

# Population Turnover and Leakage in Commercial ACOs

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**T**he long-term trend of medical spending growth is unsustainable. An important effort for taming this growth by private insurance companies has been to introduce alternative payment models, such as accountable care organization (ACO) contracts, in which insurance companies and provider organizations share financial risk for medical spending of a well-defined population.<sup>1,2</sup> Tens of millions of insurance plan enrollees are part of ACO contracts, and most ACO contracts are through commercial insurers compared with Medicare or Medicaid.<sup>3-7</sup>

In theory, ACO contracts align the incentives of provider organizations with those of both plans and patients, which could help mitigate spending growth. There are a range of mechanisms through which the provider organizations holding the ACO contracts might convey these incentives to the hospitals and physicians within the organization, including both financial incentives and quality enhancement. Importantly, providers gain flexibility under ACO contracts (compared with operating under a fee-for-service contract) in choosing which mechanisms to use individually or in concert (eg, funding care coordination programs while providing financial incentives for reducing downstream emergency department visits or hospitalizations). Of note, ACO contracts may vary in benefit designs, which have implications for incentives faced by patients and indirectly affect health systems and providers. Early reports of commercial ACO contracts suggest reductions in spending growth without obvious decrements in quality, compared with the “usual” fee-for-service contracts.<sup>8-10</sup> These studies largely find decreases in short-term spending through mechanisms such as referrals to less expensive providers, as well as decreases in utilization and spending within primary care after several years within the contract.<sup>11,12</sup>

Shifting to lower-cost providers might yield short-lived spending reductions without addressing longer-term spending growth. In contrast, efforts to improve health could take longer to manifest any savings. For example, one study evaluating the cost-effectiveness of an employee wellness program found that it took 3 years until the medical cost savings exceeded the program expenses.<sup>13</sup> Understanding population stability and the payoff time required for interventions to produce spending changes is critical, particularly given that

## ABSTRACT

**OBJECTIVES:** Commercial accountable care organization (ACO) contracts attempt to mitigate spending growth, but past evaluations have been limited to continuously enrolled ACO members in health maintenance organization (HMO) plans, excluding many members. The objective of this study was to examine the magnitude of turnover and leakage within a commercial ACO.

**STUDY DESIGN:** A historical cohort study using detailed information from multiple commercial ACO contracts within a large health care system between 2015 and 2019.

**METHODS:** Individuals insured through 1 of the 3 largest commercial ACO contracts during the study period, 2015-2019, were included. We examined patterns of entry and exit and the characteristics that predicted remaining in the ACO compared with leaving the ACO. We also examined predictors of the amount of care delivered in the ACO compared with outside the ACO.

**RESULTS:** Among the 453,573 commercially insured individuals in the ACO, approximately half left the ACO within the initial 24 months after entry. Approximately one-third of spending was for care occurring outside the ACO. Patients who remained in the ACO differed from those who left earlier, including being older, having a non-HMO plan, having lower predicted spending at entry, and having more medical spending for care performed within the ACO during the initial quarter of membership.

**CONCLUSIONS:** Both turnover and leakage hamper the ability of ACOs to manage spending. Modifications that address potentially intrinsic vs avoidable sources of population turnover and increase patient incentives for care within vs outside of ACOs could help address medical spending growth within commercial ACO programs.

*Am J Manag Care.* 2023;29(4):e104-e110. doi:10.37765/ajmc.2023.89350

commercial ACOs more frequently adopt quality measures around chronic disease management than noncommercial ACOs.<sup>5</sup> At a minimum, the ACO contracts must define a specific population of patients for whom there is shared risk, while allowing the population to vary over time with changes in employment, physicians, or plan choices.<sup>14,15</sup> Much of the prior literature, however, focuses on ACO members who remain continuously enrolled in the same plans and who are enrolled in health maintenance organization (HMO)-type plans with strict benefit design constraints. Although prior studies examining turnover within Medicare ACOs have demonstrated significant differences between those who leave and those who stay, with sicker individuals being more likely to remain within the ACO, there remain limited data on commercial ACO populations, including on the stability of enrollment or the implications of population changes on provider incentives, patient use patterns (eg, leakage), and contract goals.<sup>16</sup> Policy makers, ACO contract negotiators, and ACO stakeholders must be aware of both the magnitude of the population turnover and the multiple sources of turnover, which have different implications for the goals of the payment innovation, provider organizations, and patients.

In this study, we used detailed information from the largest health system in Massachusetts with multiple commercial ACO contracts to examine the amount of ACO population turnover between 2015 and 2019 during the initial years after each individual's ACO entry. We described the patterns of entry and exit and examined the characteristics that predict remaining in the ACO compared with leaving the ACO.

## METHODS

### Population

All participants were members of the Mass General Brigham (MGB) ACO. We restricted the study sample to individuals who received health insurance from 1 of the 3 largest commercial insurance companies with which MGB has had ACO contracts for the longest time period in Massachusetts.

We focused on alignment changes between 2015 and 2019, and we deliberately excluded the initial years of the commercial ACO contracts (2012–2014), during which insurance companies and ACOs were starting to implement and learn from ACO contracts and ACO enrollment was limited to HMO-type plans. ACO contracts included individuals enrolled in multiple plan types, including preferred provider organizations (PPOs), which have less stringent provider network constraints on enrollees compared with HMOs. As part of the contract, the insurance companies sent the ACO all medical claims for individuals within the ACO population, including claims for care provided outside the ACO.

Because some individuals could have both commercial health insurance and Medicare coverage, we restricted our sample to

## TAKEAWAY POINTS

Payment models that align the financial incentives of payers, providers, and patients offer hope for mitigating medical spending growth in thoughtful ways, but the details of the models matter.

- ▶ There are substantial amounts of population turnover among those in a commercial accountable care organization (ACO), with the median time of departure being within 2 years.
- ▶ The magnitude of both turnover and leakage hamper the potential to manage spending.
- ▶ Explicitly addressing the intrinsic vs avoidable amount of population turnover and patient incentives for care within vs outside of ACOs could improve an otherwise promising tool for slowing medical spending growth.

patients 64 years or younger. We also excluded patients younger than 1 year due to the concern that claims for both infants and their mothers may be under the same membership identifier. The MGB Institutional Review Board approved this study.

### Insurance Entry and Exit

Individuals in group commercial insurance plans choose from several health plans determined by the employer. Typically, employees choose their insurance plan during an annual open enrollment period occurring late in the calendar year; under this standard schedule, the chosen plan starts in January and ends in December of the following year. The insurance company then uses information about the individual's chosen or attributed primary care physician (PCP) for ACO alignment, which generally starts in January. Entry into the ACO was defined as the first month a patient was at risk for an included commercial ACO contract, and exit from the ACO was defined as the last month a patient was at risk for a commercial ACO contract.

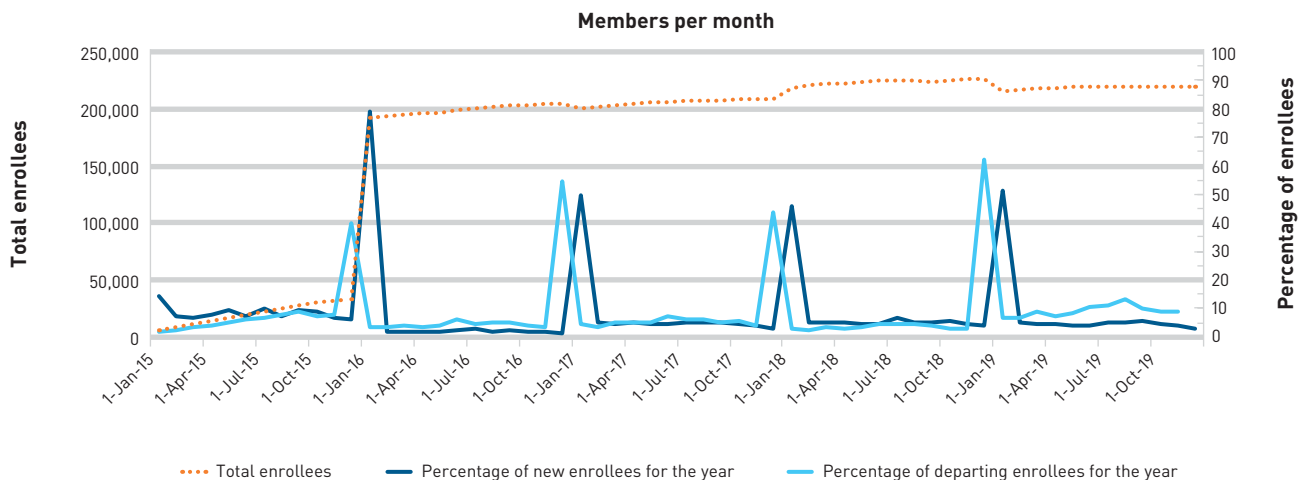
Within group commercial insurance ACOs, employment changes at any point may alter insurance status and ACO alignment. We do not have information on the timing of or reasons for employment changes, and we only observe changes in insurance plan status. One temporary exception is when individuals purchase the same insurance plan under the Consolidated Omnibus Budget Reconciliation Act (COBRA) after an employment change.<sup>17</sup>

Additionally, physician practices within the ACO could change. When a practice leaves the ACO, patients may change PCPs and remain in the ACO, although historically large percentages of patients stay with their PCP.<sup>18</sup> We included all patients who met the eligibility criteria in our study, regardless of whether their PCP left the ACO, in an effort to mirror real-world conditions. Within the MGB health care system, 3 physician practices left the ACO early in the study period.

### Spending

To assess differences in predicted medical spending, we used a prospective version of the HHS–Hierarchical Condition Category (HHS–HCC) risk scores.<sup>19</sup> These scores account for individual demographic characteristics and diagnoses and are used by the federal government to risk-adjust premiums for the individual commercial insurance market.

**FIGURE.** Enrollees Within the Mass General Brigham Commercial ACO by Month of ACO Membership\*



ACO, accountable care organization.

\*The figure displays the size of the commercially insured ACO population in each month (orange dotted line), as well as the percentage of individuals entering each month among all who enter during the year (dark blue line) and the percentage leaving each month among all who leave during the year (light blue line).

### Leakage

Because ACO contracts attempt to incentivize ACOs to mitigate spending growth for a defined population, the amount of care delivered inside the ACO vs outside the ACO (ie, system leakage) could be important.

In commercial ACO contracts, individual patients do not have constraints from the ACO limiting where they seek care or financial incentives to receive care within the ACO. Because we wanted to assess patient proclivities for using care inside vs outside the ACO but could only measure care use after ACO entry, we measured the amount of medical spending for care received during the initial quarter after ACO entry that occurred inside vs outside the ACO. We also assessed the relationship between this early use and later use, which tended to be correlated (ie, those who used care either inside or outside the ACO did so consistently over time).

Individuals within HMO plans generally face limited coverage of care outside the HMO or higher cost sharing for care delivered outside the HMO. Accordingly, we included HMO status in our analyses. We did not have information on the plan networks or their level of overlap with the ACO.

### Analyses

We first described the entry and exit patterns in ACO contracts by year and month. For each month, we recorded the numbers of individuals in the commercial ACO and, separately, the numbers entering or leaving the ACO. Because the sample had employer-sponsored insurance, we also examined the percentage of each annual entry cohort that entered in January, the typical start of the policy year, who left before the end of the policy year.

To measure population longitudinal stability for each entry cohort, we described the mean number of months until half of each entry cohort left the ACO, which is comparable with a population half-life, as well as the percentage of each entry cohort that remained in the ACO for 12, 18, 24, and 36 months. We used the minimum number of continuous months of enrollment used in prior ACO studies to set these durations. We present the results for the 24-month threshold based on prior literature and estimates of impact for population health interventions.<sup>8,13,20</sup> Findings were similar using the other durations of enrollment.

We then used logistic regression models to examine the characteristics of ACO population members associated with remaining in the ACO vs leaving earlier. We examined demographic characteristics, plan type, predicted spending using the HHS-HCC risk scores, HMO status, and the percentage of medical spending on care delivered inside the ACO (vs outside) during the initial quarter in the ACO.

In our main analysis comparing individuals who stayed at least 24 months in the ACO vs those who left, we included all individuals with the possibility of having at least 24 months of follow-up time based on their time of entry (ie, entered between 2015 and 2017). We then restricted the analyses to those whose physician practices were in the ACO for at least 24 months of follow-up time, removing individuals who might have left because their physician practice left the ACO. The results were comparable across the approaches.

We also examined characteristics associated with the amount of care delivered inside vs outside the ACO during each participant's entire time in the ACO. We used logistic regression models to examine the characteristics associated with having any medical spending. Then, among those with spending, we used linear regression models

to examine the characteristics associated with the percentage of spending on care delivered inside the ACO (vs outside the ACO). This analysis is comparable with the individual portions of a 2-part cost model. Finally, we examined the characteristics associated with monthly unique hospitalization rates (or rates of postacute care use) using negative binomial models and adjusting for the same explanatory variables. In sensitivity analyses, we examined differences in entry and exit and leakage. We also examined outcomes using a Cox proportional hazard model.

## RESULTS

### Characteristics of the ACO Population

Among the 453,573 commercially insured individuals newly aligned to the ACO in 2015 through 2019, the mean (SD) age was 34.3 (17.6) years: 19.4% were 17 years or younger; 12.7%, aged 18 to 25 years; 20.1%, aged 26 to 35 years; 16.1%, aged 36 to 45 years; 17.7%, aged 46 to 55 years; and 14%, aged 56 to 64 years. Approximately half (53.7%) were female. Characteristics were comparable across different entry years (eAppendix Table 1 [available at [ajmc.com](http://ajmc.com)]).

### ACO Population Changes

The Figure displays the number of individuals entering the commercial ACO and percentage entering or leaving during each month for that year between 2015 and 2019. There was a large increase in the population size between December 2015 and January 2016 because of the expansion of ACO contracts, including contracts containing PPO plan members starting in 2016 (eAppendix Figure 1). After 2016, the ACO population size remained relatively steady from year to year, despite continued entry and departure each month. In January 2016, HMO members comprised 34.5% and PPO members comprised 62.2% of the ACO population.

In each year, the largest percentage of entries occurred in January and the largest percentage of exits occurred in December (ie, the beginning and end of the typical insurance policy year). Across all entry cohorts, a mean of 40.4% of entries to the ACO occurred between February and December, and a mean of 28.7% departures occurred between January and November. In general, individuals who entered the ACO in the middle of the calendar year were younger than those who entered in January (eAppendix Table 1). Individuals who left the ACO prior to December compared with those who left in December of a given year were less likely to have a chronic condition, including diabetes or asthma (eAppendix Table 2). Eleven percent of individuals had gaps in their ACO membership (eg, leaving then rejoining the ACO during the observation period). Further, 1% of participants had 2 or more gaps in ACO membership and 10% had 1 gap.

### Characteristics Associated With Remaining in the ACO

On average, approximately half of commercially insured individuals left the ACO before 24 months. Table 1 displays the characteristics of those leaving before vs staying at least 24 months among the

338,728 individuals with adequate follow-up time in the study. Characteristics associated with remaining in the ACO (vs leaving) included being in older age groups, being in a non-HMO plan, having lower predicted spending at entry, and having more medical spending for care performed within the ACO during the first quarter after entry (Table 1 and eAppendix Table 3). Moreover, individuals who remained had lower monthly hospitalization rates compared with those who left (eAppendix Table 4).

### Characteristics Associated With the Amount of Care Delivered Within the ACO

Table 2 displays the characteristics associated with having any medical spending; 93% of all commercially insured patients in the ACO who entered between 2015 and 2017 had at least some medical spending. Individuals with either longer tenures in the ACO or higher risk scores were more likely to have any medical spending. Members in HMO plans were less likely to have any medical spending compared with non-HMO members.

Approximately one-third of spending was on care outside the ACO. Table 2 displays the characteristics associated with the percentage of total medical spending on care delivered inside the ACO. Individuals who were older, had higher predicted spending, or remained in the ACO at least 24 months also had a greater percentage of medical spending on care delivered inside the ACO. For individuals with any medical spending, members in a PPO plan had a greater percentage of spending on care delivered within the ACO compared with those in an HMO plan.

In sensitivity analyses, results were similar using a Cox proportional hazard model (eAppendix Table 5 and eAppendix Figure 2).

## DISCUSSION

ACO contracts are an increasingly common approach to address spending growth within group commercial insurance plans. We found evidence of substantial commercial ACO population turnover, with more than half of the population leaving the ACO within 2 years. Moreover, those who remained differed from those who left in their predicted spending levels and likelihood of using care within the ACO. Prior studies examining levels of disenrollment and reenrollment in commercial plans have demonstrated high levels of turnover and reenrollment over several years.<sup>21</sup> However, to our knowledge, this is the first examination of population stability and leakage within ACOs in the broader group commercial insurance market.

Interestingly, we found high levels of midyear turnover, with 30% of individuals leaving prior to December of a given year. Further, more than 40% of individuals entered the ACO after January. Several possible explanations exist for this substantial and potentially off-cycle turnover, including changes in ACO composition (eg, physician practices entering or leaving) or changes in employment. Those leaving midyear also differed clinically from those who remained, which would be consistent with sicker individuals being more hesitant about job changes, thus making them more likely to

**TABLE 1.** Characteristics Associated With Remaining in the ACO for 24 Months vs Leaving Earlier<sup>a</sup>

Characteristics	< 24 months in the ACO	≥ 24 months in the ACO	OR	95% CI
Number of participants	145,905	192,823		
Female	53.0%	54.3%	1.02	1.01-1.04
Aged <18 years	15.3%	17.8%	0.70	0.68-0.72
Aged 18-25 years	12.2%	11.2%	0.67	0.65-0.69
Aged 26-35 years	25.0%	14.1%	0.49	0.48-0.50
Aged 36-45 years	15.7%	16.0%	0.88	0.86-0.91
Aged 46-55 years	14.8%	19.6%	1.14	1.11-1.17
Aged 56-64 years	16.9%	21.4%	Reference	
Mean HHS-HCC risk score in ACO entry year	1.22	1.24	0.990	0.988-0.992
Percentage of medical spending on care performed within the ACO in the first quarter	55.8%	66.4%	1.003	1.003-1.004
Plan type: HMO	47.9%	39.7%	Reference	
Plan type: PPO	49.4%	57.3%	1.14	1.12-1.16
Plan type: POS	2.7%	2.9%	1.17	1.12-1.22

ACO, accountable care organization; HHS-HCC, HHS-Hierarchical Condition Category (a measure of predicted medical spending); HMO, health maintenance organization; OR, odds ratio; POS, point of service; PPO, preferred provider organization.

<sup>a</sup>Logistic regression models adjusting for insurance plan, year of entry, and primary physician practice group.

**TABLE 2.** Characteristics Associated With Having Any Medical Spending and Associated With the Amount of Spending on Care Occurring Inside the ACO (among those with spending)<sup>a</sup>

Characteristics	All individuals		Among those with any medical spending	
	Odds of having any medical spending		% of spending on care delivered inside the ACO	
	OR	95% CI	Coefficient	95% CI
≥ 24 months in the ACO (vs < 24 months)	1.17	1.16-1.18	4.40	4.17-4.62
Female	1.66	1.64-1.67	-1.41	-1.61 to -1.21
Aged < 18 years	0.71	0.70-0.72	7.74	7.37-8.10
Aged 18-25 years	0.55	0.54-0.56	-6.27	-6.65 to -5.88
Aged 26-35 years	0.61	0.60-0.62	-4.71	-5.04 to -4.38
Aged 36-45 years	0.73	0.72-0.74	-3.53	-3.86 to -3.20
Aged 46-55 years	0.80	0.78-0.81	-2.74	-3.05 to -2.42
Aged 56-64 years	Reference		Reference	
Mean HHS-HCC risk score in ACO entry month	1.10	1.10-1.10	0.03	0.00-0.05
Plan type: HMO	Reference		Reference	
Plan type: PPO	1.14	1.12-1.15	3.03	2.78-3.29
Plan type: POS	1.14	1.11-1.17	-1.37	-1.96 to -0.79

ACO, accountable care organization; HHS-HCC, HHS-Hierarchical Condition Category (a measure of predicted medical spending); HMO, health maintenance organization; OR, odds ratio; POS, point of service; PPO, preferred provider organization.

<sup>a</sup>We used logistic regression models to examine the odds of having any monthly medical spending, adjusting for insurance plan, insurance plan type, year of entry, month, and primary physician practice group, plus individual-level random effects. We then used linear regression models to examine the percentage of monthly spending on care occurring outside the ACO among those with any spending, adjusting for insurance plan, insurance plan type, year of entry, month, and primary physician practice group, plus individual-level random effects. These 2 models are analogous to the components of a 2-part model.

remain in their current job with the same insurance plan.

Surprisingly, individuals who remained in the ACO appeared to be healthier (based on HHS-HCC risk capture) than those who left, which is the opposite of what was observed within the Pioneer ACO program<sup>18</sup>; we had hypothesized that sicker patients tended to receive more care from their physicians and might need more hospital care. Prior studies examining the Massachusetts Alternative Quality Contract also found that sicker individuals left earlier than those remaining.<sup>8</sup> In our study, individuals who left the ACO not only were sicker on average but also had higher hospitalization rates. Several possible explanations exist, including that illness led to employment changes or that the postacute care affected the commercial ACO attribution algorithm in unintentional ways as observed in the Medicare Shared Savings ACO Program attribution.<sup>22</sup>

Further, HMO patients were less likely to have any medical spending compared with members in other plan types, suggesting that utilization for patients in HMO plans may be mitigated in ways that are distinct from those associated with the ACO. We found that HMO patients received less care within the ACO, which potentially could reflect mismatches between HMO and ACO structure such that patients in HMO plans are incentivized to seek care within their HMO, but at least some of this care could be outside the ACO (ie, only partially overlapping network definitions).

ACOs may face competing financial and nonfinancial incentives with respect to groups of patients. For example, the potential to alter patient trajectories and future spending likely varies by illness levels and conditions, and the costs associated with care or investments needed to alter spending patterns also could vary, albeit in potentially different ways. The degree and timing of turnover could alter ACO evaluations of investments that target long-term utilization and cost. In one study evaluating the cost effectiveness of an employee wellness program, it took 3 years until the medical cost savings exceeded the program expenses.<sup>13</sup> Another study modeled the amount of time needed for an intervention to pay off both financially and with respect to quality-adjusted

life-years for patients at risk for cardiovascular disease; for the highest risk patients, the payoff time for the intervention was 3.3 years.<sup>20</sup>

To the extent that turnover increases the difficulty of mitigating spending growth through medical improvements, ACOs might face perverse incentives with respect to other approaches (eg, restricting care) to reduce spending.<sup>23,24</sup> Nevertheless, it remains possible that well-targeted programs could identify high-risk patients who might benefit from better clinical management and yield short-term changes in medical spending growth.

Overall, our study suggests several ways to improve commercial ACO contracts. First, monitoring how the at-risk population evolves over time would be valuable. In some cases, there could be industry-/employer-specific reasons for greater employee turnover, or the ACO's underlying medical ecosystem could influence the likelihood of population turnover. Attention to the details of the attribution and updating processes with respect to stability could reduce unintentional changes in the population, encouraging greater stability (eg, redetermine each patient's PCP every other year instead of every year).<sup>25</sup>

Second, reducing use of care outside the system could improve clinical coordination and management, as well as better align individual and ACO incentives, but potentially at the cost of limiting patient choices.<sup>26,27</sup> Matching insurance plan provider networks with ACO systems and using benefit design levers such as differential cost sharing could reduce leakage, but safeguards would be necessary for care that could be difficult to obtain within the ACO (eg, mental health or cancer care).

Third, there may be intrinsic limits to the amount of population stability that is feasible or desirable within commercial ACOs, given the age distribution of the populations and nature of employer-sponsored health insurance. With high population turnover rates, there are few financial incentives to invest in care with multiyear payoff times. Although this is not unique to ACO contracts, attention to these scenarios and careful attention to specific quality requirements could mitigate this disconnect.<sup>28-31</sup>

## Limitations

This study has several limitations. First, Massachusetts was one of the earliest states to engage in health reform efforts expanding insurance coverage and reducing spending growth, so these results may not generalize to newer ACOs in other states. Second, although participants included in this study received insurance from multiple companies, they received their care in a single ACO system. Therefore, these results might not be generalizable to other health systems or ACOs. Third, because of data availability constraints, we were unable to determine the reasons that participants left the ACO or changes at other levels (eg, consumers switching plans, employers switching insurance companies or plans, employee-employer relationship changes), which could influence the magnitude of ACO population turnover. Fourth, we were unable to observe the benefit design structure or provider network associated with each individual's insurance plan.

## CONCLUSIONS

New payment models that align the financial incentives of payers, plans, providers, and patients offer hope for mitigating medical spending growth in thoughtful ways, but the details of the models matter. In this study, we found substantial amounts of population turnover among those in a commercial ACO, with the median time of departure being within 2 years. Attribution also continues to be more of an art than a science, with potentially unintended consequences for some efforts to operationalize this patient-physician linkage. This amount of population churn inherently limits the amount of clinical engagement feasible because the ACO is constantly gaining familiarity with new patients while the clock ticks down with existing patients. Explicitly addressing the intrinsic as well as avoidable amount of population turnover and patient incentives for care within vs outside of ACOs could further improve a promising tool for slowing medical spending growth. ■

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**Source of Funding:** Dr Benson received funding support from the National Library of Medicine (T15 LM007092). Dr Hsu received funding support from the National Institutes of Health (P50MH115846, P01AG032952).

**Author Disclosures:** All authors work for Mass General Brigham or associated entities, which hold accountable care organization contracts. Dr Benson volunteers for the Epic Systems Behavioral Health Subspecialty Steering Board. Dr Mendu is a member of the New England Life Care Advisory Board. Dr Hsu reports consulting with CHA, USC, Columbia University, Community Servings, and Delta Health Alliance.

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

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# Population Turnover and Leakage in Commercial ACOs

## *eAppendix*

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**eAppendix Table 1.** Characteristics of commercial ACO members by entry cohort

	Full ACO	2015 Entry		2016 Entry		2017 Entry		2018 Entry		2019 Entry	
		January	February-December	January	February-December	January	February-December	January	February-December	January	February-December
Number of Subjects	453,573	5,637	34,582	162,471	42,590	35,818	35,943	31,078	36,429	35,246	33,769
Female (%)	53.7%	51.8%	52.4%	54.7%	52.8%	54%	53%	53.1%	53.3%	53.3%	53.1%
Age (mean $\pm$ SD)	34.3 $\pm$ 17.6	32.7 $\pm$ 17.7	32.1 $\pm$ 16.7	36.9 $\pm$ 17.9	31.7 $\pm$ 17.4	36.1 $\pm$ 16.8	30.6 $\pm$ 17.5	34.2 $\pm$ 16.5	30.2 $\pm$ 17.4	36.8 $\pm$ 16.5	31 $\pm$ 17.3
Age Group											
1-17	19.4%	21.4%	19.7%	19.3%	21.6%	15.8%	22.8%	16.8%	23.7%	13%	21.7%
18-25	12.7%	11.8%	13.1%	11%	12.7%	12.5%	14.4%	15.5%	13.5%	14.6%	14.1%
26-35	20.1%	22.6%	26.5%	13.5%	25.3%	19.5%	25.2%	21.8%	26.1%	19.6%	26.2%
36-45	16.1%	16.1%	16%	16.5%	15%	18%	14.1%	16.8%	14.6%	17.4%	15.1%
46-55	17.7%	15.9%	15.1%	21.6%	14.8%	19.5%	13.5%	16.6%	12.7%	19%	12.8%
56-64	14%	12.3%	9.6%	18.1%	10.6%	14.7%	9.9%	12.5%	9.5%	16.4%	10.2%
Insurance											
Plan 1	74.8%	55.3%	58.1%	78.4%	62.5%	83.1%	65.4%	91.6%	69.2%	90.4%	68.4%
Plan 2	18.6%	27.5%	26.1%	20.2%	25.4%	13.9%	22.1%	5.2%	18.6%	6.4%	19%
Plan 3	6.7%	17.1%	15.9%	1.5%	12%	3%	12.5%	3.3%	12.3%	3.2%	12.6%
HHS-HCC risk score in ACO entry year (mean $\pm$ SD)	1.20 $\pm$ 4.0	1.10 $\pm$ 3.5	0.87 $\pm$ 3.0	1.39 $\pm$ 4.4	0.93 $\pm$ 3.2	1.37 $\pm$ 4.4	0.96 $\pm$ 3.5	1.31 $\pm$ 4.3	0.94 $\pm$ 3.3	1.39 $\pm$ 4.4	1.02 $\pm$ 3.7

**Notes:** ACO: accountable care organization; SD: standard deviation. This table depicts the characteristics for patients who enter the ACO in January vs the rest of the year for each year.

**eAppendix Table 2.** Characteristics of ACO members, by early exit and end of year exit

	<b>January-November Exit</b>	<b>December Exit</b>	<b>p-value</b>
Number of Subjects	130,006	323,567	
Female (%)	28.6%	71.4%	0.264
Age at Exit (mean $\pm$ SD)	36.3 $\pm$ 17.6	36 $\pm$ 17.7	<0.001
Age Group – <18	14.2%	18.3%	-
Age Group – 18-25	11.5%	12.1%	-
Age Group – 26-35	27.4%	17.2%	-
Age Group – 36-45	14.6%	16.5%	-
Age Group – 46-55	12.8%	18.6%	-
Age Group – 56-64	19.5%	17.4%	-
Insurance – Plan 1	67.4%	79%	(ref)
Insurance – Plan 2	22.7%	15.2%	<0.001
Insurance – Plan 3	10%	5.9%	<0.001
Mean spending in ACO entry month	\$449.65 $\pm$ \$3243.11	\$414.15 $\pm$ \$3031.20	-
Mean spending in ACO exit month	\$550.52 $\pm$ \$5011.29	\$453.50 $\pm$ \$3228.42	-
Mean HHS-HCC risk score in ACO entry month	1.2 $\pm$ 4.5	1.2 $\pm$ 3.8	<0.001
Mean HHS-HCC risk score in ACO exit month	1.3 $\pm$ 5.1	1.3 $\pm$ 4.2	-
Number of HHS-HCC Conditions Present in ACO Exit Year	0.24 $\pm$ 0.70	0.31 $\pm$ 0.70	-
Any HHS-HCC Condition Present in ACO Exit Year	16.8%	22.8%	-
Selected HHS-HCC Conditions Present in ACO Exit Year	-	-	
Diabetes with Chronic Complications	1.5%	1.8%	-
Diabetes without Complications	1.3%	1.5%	-
Depression/Bipolar Disorder	1.6%	1.6%	-
Seizure Disorders	0.6%	0.7%	-
Congestive Heart Failure	0.6%	0.5%	-
Chronic Obstructive Pulmonary Disease	0.6%	0.5%	-
Asthma	4%	6.6%	-
Pregnancy in Exit Year	0.6%	0.8%	-

**Notes:** Table of characteristics including total population size, mean age, percent within separate age categories, percent female, mean spending upon entry, percent with specific chronic conditions; Logistic regression results shown including age, gender, insurance plan type, risk score at entry; ACO: accountable care organization; HHS-HCC: Department of Health and Human Services-Hierarchical Condition Categories; SD: standard deviation

**eAppendix Table 3.** Characteristics associated with remaining in the ACO for 24 months vs. leaving earlier

	<b>&lt;24 months in the ACO</b>	<b>24+ months in the ACO</b>	<b>OR</b>	<b>95% CI</b>	<b>95% CI</b>
Number of Subjects	145,905	192,823			
Female (%)	53.0%	54.3%	1.03	1.01	1.04
Aged <18 years	15.3%	17.8%	0.68	0.66	0.70
Aged 18-25 years	12.2%	11.2%	0.71	0.69	0.73
Aged 26-35 years	25.0%	14.1%	0.51	0.50	0.53
Aged 36-45 years	15.7%	16.0%	0.91	0.88	0.93
Aged 46-55 years	14.8%	19.6%	1.16	1.13	1.19
Aged 56-64 years	16.9%	21.4%	reference		
Mean HHS-HCC risk score in ACO entry year	1.22	1.24	0.99	0.99	0.99
Percentage of medical spending on care performed within the ACO	57.5%	68.3%	1.01	1.01	1.01
Plan type – HMO	47.9%	39.7%	reference		
Plan type – PPO	49.4%	57.3%	1.02	1.00	1.04
Plan type - POS	2.7%	2.9%	1.17	1.12	1.23

Notes: ACO: accountable care organization; OR: odds ratio; CI: confidence interval; HHS-HCC: refers to a measure of predicted medical spending, i.e., the Department of Health and Human Services-Hierarchical Condition Categories; HMO: health maintenance organization; PPO: preferred provider organization; POS: point of service. Logistic regression models adjusting for insurance plan, year of entry, primary physician practice group.

**eAppendix Table 4.** Characteristics associated with monthly hospitalization rates

	<b>IRR</b>	<b>95%</b>	<b>CI</b>
24+ months in the ACO	0.84	0.81	0.86
Female	1.57	1.52	1.62
Aged <18 years	0.30	0.27	0.32
Aged 18-25 years	0.63	0.59	0.67
Aged 26-35 years	1.20	1.15	1.25
Aged 36-45 years	1.24	1.19	1.30
Aged 46-55 years	0.70	0.67	0.73
Aged 56-64 years	ref		
Mean HHS-HCC risk score in ACO entry month	1.057	1.057	1.058

Notes: ACO: accountable care organization; IRR: incident rate ratio; CI: confidence interval; HHS-HCC: refers to a measure of predicted medical spending, i.e., the Department of Health and Human Services-Hierarchical Condition Categories. We used population-averaged negative binomial regression models to examine the rates of monthly hospitalizations, adjusting for insurance plan, year of entry, month, and primary physician practice group.

Source: Authors' analyses of 2015-2019 ACO electronic health record and insurance claims data.

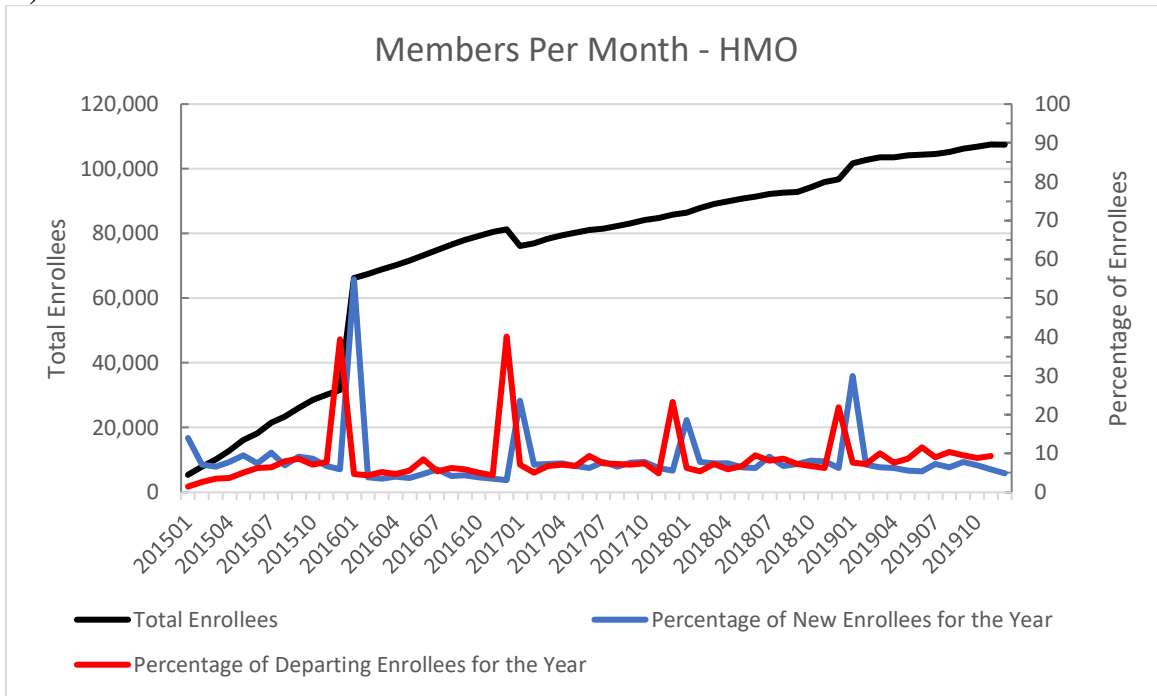
**eAppendix Table 5.** Cox proportional hazard model sensitivity analysis.

	Table 1: Odds of staying In the ACO for 24 months vs. leaving earlier			Table 1v2: Odds of leaving the ACO before 24 months vs. staying			Survival Analysis: Characteristics associated with departure from the ACO within 24 months		
	OR	95%	CI	OR	95%	CI	HR	95%	CI
Female (%)	1.02	1.01	1.04	0.98	0.96	0.99	0.99	0.98	1.00
Aged <18 years	0.7	0.68	0.72	1.42	1.39	1.46	1.30	1.27	1.32
Aged 18-25 years	0.67	0.65	0.69	1.49	1.45	1.53	1.34	1.31	1.37
Aged 26-35 years	0.49	0.48	0.5	2.03	1.98	2.08	1.58	1.56	1.61
Aged 36-45 years	0.88	0.86	0.91	1.13	1.10	1.16	1.10	1.08	1.12
Aged 46-55 years	1.14	1.11	1.17	0.88	0.85	0.90	0.93	0.91	0.94
Aged 56-64 years	ref			ref			ref		
Mean HHS-HCC risk score in ACO entry year	0.99	0.99	0.99	1.01	1.01	1.01	1.01	1.01	1.01
Percentage of medical spending on care performed within the ACO in the first quarter	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Plan type – HMO	ref			ref			ref		
Plan type – PPO	1.14	1.12	1.16	0.86	0.82	0.90	0.83	0.82	0.84
Plan type - POS	1.17	1.12	1.22	0.88	0.86	0.89	0.87	0.84	0.90

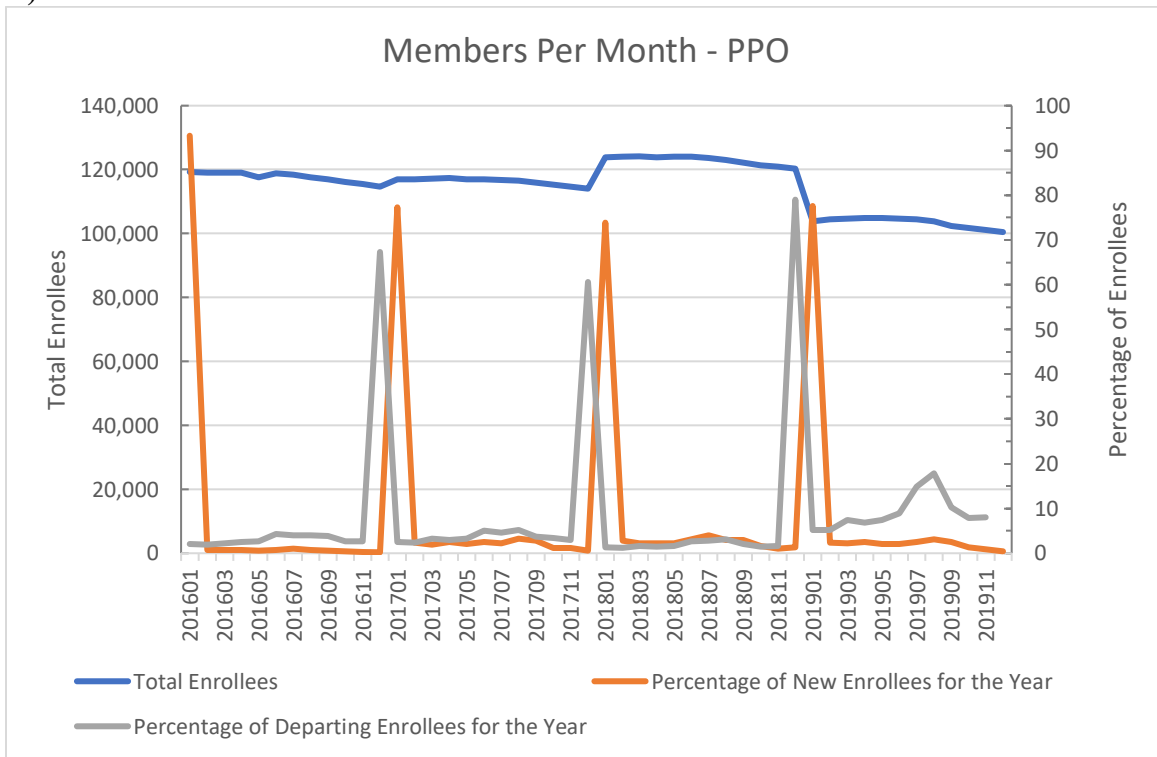
Notes: in this analysis, the main study model was rerun using a primary outcome of leaving the ACO before 24 months (vs staying in ACO for 24 months) to align with the survival model outcome. ACO: accountable care organization; OR: odds ratio; CI: confidence interval; HHS-HCC: refers to a measure of predicted medical spending, i.e., the Department of Health and Human Services- Hierarchical Condition Categories; HMO: health maintenance organization; PPO: preferred provider organization; POS: point of service.

**eAppendix Figure 1.** Persons within the Mass General Brigham Commercial ACO by month of ACO membership stratified by A) HMO vs B) PPO plan type

**A)**

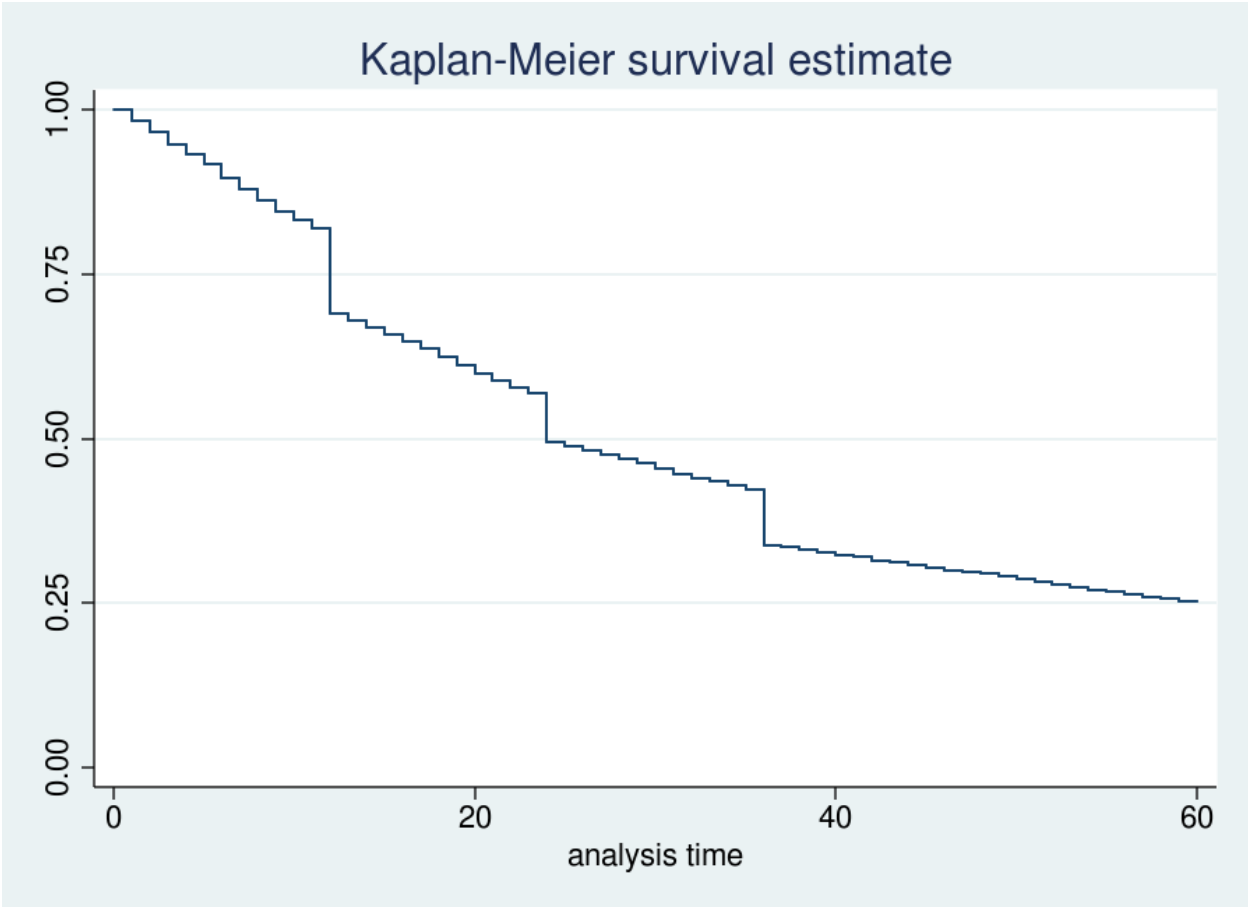


**B)**



Notes: HMO: health maintenance organization; PPO: preferred provider organization

**eAppendix Figure 2.** Kaplan-Meier survival estimate



Notes: this figure depicts departure across the full study period (not just within 24 months)