organizational structure (physician-led, hospital-led, or physician-hospital partnership) and concurrent entry in a commercial ACO contract (yes/no).

Analyses.

We first tested for changes in coding intensity by evaluating the association between beneficiary MSSP exposure and within-beneficiary changes in risk score over time. We estimated a linear regression model that included a time-varying indicator of cumulative MSSP exposure, beneficiary fixed effects, year fixed effects (to control for secular trends), and time-varying area-level characteristics. By using beneficiaries as their own controls, these models controlled for fixed, unobserved differences across beneficiaries that may confound the relationship between MSSP exposure and risk score. We performed two sensitivity analyses. First, to better isolate the effect of coding practices on risk score, we estimated changes in the component of the risk score originating from provider-reported diagnoses (count of condition categories), thus excluding the components originating from administrative data (e.g., age, sex, disability). Second, because ACOs also face an incentive to lower spending, we evaluated changes in risk scores normalized by total price-standardized spending.

We next assessed whether MSSP ACOs engage in favorable selection – avoid high-risk beneficiaries or clinicians with high-risk patient panels – by examining the relationship between beneficiary risk score and subsequent beneficiary exit from the MSSP. We estimated exit as a function of prior-year risk score, market fixed effects (defined by hospital referral region), year fixed effects, and beneficiary characteristics. Beneficiaries who transitioned between different ACOs in the MSSP were treated as remaining in the MSSP.

We performed sensitivity analyses to determine whether exit was more likely driven by limitations to MSSP attribution or limitations to MSSP risk-adjustment. Limitations to attribution refers to passive “leakage” of beneficiaries who become acutely sick and receive care exclusively from non-ACO specialists or post-acute care facilities. If exit was driven by passive leakage to non-ACO specialists or post-acute care facilities, we would expect lower levels of high-risk beneficiaries with eligible outpatient claims from primary care clinicians or who were attributed to ACOs offering greater specialty care (e.g., hospital-led ACOs). Limitations to risk-adjustment refers to ACOs avoiding high-risk beneficiaries or clinicians with high-risk patient panels. If ACOs were dropping clinicians with high-risk patient panels, we would expect an association between clinicians’ average patient panel risk score and the probability of clinician exit from the MSSP. (More details on our methods for these sensitivity analyses are contained in the online Appendix⁹).

We then investigated the impact of CMS’ decision against upward adjustment of spending benchmarks. Among those ACOs beginning in 2012, we compared growth in risk score across beneficiaries who were never in the MSSP, always in the MSSP, entered the MSSP in 2014, or exited the MSSP in 2014. This classification scheme followed a recent report by the Medicare Payment Advisory Commission.¹⁵ We used a linear spline model with splines capturing changes across two periods: 2012–2013 and 2013–2014. These models included MSSP status (always, never, entered, exited) and interactions between MSSP status and the

two splines. Models also controlled for beneficiary characteristics, and market and year fixed effects.

Finally, we performed a decomposition analysis to assess the relative contribution to MSSP exit of risk score growth and non-increasing risk score levels. We estimated beneficiary exit in the year 2014 as a function of risk score growth (2012–2014), prior-year risk score (2013), beneficiary characteristics, and market and year fixed effects. We also performed an analogous decomposition analysis of clinician exit.

All analyses specified robust standard errors to account for clustering at the market level. Statistical analyses were performed using Stata version 15.1. Our study using administrative data was deemed exempt from review by the University of Michigan Institutional Review Board.

Limitations.

First, administrative data cannot be used to determine whether risk score changes reflect changes in health status, health care utilization, or coding practices. It is possible that ACOs have both improved health and lowered utilization (lowering risk score) and increased coding intensity (raising risk score), with uncertain net effects. Nonetheless, results from our main analysis were comparable to sensitivity analysis using risk scores normalized by price-standardized spending (Exhibit A2 in the Online Appendix⁹).

Second, although our analysis of risk score changes controlled for fixed differences between MSSP and non-MSSP beneficiaries, time-varying confounding is a threat. For instance, MSSP exit by high-risk beneficiaries would create a negative association between MSSP exposure and risk score, inducing a downward bias and underestimation of the true effect of MSSP exposure on risk score. Our use of cumulative MSSP exposure reduces but does not eliminate this bias. Third, historical data ending in 2014 may not generalize to today's ACOs. It is possible that the relationship between the MSSP and beneficiary risk profiles has changed in the intervening years. Finally, results may also not generalize to younger beneficiaries or those that move in and out of FFS Medicare and the health system more generally.

Results

Beneficiary MSSP attribution and risk profiles.

There were 1,980,661 beneficiaries in our sample who contributed 13,864,627 beneficiary-years from 2008 through 2014. By the end of 2014, 21.4% of beneficiaries had been attributed at some point to the MSSP, with MSSP beneficiaries exposed to the program for an average of 1.65 years.

Unadjusted differences in baseline characteristics between MSSP and non-MSSP beneficiaries were typically small, though MSSP beneficiaries resided in areas with higher education and lower poverty (Exhibit 1). The average risk score in the pre-period (2008–2011) was 1.06. Pre-period trends in adjusted risk score were similar between MSSP and non-MSSP beneficiaries (Exhibits A3 and A4 in the online Appendix⁹). Because we

required enrollment in FFS Medicare for each year of the study, beneficiaries in our sample were more likely to have become entitled to Medicare due to old age rather than end-stage renal disease or disability and were thus older than excluded beneficiaries (Exhibit A5 in the Online Appendix⁹).

Change in within-beneficiary risk score.

Overall, MSSP exposure was not associated with changes in risk score (Exhibit 2). MSSP exposure was associated with change in average risk score among beneficiaries entering the MSSP in 2014 (1.1 percent increase) but not 2012 or 2013. (Exhibit 2 and Exhibit A6 in the Online Appendix⁹). Changes in risk score also varied according to Medicare Advantage penetration, with MSSP participation associated with a 0.6% increase in risk score among beneficiaries residing in areas with high penetration by Medicare Advantage plans. The relationship between MSSP exposure and beneficiary risk score did not vary based on ACO shared savings, organizational structure, or having a concurrent commercial ACO contract.

Overall, we observed a similar pattern non-significant associations among all patients and significant associations among subgroups in sensitivity analyses using condition category counts or risk scores normalized by price-adjusted spending (Exhibit A2 in the Online Appendix⁹).

Beneficiary exit from the MSSP.

Beneficiary exit from MSSP ACOs was not uncommon (Exhibit 1). Of the 245,239 beneficiaries attributed to the MSSP in 2012 or 2013, 40,428 (16.4%) exited the MSSP in 2014. Exhibit 3 shows the relationship between beneficiary risk score and subsequent exit from the program. Beneficiaries at the 95th percentile of risk score in the prior year had a 21.6% chance of exiting an MSSP ACO in the subsequent year, as compared to a 16.0% chance among beneficiaries at the median risk score. The difference of 5.7 percentage points was statistically significant. (Exhibit A6 in the Online Appendix⁹).

The magnitude of the association between beneficiary risk and exit from the MSSP was similar across a number of patient and ACO characteristics in sensitivity analysis. (Exhibits A7 and A8 in the Online Appendix⁹). Sensitivity analysis also showed a similar magnitude of association among beneficiaries who were attributed to ACOs via claims submitted by primary care physicians in the outpatient setting and a similar magnitude of association when beneficiary risk was defined using data from prior years (Exhibit A8 in the Online Appendix⁹).

Moreover, beneficiary risk was not associated with entry into the MSSP (Exhibits A7 and A8 in the Online Appendix⁹).

Because beneficiary risk 1) maintained a similar association with exit across patients who were attributed via outpatient claims from primary care physicians and remained similar when risk was defined using prior years of data; and 2) was not associated with MSSP entry, these results suggest that MSSP exit among high-risk beneficiaries does not represent passive leakage through beneficiary “churn.”

Clinician exit also appeared to drive exit of high-risk beneficiaries from the program (Exhibit A9 in the Online Appendix⁹). Clinicians at the 95th percentile of the average panel risk score had a 20.6% chance of exiting an MSSP ACO, compared to a 16.0% chance among clinicians at the median panel risk score. The difference of 4.5 percentage points was statistically significant.

Change in MSSP risk profile composition.

Beneficiaries who exited MSSP ACOs demonstrated the highest risk score growth prior to exit (2012–2013) and following exit (2013–2014) (Exhibit 4 and Exhibit A10 in the Online Appendix⁹). Compared to beneficiaries always in the MSSP, exiting beneficiaries had risk score growth that was 4.9 percentage points higher prior to exit and 3.1 percentage points higher following exit. Compared to beneficiaries always in the MSSP, entering beneficiaries also demonstrated risk score growth that was 2.2 p.p. higher prior to entry and 1.6 p.p. higher following entry. When directly comparing exiting vs. entering beneficiaries, exiting beneficiaries had risk score growth that was 2.7 p.p. in 2012–2013 and 1.5 p.p. higher in 2013–2014. These risk growth differences between beneficiaries exiting and entering the MSSP are large, representing a 71% increase relative to overall risk score growth in 2012–2013 and 27% increase in 2013–2014. Because the MSSP does not allow for increases in patient risk, this suggest that exiting beneficiaries were making shared savings more challenging for ACOs.

In our decomposition analysis, we found that 73% of beneficiary exit was due to higher risk score growth in MSSP beneficiaries compared to non-MSSP beneficiaries, and 27% was due to higher risk score levels. Conversely, 44 percent of clinician exit was due to higher risk score growth (in clinician MSSP patient panels) and 56% of clinician exit was due to risk score levels. (Exhibit A11 in the Online Appendix⁹).

Discussion

In this national cohort study of Medicare beneficiaries, we found limited evidence that exposure to the MSSP increased within-beneficiary risk score. At the same time, we found that high-risk beneficiaries and clinicians with higher-risk patient panels were disproportionately likely to exit MSSP ACOs. MSSP exit was particularly concentrated among beneficiaries with increased risk score growth while in the MSSP and following exit from the program. These findings suggest that the current system of risk adjustment may have successfully deterred coding increases but not adequately encouraged ACOs to care for high-risk beneficiaries in the MSSP.

To our knowledge, this is the first comprehensive analysis of within-beneficiary changes in coded risk in the MSSP. Much more attention has been paid to coded risk in Medicare Advantage, where use of HCC risk scores to adjust capitated payments has been associated with substantial increases in coded risk and billions of taxpayer dollars in potential overpayment to Medicare Advantage plans.^{11–14} In FFS Medicare, the introduction of the Physician Group Practice demonstration - an early model for ACOs-was associated with increases in risk coding.¹⁸

Several features of the MSSP may limited its association with coded risk. First, in contrast to Medicare Advantage plans, beneficiary risk in ACOs is determined by submitted claims. ACOs are not able to increase coded risk through health risk assessments in enrollee's homes and perform retrospective reviews of medical charts.¹³ Because ACOs are not sure who will be attributed to them, retrospective attribution of beneficiaries to MSSP ACOs may hamper organizational efforts to target coding.⁴ Also, the high rates of MSSP exit and entry we uncovered may impede organizations' ability to systematically intensify coding.

MSSP ACOs may also face weakened incentives to intensify coding. Discouraging coding intensification is the explicit motivation underlying CMS' decision to not adjust risk scores upward.²⁻⁴ The spread of risk-based contracts across public and private insurance has raised the salience of coding for all providers,¹ reducing the incentive to increase coding for MSSP beneficiaries. Our finding that coded risk increased among MSSP beneficiaries in areas with high Medicare Advantage penetration suggests that MSSP incentives may depend on organizations' coding expertise and ability to spread fixed costs of coding initiatives. It is also possible that early MSSP ACOs were more focused on basic operational and technical hurdles in the initial years of the program and have only recently shifted attention to coding practices as they gained experience and partnered with management consultants.¹⁹ Although our data end in 2014, the finding that within-beneficiary risk scores increased among beneficiaries entering the MSSP in 2014 supports this possibility.

ACOs and other stakeholders expressed concern during final rulemaking that CMS' failure to upwardly adjust beneficiary risk may cause ACOs to avoid high-risk beneficiaries in the MSSP.²⁻⁴ However, ours is the first study to empirically evaluate this question using national data. We found that high-risk beneficiaries and clinicians with high-risk patient panels were more likely to exit the MSSP. Our results are consistent with a recent study by Hsu and colleagues, who found that clinicians with high-risk patient panels were more likely to exit Partners HealthCare Pioneer ACO.⁵

Why are high-risk beneficiaries more likely to exit MSSP ACOs? One possible explanation is the MSSP attribution methodology. Attribution to an MSSP ACO will stop for beneficiaries who "leak" out of the ACO – become acutely-ill and move to the care of non-ACO specialists or post-acute care.²⁰ However, we found the association between beneficiary risk and exit was similar beneficiaries who remained eligible for ACO attribution on the basis of claims from primary care providers. Beneficiary leakage would also not account for our finding that clinicians with high-risk panels were also more likely to exit the MSSP. The exit of ACOs out of the MSSP also has the potential to disproportionately affect high risk beneficiaries. However, because the MSSP began in 2012, our study period ended in 2014, and ACOs sign three year contracts, the exit of entire ACOs could not explain our findings.

An alternative explanation is the MSSP's risk adjustment system. For instance, ACOs may strategically drop high-risk beneficiaries or clinicians with high-risk patient panels to decrease measured spending and increase the likelihood of earning shared savings. Because the MSSP does not upwardly adjust risk scores following ACO attribution, beneficiaries with worsening health challenge ACOs to meet savings targets.

Because ACOs can contract with different clinicians each year, ACOs could improve their risk profile by dropping clinicians with higher-risk patient panels.^{2–5} ACOs may also exploit the MSSP's retrospective attribution methodology to prevent high-risk beneficiaries from being attributed. ACOs could do this by only submitting claims that aren't counted toward MSSP attribution or by billing under a provider group not included in its ACO Participant List, such as a skilled nursing facility. Regardless of the mechanism, exit from the MSSP threatens policy efforts to improve the efficiency and quality of care for high-risk beneficiaries.

Policy Implications.

The tension between adequate risk adjustment and inappropriate coding practices will increase as the MSSP transitions to regional benchmarks (which will incorporate into the benchmark spending for more diverse patient populations) and two-sided risk contracts (in which ACOs are penalized for not meeting a benchmark).⁴ To strengthen incentives to care for beneficiaries who become much sicker after ACO attribution, CMS could consider upward adjustment of risk scores while capping changes at plus or minus three percent, as in the Next Generation ACO model. However, this may not alter selection incentives if and when most ACOs reach this cap. CMS could also incorporate other sociodemographic factors that predict spending but are less subject to coding practices, e.g., race, education, area-level poverty.^{21–23} However, our decomposition analysis suggests that beneficiary exit from the MSSP is more strongly associated with risk score growth compared to levels, and stable sociodemographic characteristics may not capture changes to health status. Instead, CMS could adjust for growth in patient risk score in the years prior to MSSP attribution. This may mitigate the coding intensification²⁴ while preserving incentives to care for beneficiaries with worsening health.^{11–14} To minimize under-coding of new ACO beneficiaries and incentives to increase coding among already-attributed beneficiaries, CMS should develop a risk score validation system that makes coding more consistent across the MSSP while also lessening incentives to code more intensely.^{2–4,11}

In addition to reducing incentives to engage in favorable selection, CMS should make it more difficult for ACOs to drop high-risk beneficiaries or their clinicians. Prospective attribution – used in the Next Generation and MSSP Track 3 models – would prevent ACOs from avoiding beneficiaries during the performance year and prior to attribution. Likewise, CMS could fix ACOs' Participant List across the length of the three-year MSSP contract instead of allowing ACOs' to deliberately select clinicians year-to-year.⁵

Conclusion.

This study contributes important evidence to ongoing discussions about the role of risk adjustment in alternative payment models. Our results suggest that the current risk adjustment system has successfully deterred coding increases but may not adequately encourage ACOs to care for high-risk beneficiaries in the MSSP. As MSSP and other Medicare ACOs expand, it will be important to achieve a balance between preventing inappropriate coding increases and ensuring that high-risk beneficiaries are cared for in the MSSP.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Characteristic

Average change

MSSP Cohort

2012

2013

2014

Earned shared savings

No

Yes

High Medicare Advantage area

No

Yes

Commercial ACO contract

No

Yes

Organizational structure

Physician-led

Hospital-led

Physician-hospital partnership

Exhibit 2.

Caption: Association between attribution to the Medicare Shared Savings Program and within-beneficiary change in risk score

SOURCE: Authors' analysis of 2008–2014 data from: 20% sample of Medicare claims; the American Community Survey; CMS' Beneficiary-level Shared Savings Program File; Leavitt Partners ACO Database; CMS' Shared Savings Program Public-Use File.

Notes: Models used risk score values derived from claims in the same year to capture contemporaneous associations between MSSP exposure and risk score. High Medicare Advantage penetration was defined as residing in a county ranking at or above the 80th percentile for share of beneficiaries enrolled in Medicare Advantage. The error bars indicate 95% confidence intervals. MSSP is Medicare Shared Saving Program. ACO is accountable care organization. HCC is Hierarchical Condition Category.

Exhibit 3.

Caption: Association between risk score and change in probability of beneficiary exiting the Medicare Shared Savings Program

SOURCE: Authors' analysis of 2012–2014 data from: 20% sample of Medicare claims; the American Community Survey; CMS' Beneficiary-level Shared Savings Program File.

Notes: Analyses of MSSP exit were restricted to beneficiaries attributed to the MSSP in the year prior to analysis. Analyses were restricted to ACOs entering MSSP contracts in 2012 or 2013, as, as we could not observe exit from 2014 ACOs using 2008–2014 data. Probability of exit was estimated as a function of prior-year risk score, market fixed effects, year fixed effects, beneficiary characteristics, and a quadratic risk score term (to allow for potential non-linearity).

Exhibit 4.

Caption: Growth in risk score and beneficiary entry and exit to and from the Medicare Shared Savings Program from 2012–2014

SOURCE: Authors' analysis of 2012–2014 data from: 20% sample of Medicare claims; the American Community Survey; CMS' Beneficiary-level Shared Savings Program File.

Notes: Analyses were restricted to ACOs entering MSSP contracts in 2012 or 2013, as, as we could not observe exit or entry to or from 2014 ACOs using 2008–2014 data. Differences in risk score growth were examined using a linear spline model that included market fixed effects, year fixed effects, beneficiary characteristics, beneficiary MSSP status, and splines for the years 2012–2013 (when no entry or exit occurred) and 2013–2014 (when entry or exit could occur), and an interaction between MSSP status and the two splines. We then tested for differences in risk score growth estimated from this fully-interacted spline model.

Exhibit 1

Characteristics of Medicare beneficiaries by inclusion in Medicare Shared Savings Program (MSSP) accountable care organizations (ACOs)

Beneficiary characteristics	All non-MSSP Beneficiaries (N=1,555,308)	All MSSP Beneficiaries (N=425,353)	Beneficiaries Always in MSSP (N=205,811)	Beneficiaries Who Entered MSSP in 2014 (N=72,861)	Beneficiaries Who Exited MSSP in 2014 (N=40,428)
	Unadjusted mean	Unadjusted mean	Unadjusted mean	Unadjusted mean	Unadjusted mean
Age, years	74.2	74.6	74.7	74.5	74.4
Female	60.7%	60.8%	60.7%	61.2%	61.2%
Race/Ethnicity ^c					
Non-Hispanic white	86.1%	86.4%	87.4%	86.4%	86.2%
Non-Hispanic black	7.2%	6.9%	6.3%	6.4%	7.1%
Hispanic	3.7%	3.7%	3.2%	4.2%	4.1%
Other	3.0%	2.9%	3.1%	3.0%	2.7%
Dual-eligibility for Medicaid (months per year) ^d	1.8	1.6	1.6	1.7	1.8
Disability ^e	20.2%	18.1%	17.4%	19.2%	20.2%
End-stage renal disease ^f	0.4%	0.4%	0.4%	0.6%	0.5%
Area-level characteristics					
Medicare Advantage ^g	22.3	22.5	22.8	21.8	22.3
Below federal poverty level ^h	14.0	12.6	12.5	12.6	12.5
With high school degree ^h	27.7	30.6	30.4	30.8	30.9
With college degree ^h	86.3	87.5	87.7	87.6	87.6
Beneficiary outcomes					
HCC risk score ^a	1.160	1.154	1.131	1.202	1.243
Total annual spending, \$ ^b	7,485	7,420	7,133	8,017	8,437

SOURCE: Authors' analysis of 2008–2014 data from: 20% sample of Medicare claims and the American Community Survey.

NOTES:

MSSP beneficiaries were defined as beneficiaries who were ever attributed to the MSSP during 2014. Non-MSSP beneficiaries were never attributed to the MSSP. Comparisons of beneficiaries who were always in the MSSP (through 2014), entered the MSSP or exited the MSSP were restricted to ACOs entering MSSP contracts in 2012 or 2013 as we could not observe exit from 2014 ACOs using 2008–2014 data.

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HCC risk scores were calculated using Medicare demographic and diagnostic data from the prior year's enrollment and claims files. Higher HCC risk scores indicate higher predicted spending in the present year. The risk score for the average beneficiary is 1.

Total spending was the sum of spending for inpatient, outpatient, professional, and skilled nursing facility services and was price-standardized.