

# Tacking Upwind: Reducing Spending Among High-risk Commercially Insured Patients

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**M**edical spending growth remains a major threat to the sustainability of the health care system in the United States.<sup>1,2</sup> Accountable care organization (ACO) contracts seek to better align payer and provider incentives. An estimated 40 million-plus Americans are part of an ACO, and 60% of these individuals are in a commercial ACO.<sup>3,4</sup> The literature on altering spending growth for commercially insured, working-aged adults has yielded mixed results,<sup>5-11</sup> with limited data on the extent to which commercial ACOs achieve financial benefits through improving health outcomes rather than discouraging utilization.

Much of the favorable ACO evidence with respect to cost savings has come from the traditional, fee-for-service Medicare program (eg, Medicare Pioneer ACO). The relevance of these Medicare ACO findings is questionable given program and population differences between traditional Medicare and those of commercial insurance plans.<sup>12</sup> For example, employer-based commercial insurance plans cover working-aged persons and their dependents, who tend to be much younger and have lower spending and hospitalization rates compared with Medicare beneficiaries.

The ACO contract in theory both aligns the incentives of the provider organization with those of the payer and society writ large and shapes the incentive framework within which the organization makes investment and organizational decisions. In a well-designed contract, the ACO has incentives to improve the health of the patient population but fewer incentives to reduce spending by skimping on care or manipulating the risk pool. One additional challenge of commercial ACO contracts is that the patient population tends to be considerably younger and healthier than that of Medicare ACO contracts, which could affect the numbers of patients with high predicted levels of spending or the frequency of mutable sources of spending among these patients.

Indeed, the literature on the impact of commercial ACO contracts on spending growth has been mixed.<sup>5-11</sup> Moreover, early studies have focused on individuals who are continuously enrolled in an ACO, who could differ from those who leave the ACO.<sup>5</sup> Some ACOs also appear to have reduced spending by switching to lower-cost suppliers or providers; such price reductions alone

## ABSTRACT

**OBJECTIVES:** The study examined a commercial accountable care organization (ACO) population and then assessed the impact of an integrated care management program on medical spending and clinical event rates.

**STUDY DESIGN:** Retrospective cohort study of high-risk individuals (n = 487) in a population of 365,413 individuals aged 18 to 64 years within the Mass General Brigham health system who were part of commercial ACO contracts with 3 large insurers between 2015 and 2019.

**METHODS:** Using medical spending claims and other enrollment data, the study assessed the demographic and clinical characteristics, medical spending, and clinical event rates of patients in the ACO and its high-risk care management program. The study then examined the impact of the program using a staggered difference-in-difference design with individual-level fixed effects and compared outcomes of those who had entered the program with those of similar patients who had not entered.

**RESULTS:** The commercially insured ACO population was healthy on average but included several hundred high-risk patients (n = 487). After adjustment, patients within the ACO's integrated care management program for high-risk patients had lower monthly medical spending (by \$1361 per person per month) as well as lower emergency department visit and hospitalization rates compared with similar patients who had yet to start the program. Accounting for early ACO departure decreased the magnitude of the program effects as expected.

**CONCLUSIONS:** Commercial ACO populations may be healthy on average but still include some high-risk patients. Identifying which patients might benefit from more intensive care management could be critical for reaping the potential savings.

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may be difficult to sustain or unlikely to alter longer-term spending growth.<sup>13</sup> Although an ACO contract applies to a defined population and creates incentives for the health care organization, the ACO also must account for the underlying levels and types of turnover within the population while determining investments in new programs or additional care processes.<sup>14</sup> Any care management intervention initiated in the context of an ACO should then be assessed on an ongoing basis to determine whether health outcomes are improved while spending is mitigated, conditional on changes in the population. This is analogous to losses during follow-up in a clinical trial of a new investigation; differential losses across study arms create a serious competing risk, and substantial equal losses within the trial raise concerns about the relevance of the intervention and generalizability of the findings. To date, specific care intervention programs within commercial ACOs have not been evaluated. Our objective was to evaluate the effects of a care management program within the context of the ACO.

In this study, using data from one of the largest commercial ACOs in the United States, we examined the characteristics of the commercial ACO population and a high-risk subgroup. We then examined the impact of an integrated care management program for the high-risk group on medical spending and clinical event rates while accounting for ACO departures.<sup>12,15,16</sup> The analyses help address whether care improvements and investment in intensive care management programs represent a feasible strategy for reducing spending growth within commercial ACO populations.

## METHODS

### ACO Population

The study population included all individuals within the Mass General Brigham (MGB) health system who received health insurance from any 1 of the 3 largest contracted commercial insurers. MGB is a large academic health system providing care in Massachusetts and surrounding states.<sup>17</sup> The ACO structure and health care delivery system are the same across all ACOs, and the ACO contracts and incentives are largely similar across insurance types.

We included all individuals who entered the risk contract from 2015 to 2019. Individuals could join the ACO at any point during the year with a qualifying insurance change. After 2015, the commercial risk contracts included multiple plan types (eg, health maintenance organizations, preferred provider organization, point of service). For all risk contracts, the health plans provided complete medical claims for individuals within the risk population, including claims for care provided outside of the MGB system; however, there were no systematic claims data from before ACO entry.

To minimize the inclusion of patients with overlapping noncommercial insurance, we restricted our population to patients 64 years

or younger. We then excluded pediatric patients (< 18 years) because MGB pediatric care management was in a nascent stage during the study period.

### ACO's Integrated Care Management Program for High-risk Patients

As part of a Medicare demonstration program starting in 2006, MGB created a primary care practice–based integrated care management program for high-risk Medicare beneficiaries, supplementing care through care managers.<sup>17</sup> Details evaluating the Medicare program are available in published articles.<sup>12,18,19</sup> MGB later extended the program to younger, commercially insured patients.

Since its inception, the program has provided care to more than 40,000 patients.<sup>20</sup> The care managers perform the following main functions: (1) assess patients for unmet care needs; (2) outline and implement care plans; (3) educate patients regarding emergency department (ED) avoidance strategies (eg, urgent care or telehealth options); (4) connect patients with appropriate community resources; (5) connect with inpatient care managers to ensure safe discharge planning; (6) conduct follow-up visits post discharge; and (7) partner with primary care physicians to improve patient engagement in ambulatory care. The care managers are supported by ancillary staff, including pharmacists and community resource specialists. Previously, we assessed the impact of this program on Medicare ACO beneficiaries.<sup>12,18,19</sup>

### Patient Identification

Each year, the health system identified a subgroup of the ACO population that was at risk for high levels of spending and hospitalizations. Eligibility criteria for this study included the following: (1) coverage through a group health insurance plan offered by 1 of 3 main insurers in Massachusetts starting in 2015-2019 and (2) being 18 years or older but younger than 65 years at the time of ACO entry.

The integrated high-risk care management program sought to systematically identify patients who had substantial illness burden and high levels of predicted spending, which could be amenable to care improvements. Specifically, during the study period, the ACO would risk-stratify all patients once annually using a sophisticated algorithm to identify high-risk patients using variables such as presence of chronic medical conditions, health care utilization

## TAKEAWAY POINTS

Although commercial accountable care organization (ACO) populations might be healthy on average, some individuals might benefit from programs for high-risk patients. Identifying this subset of patients could be critical for reducing spending.

- ▶ The ACO population included several hundred patients who were substantially sicker than the overall population.
- ▶ For these patients, entry into an integrated care management program was associated with decreased spending and rates of unfavorable clinical events compared with outcomes for patients who had not yet entered the program.
- ▶ Longer duration in the program yielded greater reductions in spending and clinical event rates.

patterns, and risk of having increased spending. The aim was to identify patients likely to have high levels of future medical spending whose spending was potentially mutable given improvements in care management. Details on the identification of candidates are available in published articles.<sup>15,16</sup>

After generating this high-risk list, each patient's primary care team reviewed the list to further assess mutability and fit for the program. As each primary care team completed their review, care managers received the names of patients who met the entry criteria for the integrated care management program; the care managers did not receive information from the identification process (ie, they did not receive individual patient spending risk level or mutability information). Care managers set up individual assessments with each patient to review their specific medical and social needs and to develop a management plan with the goal of assessing all eligible patients during the next year. We found no association between the order of the assessments and predicted spending levels, which is consistent with using a level playing field approach for starting the program among eligible patients. However, there were additional sources of variation, including capacity constraints such that individuals might not automatically be entered into the program even if eligible.

## Analysis

We first examined the characteristics of the ACO population, tracking the year of entry and months of ACO membership. We then identified the patients who were eligible for the care management program and again tracked the timing of program entry and duration within the program. Participants could enter the ACO or care management program at any point during the study period, but they were required to be part of the ACO to enter the care management program.

Using medical spending claims and other enrollment data, we summarized demographic and clinical characteristics of patients in the ACO and in the high-risk care management program. We also calculated total medical spending, ED visit rates, and inpatient hospital admission rates per month for each individual. For the subgroup who entered the high-risk care management program, we described the patterns of these outcomes during the months preceding and following entry into the high-risk intervention program.

To assess the impact of the care management intervention, we exploited timing differences created by sequential ACO entry across years and annual risk evaluation (ie, compared high-risk participants who entered the program early vs later in time or a staggered difference-in-difference design with individual-level fixed effects as in prior analyses).<sup>12</sup>

Using linear regression models that included both individual-level and time fixed effects, we first compared outcomes among high-risk patients in the program with those who have yet to start the program. Because we sought to identify downstream clinical changes and hypothesized that such changes would require time to manifest themselves, we assessed program effects among those who were in the program 7 months or longer compared with those

who had not yet started or were in the program for 6 months or less. Importantly, this approach attempts to account for secular trends by comparing participants who entered the high-risk program earlier with those who entered later, exploiting the staggered entry into the high-risk care program over time.

Several factors affected the program entry timing, including the timing of ACO entry, discrepancies between ACO entry and the annual risk assessments, practice-level lags in review of high-risk candidates, and capacity constraints of care managers within the program. To help assess the design validity, we compared the preprogram spending trends for those entering earlier vs later using multiple approaches for differentiating between early and later entry. We compared the preprogram spending trends for those entering the program early vs later in time; we did so both visually and by using a logistic regression model with an interaction term for calendar time and timing of entry. The trends were comparable.

We also used inverse probability weighting to adjust for potential differential attrition from the ACO that could influence estimates of the impact of care management within the ACO program, because in prior work we found substantial turnover in the commercial ACO population with differential attrition with respect to risk level, and we wanted to account for any factors related to leaving that might affect program entry or the probability of having unfavorable events. Specifically, we modeled the probability of staying in the ACO for 36 months or more or the maximum possible time an individual could have remained in the ACO if their ACO entry was later than January 2017. We calculated inverse probability weights by selecting baseline predictors of remaining in the ACO and employing stepwise backward selection, removing terms with *P* values greater than or equal to .2. The final model included age, ACO start year, chronic obstructive pulmonary disease (COPD), seizure disorders, plan type, and indicators for several physician groups within the system. We then calculated the inverse probability weight (IPW) based on 1 divided by the predicted probability of staying in the ACO.

We used the IPWs in linear, fixed-effect models evaluating monthly cost and event rates for the high-risk population, accounting for time period, time-varying medical condition indicators (diabetes, cardiorespiratory failure, cancer, asthma, depression or bipolar disorder, heart arrhythmias, COPD, seizure disorders, endocrine disorders), and a time-varying pregnancy indicator.

Finally, using the above analytic approaches, we also examined changes in accidental injuries, which should not be affected by the high-risk care program (ie, a falsification test). The Mass General Brigham Institutional Review Board approved this study.

## RESULTS

### ACO Population

Between 2015 and 2019, 365,413 adults entered the ACO. As expected, the overall ACO population was relatively young (mean age, 41 years), had low spending in their first month in the ACO (mean monthly spending, \$476), and had few chronic diseases (Table<sup>21</sup>).

### High-risk Population

The ACO identified 487 individuals as being at high risk, and they entered the care management program for high-risk patients between 2015 and 2019. Compared with the broader ACO population, individuals in the high-risk program were older (mean age, 50 years), were more likely to have chronic medical and psychiatric conditions, and had higher medical spending in their month of ACO entry (mean spending, \$3381) (Table<sup>21</sup>).

Participants entering over time had comparable spending and clinical event rates prior to program entry (eAppendix Figure 1 and eAppendix Table 1 [eAppendix available at [ajmc.com](http://ajmc.com)]). In the months prior to program entry, the mean monthly spending amount was \$3719; mean monthly ED visit rates were 102 per 1000 persons and hospital admission rates were 55 per 1000 persons. More than half (59%) remained in the ACO for at least 12 months after entering the care management program (eAppendix Figure 2).

### Medical Spending in High-risk Patients

After adjustment and accounting for population losses through weighting, total monthly medical spending was \$1361 less per month for those with at least 7 months in the program (95% CI, -\$2542 to -\$181) (Figure 1<sup>21</sup>), which represents a 37% decrease in spending. No statistically significant differences in spending were associated with being in the program for 6 months or less compared with spending for those not yet in the program. As expected, ignoring the population losses yielded larger spending reductions (ie, larger effects when limiting the population to those continuously enrolled). Other sensitivity analyses yielded similar findings (eAppendix Table 2).

### Clinical Event Rates

After adjustment and accounting for population losses, ED visit rates were 50 per 1000 persons lower per month (or 0.05 per person per month) for those with at least 7 months in the program (95% CI, -80 to -20 per 1000 persons) (Figure 2<sup>21</sup>) compared with those who had not yet entered; the change represents a 47% decrease in ED visits. Hospitalization rates were 21 per 1000 persons lower per month for those with 7 months or more in the program (95% CI, -42 to -1 per 1000 persons) (Figure 2<sup>21</sup>) compared with those who had not yet entered; this change represents a 39% decrease. As with spending, ignoring the population losses yielded larger outcome reductions. Other sensitivity analyses yielded similar findings (eAppendix Table 3). There also were no statistically significant changes with respect to accidental injuries (ie, the falsification test), as expected (eAppendix Table 4).

## DISCUSSION

The commercially insured ACO population in this study was relatively young and healthy on average, as expected. The large population, however, included several hundred patients who were substantially sicker and for whom entry into an integrated care management

**TABLE.** Characteristics of Commercial ACO Members and the High-risk Subgroup<sup>21,a</sup>

Characteristic	Eligible adult commercial ACO members	High-risk subgroup
Number of participants	365,413	487
Female (%)	55%	59%
Mean (SD) age in years	41 (13)	50 (11)
Aged 18-25 years	16%	5%
Aged 26-35 years	25%	9%
Aged 36-45 years	20%	14%
Aged 46-55 years	22%	31%
Aged 56-64 years	17%	41%
Mean total spending in ACO entry month	\$476	\$3381
Mean (SD) baseline HHS-HCC entry-year risk score	1.4 (4.2)	11.1 (16.2)
% with diabetes	4%	29%
% with cardiorespiratory failure	1%	18%
% with cancer	3%	16%
% with asthma	5%	15%
% with depression/bipolar disorder	2%	13%
% with heart arrhythmias	1%	9%
% with COPD	1%	8%
% with seizure disorders	1%	6%
% with significant endocrine disorders	1%	6%
% with pregnancy	1%	1%

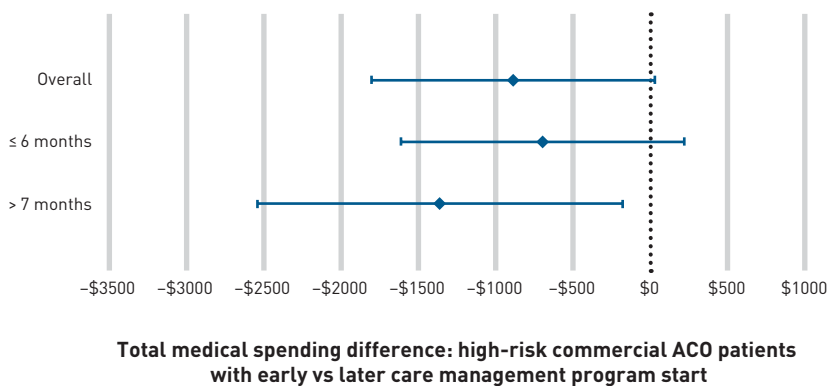
ACO, accountable care organization; COPD, chronic obstructive pulmonary disease; HHS-HCC, HHS Hierarchical Condition Category.

<sup>a</sup>The table displays the baseline characteristics of all adult commercial ACO patients and a subset identified by the ACO as being eligible for a high-risk integrated care management program. The HHS-HCC risk score refers to the HHS-HCC risk adjustment model for individual and small group commercial insurance plans,<sup>21</sup> which the federal government uses to risk-adjust premiums in commercial marketplaces. Cardiorespiratory failure includes patients with heart failure, cardiac shock, and respiratory failure.

program was associated with decreased spending and rates of unfavorable clinical events compared with outcomes for those who had not yet entered the program. No measurable changes in the outcomes occurred during the initial 6 months of being in the program, but there were sizable reductions after 7 months in the program. Many ACO members left, including high-risk patients, after entering the care management program, and the program-related changes were more modest after accounting for the ACO population losses. Prior work has demonstrated that ACO programs for Medicare patients yield significant reductions in clinical event rates and medical spending<sup>12</sup>; however, to our knowledge, this is one of the first studies demonstrating the feasibility of a targeted program within a real-world, commercially insured ACO population with attention to population stability and an intervention with prior data supporting its effectiveness (ie, a mechanism for the changes).

The number of high-risk patients within the program, however, was relatively small, representing a fraction of 1% of the overall ACO population. Nevertheless, the savings were substantial at the

**FIGURE 1.** Changes in Total Monthly Medical Spending<sup>21,a</sup>



ACO, accountable care organization.

\*The analysis compared high-risk patients who started the program early vs later, thus using the staggered program entry to help address changes in secular trends. There were 2 models: (1) comparison of monthly spending among high-risk patients in the program with those who have yet to start the program and (2) examination of monthly spending among high-risk patients who have been in the program between 1 and 6 months or those in the program for 7 or more months vs those who have yet to start the program. The individual-level fixed effects allow for measured and unmeasured time-stable factors to drop out of the analysis, thus performing a within-person analysis. The analytic model allows for chronic medical conditions and pregnancy status to change annually and includes year and month indicators. The chronic medical condition indicators are based on the HHS Hierarchical Condition Category risk adjustment model for individual and small group commercial insurance plans,<sup>21</sup> which the federal government uses to risk-adjust premiums in commercial marketplaces. The analysis also includes inverse probability weights to address early attrition from the ACO.

individual level, with a decrease of \$1361 per person per month among those with at least 7 months in the program. Indeed, the additional care for the 327 individuals present in the high-risk program for at least 7 months resulted in an estimated aggregate savings of \$445,000 per month or as much as \$2.7 million over 6 months. One important contribution of this study is the demonstration that a sizable number (albeit a small percentage) of commercial ACO members have high levels of predicted spending and that a high-risk integrated care management program developed for Medicare ACO beneficiaries translates well to these high-risk commercial ACO patients.

These results are important given challenges with extending findings from the Medicare ACO literature to a commercially insured population. For example, commercially insured patients generally have fewer chronic medical conditions compared with Medicare beneficiaries; chronic conditions represent an attractive area for improving care given the greater predictability of spending and larger evidence base regarding approaches for reducing disease exacerbations compared with acute medical conditions.<sup>22</sup> Moreover, because many commercial insurance plans employ a range of strategies to manage medical use whereas traditional Medicare arguably has few limits on use, it could be more difficult to find new opportunities to reduce spending among commercially insured vs Medicare populations.<sup>23-27</sup> Nevertheless, there were substantial reductions in spending for high-risk patients as well as reductions in downstream unfavorable clinical event rates that likely contributed to the spending reductions; thus, it was possible to make progress

with the commercially insured population and not only with the wind at one's back such as within traditional Medicare.

The extent to which this type of intervention might generalize to more patients within the commercially insured population or extend to less sick individuals is unknown. At some point, there will be diminishing returns and more uncertain value to programs for those at high risk. Indeed, these findings highlight the importance of targeting those patients who would be most likely to benefit (ie, have clinically modifiable spending) and for whom the intervention offers a favorable value.

Arguably, ACOs should create incentives for improving care and reducing expensive downstream events such as hospitalizations and not just reduce use or short-term costs. Achieving downstream savings from fewer disease exacerbations, however, would require both investments and time before benefits manifest themselves.<sup>28</sup> In a working-aged population that is relatively young and healthy, the payoff time could be long and yield could be low, in part because of the low prevalence of serious chronic illnesses and because of

limited follow-up time in this population for whom employment changes alter insurance coverage and likely result in ACO departure.

Within ACO contracts, health systems and providers could alter spending growth for the population in several other ways, including reducing access to care (eg, limiting the numbers of physicians available, restricting access to care) or finding lower-cost providers/suppliers.<sup>2,29</sup>

Employer-sponsored commercial insurance plans also could alter the benefit design (eg, raise patient cost sharing) to reduce spending growth, but patients often do not differentiate well between necessary and unnecessary care and more stringent constraints could lead to poor outcomes.<sup>23,30,31</sup> Altering benefit designs and reducing coverage generosity also could be less attractive to employers when there is greater competition for labor.<sup>32</sup>

Aligning the benefit designs with the ACO contracts, however, could help ACOs better manage the health of the population, such as requiring less cost sharing for care obtained within the ACO compared with care obtained elsewhere. Similarly, linking cost sharing with specific ACO programs (eg, reductions in cost sharing when patients adhere to protocols for contacting care managers before presenting to EDs) or even ACO tenure could align patient incentives closer to those of payers and providers.

**Limitations**

The study has several limitations. First, this study was conducted in a single state, Massachusetts, which was one of the earliest states

to expand insurance coverage and reduce spending growth; therefore, these results may not generalize to newer ACOs or states with fewer prior efforts to target spending growth. Second, this study was conducted within a single health system and ACO, although individuals received insurance from multiple insurance companies. Therefore, these results might not be generalizable to other health systems or ACOs. Third, we were unable to observe the benefit design structure or provider network associated with each individual's insurance plan, which might have affected care sought during the study period.

## CONCLUSIONS

The commercial ACO population is relatively young and healthy on average, which poses challenges in designing programs that reduce spending growth through improving medical care. Nevertheless, within these large populations, there may be a subset of patients who benefit from targeted programs to lower unfavorable downstream events and spending. In this study, entering the ACO's care management program appears to reduce relative spending among these high-risk patients, with measurable effects manifesting after several months in the program, as expected. These findings offer hope for reducing the growth of spending within commercially insured populations. Identifying which patients might benefit and paying particular attention to the duration that they remain in ACO contracts and care programs are critical for tacking upwind (ie, lowering spending growth within a population with modest average spending). ■

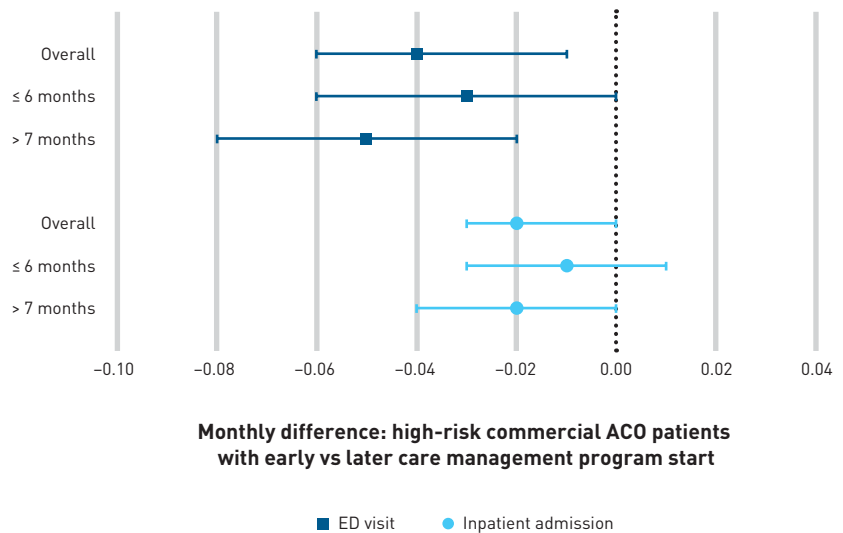
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**Authorship Information:** Concept and design (NMB, MMV, AF, LB, GSM, JH); acquisition of data (LB, GSM); analysis and interpretation of data (NMB, MP, MW, MLM, AF, LB, JH); drafting of the manuscript (NMB, MP, MMV, MLM); critical revision of the manuscript for important intellectual content (MW, CV, MMV, MLM, AF, LJ, GSM, JH); statistical analysis (NMB, MP); provision of patients or study materials

**FIGURE 2.** Changes in ED Visit and Hospitalization Rates<sup>2,1,a</sup>



ACO, accountable care organization; ED, emergency department.

<sup>a</sup>The figure displays the monthly rate differences in hospitalization (inpatient admissions or ED visits) per person per month, which in the text we convert to the rate difference per 1000 persons (eg, 0.05 fewer ED visits/person/month = 50 fewer visits/1000 persons/month). The analysis compared high-risk patients who started the program early vs later, thus using the staggered program entry to help address changes in secular trends. There were 2 models: (1) comparison of monthly spending among high-risk patients in the program with those who have yet to start the program and (2) examination of monthly spending among high-risk patients who have been in the program between 1 and 6 months or those in the program for 7 or more months vs those who have yet to start the program. The individual-level fixed effects allow for measured and unmeasured time-stable factors to drop out of the analysis, thus performing a within-person analysis. The analytic model allows for chronic medical conditions and pregnancy status to change annually and includes year and month indicators. The chronic medical condition indicators are based on the HHS Hierarchical Condition Category risk adjustment model for individual and small group commercial insurance plans,<sup>21</sup> which the federal government uses to risk-adjust premiums in commercial marketplaces. The analysis also includes inverse probability weights to address early attrition from the ACO.

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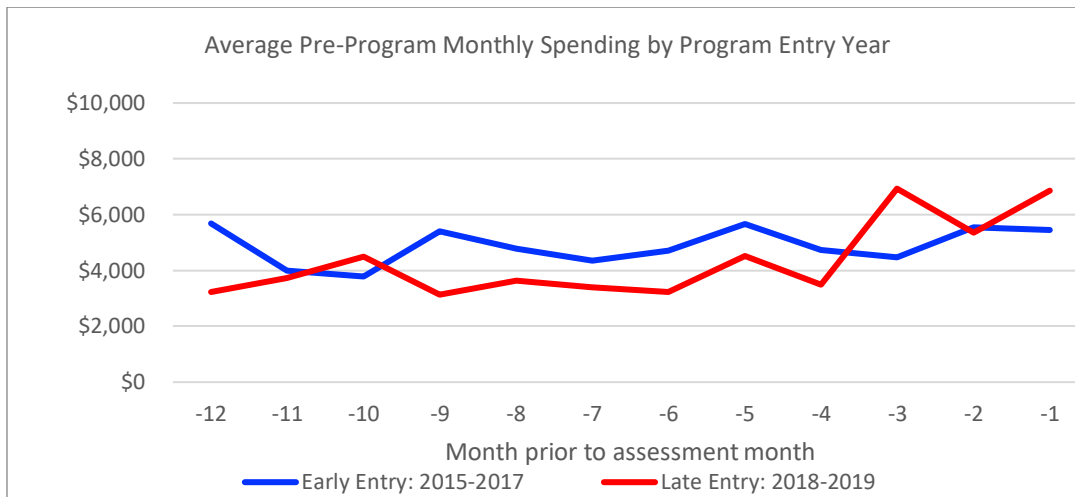
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## eAppendix

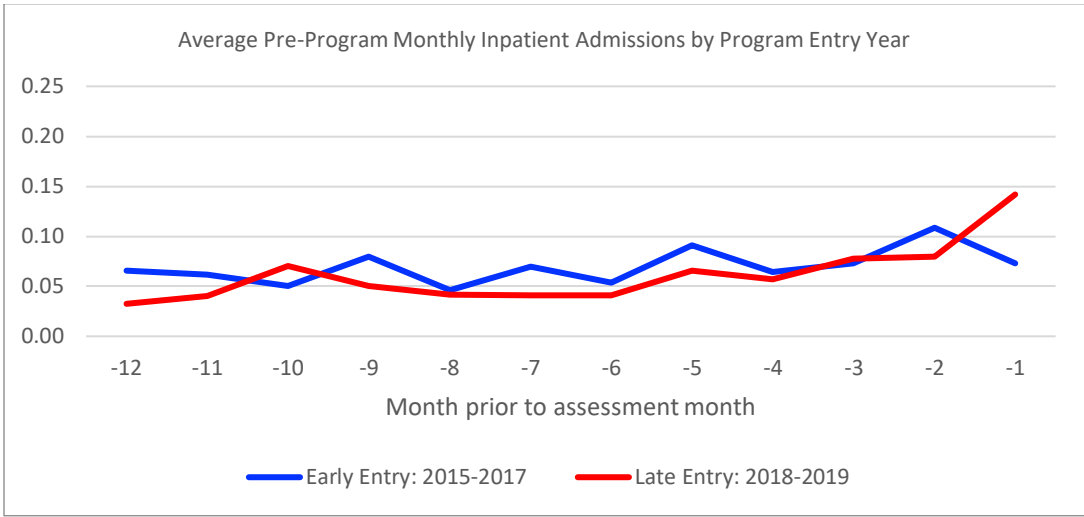
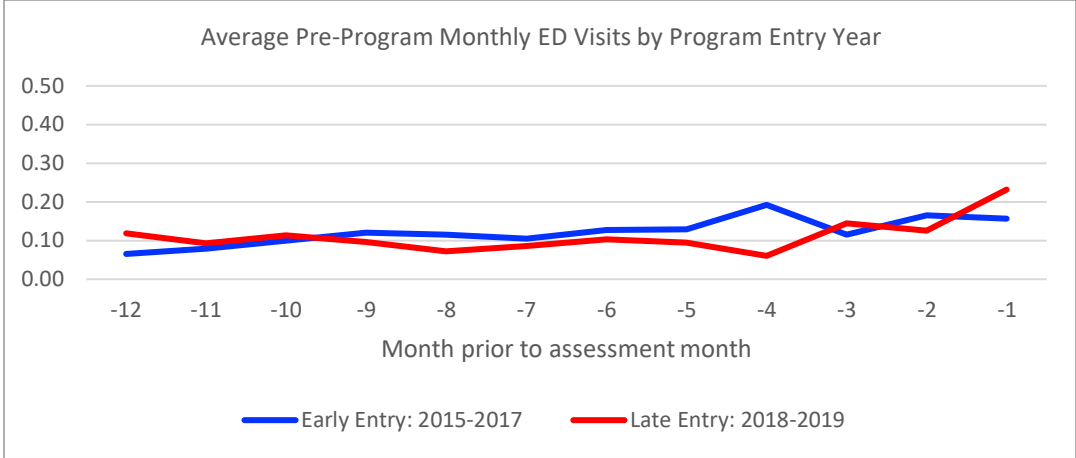
### I. Comparability of historical trends

We assessed the comparability of the historical trends for our main outcomes. eAppendix Figure 1 displays the mean monthly spending amounts for high-risk patients entering the care management program during the 12 months prior to program entry. The exhibit illustrates the monthly spending amounts during the pre-program months, independent of the program entry date, for patients entering early (in 2015 through 2017) versus later (in 2018 through 2019). eAppendix Table 1 displays the estimation of differences in outcome trends for those entering the program early vs. later. In other sensitivity analyses, we examined other categorizations of early versus later program entry and other durations of pre-program months. In all of these analyses, the historical trends appeared to be comparable, which represents an important check on the validity of the difference-in-difference design.

**eAppendix Figure 1. Historical outcome trends: monthly spending, ED visit rates, and hospitalization rates for high-risk patients entering early (2015-2017) vs. later (2018-19)**







Notes: The above panels illustrate the monthly spending, ED visit rate, and hospitalization rate patterns during the 12 months preceding entry into the high-risk program for those entering early vs. later. For this illustration, we classified patients entering in 2015-2017 as having “early entry,” and those entering in 2018-19 as having “later entry.”

**eAppendix Table 1. Assessment of potentially differential historical outcome trends: monthly spending, ED visit rates, and hospitalization rates for high-risk patients entering early (2015-2017) vs. later (2018-19)**

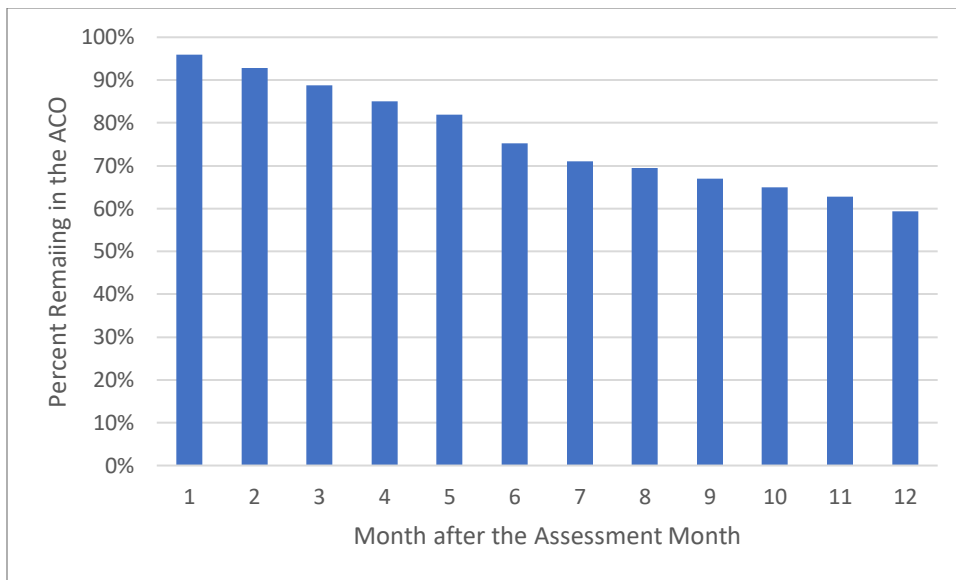
	<b>Coeff</b>	<b>95%</b>	<b>CI</b>
Differential spending/month	-\$57	-\$174	\$60
Differential ED visit rates	0.000	-0.003	0.003
Differential hosp rates	0.000	-0.002	0.002

Notes: The above table displays the coefficient for the interaction term capturing potentially different outcome trends during the pre-program time period. The logistic regression model includes indicators for time\_to\_program\_entry, timing\_of\_entry (e.g., early vs. late), and an interaction term for time\*timing.

## II. ACO departures (attrition)

In prior work, we examined the patterns of enrollment within the commercial ACO. eAppendix Figure 2 displays percentage of high-risk patients who left the ACO in the months after entering the care management program. After one month in the program, 95% of patients remained in the ACO on average; after 12 months in the program, 59% of patients remained on average. Stated differently, restricting the sample to patients continuous enrolled in the ACO would result in a smaller and select subsample of the population.

**eAppendix Figure 2. Percent with continued ACO membership among patients entering the high-risk care management program**



Data available through 2019, allowing us to examine ACO departures in the 12 months post program entry for patients assessed in 2015-2018 (n=376).

### III. Comparison of outcome analyses with and without consideration of attrition

In sensitivity analyses, we ignored the attrition from the ACO population using two alternative approaches: a) we allowed patients to contribute to the estimates when they were present but made no attempt to adjust for differential attrition; and b) we restricted the sample to patients continuously enrolled in the ACO for 24 months, which represents a commonly used eligibility criterion in published commercial ACO studies. eAppendix Table 2 displays the three approaches: 1) main approach in which we account for differential attrition over time using inverse probability weighting; 2) a similar approach but without accounting for differential attrition; and 3) a similar approach but with a restricted sample, i.e., patients continuously enrolled for 24 months. As expected, the estimates differ across the three approaches with larger estimated effects using more relaxed approaches or restricted samples. State differently, our main analyses attempted to address additional sources of bias related to differential attrition or selected subsampling, and as expected these analyses resulted in more conservative estimates compared to those derived using the other approaches. eAppendix Table 3 displays similar information, but for ED visit and hospitalization rates.

**eAppendix Table 2. Comparison of monthly spending model estimates with and without addressing ACO attrition and with a continuously enrolled sample**

<b>High-risk program spending effect</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>
Main Analysis	-887	-1805	31
Analysis without IPW weighting	-1004	-1931	-77
Analysis with 24 months pre/post with continuous enrollment*	-1180	-2939	580
<b>High-risk program spending effect (1-6 mo v. not yet started)</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>
Main Analysis	-697	-1615	222
Analysis without IPW weighting	-802	-1746	142
Analysis with 24 months pre/post with continuous enrollment*	-975	-2654	705
<b>High-risk program spending effect (7+ mo v. not yet started)</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>
Main Analysis	-1361	-2542	-181
Analysis without IPW weighting	-1442	-2584	-300
Analysis with 24 months pre/post with continuous enrollment*	-1824	-4099	451

\*Includes patients with <24 months in the pre-period and >=24 months in the post-period as long they are continuously enrolled in the pre-period (i.e., ACO start in Jan 2015). Similarly, includes patients with <24 months in the post-period and >=24 months in the pre--period as long as they are continuously enrolled in the post-period (i.e., enrolled in ACO through Dec 2019). Only the 24 months pre- and post- are included in the model. The assessment month counts as a post-month, but is not included in the model.

**eAppendix Table 3. Comparison of monthly event rate model estimates with and without addressing ACO attrition and with a continuously enrolled sample**

	<b>ED Visit Rates</b>			<b>Inpatient Hospitalization Rates</b>		
<b>High-risk program spending effect</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>
Main Analysis	-0.036	-0.063	-0.008	-0.016	-0.035	0.003
Analysis without IPW weighting	-0.027	-0.047	-0.007	-0.013	-0.026	0.001
Analysis with 24 months pre/post with continuous enrollment*	0.006	-0.033	0.045	-0.014	-0.041	0.013
<b>High-risk program spending effect (1-6 mo v. not yet started)</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>
Main Analysis	-0.031	-0.060	-0.002	-0.014	-0.034	0.007
Analysis without IPW weighting	-0.021	-0.041	-0.001	-0.010	-0.024	0.004
Analysis with 24 months pre/post with continuous enrollment*	0.014	-0.026	0.054	-0.010	-0.037	0.016
<b>High-risk program spending effect (7+ mo v. not yet started)</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>	<b>Coefficient</b>	<b>95%</b>	<b>CI</b>
Main Analysis	-0.048	-0.081	-0.016	-0.021	-0.042	-0.001
Analysis without IPW weighting	-0.041	-0.068	-0.014	-0.018	-0.036	-0.001
Analysis with 24 months pre/post with continuous enrollment*	-0.020	-0.069	0.029	-0.026	-0.063	0.011

\*Includes patients with <24 months in the pre-period and >=24 months in the post-period as long they are continuously enrolled in the pre-period (i.e., ACO start in Jan 2015). Similarly, includes patients with <24 months in the post-period and >=24 months in the pre--period as long as they are continuously enrolled in the post-period (i.e., enrolled in ACO through Dec 2019). Only the 24 months pre- and post- are included in the model. The assessment month counts as a post-month, but is not included in the model.

#### IV. Falsification test

The primary mechanism by which the commercial ACO reduced future spending growth in this study was entry into an integrated care management program. The program helps patients manage their health and avoid potentially preventable downstream adverse events such as need for hospitalizations to address an exacerbation of a chronic disease condition. This approach inherently relies on both the predictability of future adverse events and the evidence base supporting interventions to reduce these risks. Some medical events, however, are not predictable, e.g., accidents, thus are not amenable to the care management program. Stated differently, we do not believe that it is plausible that a care management program would reduce random accidents.

We then exploited this lack of plausible relationship and examined the impact of entry into the care management program for high-risk patients on an outcome (accidents) that should not be impacted or influenced by the program itself. eAppendix Table 4 displays the program impact on ED visits for accidental injuries. We used the NYU Billings ED classification scheme to classify the ED visits. As expected, the care management program had no measurable impact on accidents seen in the Emergency Department.

**eAppendix Table 4. Falsification test**

	Coefficient	95%	CI
<b>Model 1</b>			
Started high-risk program (vs. not yet started)	-0.005	-0.012	0.001
<b>Model 2</b>			
High-risk program for $\leq 6$ months (vs. not yet started)	-0.005	-0.011	0.001
High-risk program for 7+ months (vs. not yet started)	-0.006	-0.014	0.002

Source: authors' examination of the commercial ACO data.

Notes: The above table displays the coefficients for the difference in ED visit rates among those starting the high-risk program compared with patients who have yet to start the program.