Vermont All-Payer ACO Model Evaluation

Report

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R. Vincent Pohl, Neetu Jain, and KeriAnn Wells

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Executive Summary

This report summarizes the results of an evaluation of Vermont's All-Payer ACO Model. The purpose of this evaluation is to assist the Green Mountain Care Board (GMCB) in assessing ACO performance across the three major payer groups: commercial, Medicare, and Medicaid. To evaluate the ACO, we used data from the Vermont Health Care Uniform Reporting and Evaluation System (VHCURES), the state's all-payer claims database (APCD). The analytic file from the VHCURES included cost and utilization data, beneficiary risk scores based on the Johns Hopkins Adjusted Clinical Group® (ACG) System, and numerator and denominator designations for the quality measures of interest. We did not estimate the causal impact of the ACO on cost and quality measures but rather assessed differences between members attributed to ACO-aligned primary care providers (PCPs) and members not attributed to ACO-aligned PCPs.

After standardizing risk scores, we produced descriptive results, such as cost and utilization patterns by payer group. We also used a difference-in-differences model, comparing changes in risk-adjusted outcomes of interest before and after ACO implementation between ACO and non-ACO attributed Vermont residents. We then ran regressions, controlling for member risk, age, gender, length of ACO enrollment, and hospital service area (HSA).[1] The evaluation outcomes include total cost of care (TCOC) and performance on 16 measures. Six measures derive from the Health Effectiveness Data and Information Set (HEDIS) measures and ten derive from the Prevention Quality Indicator (PQI) measure from the Agency for Healthcare Research and Quality (AHRQ):

1. Emergency department utilization (HEDIS EDU)
2. Initiation of alcohol and other drug abuse or dependence treatment (HEDIS IET1)
3. Engagement of alcohol and other drug abuse or dependence treatment (HEDIS IET2)
4. 30-day follow-up after discharge from the ED for alcohol and other drug abuse or dependence (HEDIS FUA)
5. 30-day follow-up after discharge from the ED for mental health (HEDIS FUM)
6. Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)
7. Diabetes short-term complications (PQI-90-1)
8. Diabetes long-term complications (PQI-90-3)
9. Chronic obstructive pulmonary disease or asthma in older adults (PQI-90-5)
10. Hypertension (PQI-90-7)
11. Heart failure (PQI-90-8)
12. Community-acquired pneumonia (PQI-90-11)
13. Urinary tract infection (PQI-90-12)
14. Uncontrolled diabetes (PQI-90-14)
15. Asthma in younger adults (PQI-90-15)

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[1] HSA is based on members' residence.

16. Lower extremity amputation for patients with diabetes (PQI-90-16)

It is important to note that the difference-in-differences effect or the estimated regression coefficient on the ACO variable should not be interpreted as the causal impact of alignment with the ACO on total cost or quality measures. Although we controlled for observed member characteristics, such as age, gender, and risk score, there could be unobserved characteristics that affect cost or quality outcomes. If unobserved member characteristics are associated with their primary care provider's ACO-alignment, this might lead to selection bias, and ACO alignment alone would not necessarily cause observed differences in costs and outcomes. For example, if participating PCPs are more likely to be affiliated with health systems that invest in quality programs—such as programs offering specialized follow-up care after emergency department (ED) visits—this might affect the estimated relationship between ACO alignment and cost and quality outcomes. Furthermore, because the ACO designation is applied to members enrolled at any time during the year, results may be understated due to partial-year ACO members with less exposure to ACO services.

We report results separately for the three payer groups. Key findings include the following:

- Descriptive results for costs, ***which are adjusted for patient risk***, showed that commercial members attributed to the ACO had higher risk-adjusted costs and cost growth from 2018 to 2019 than non-ACO members. Medicare beneficiaries attributed to the ACO had lower risk-adjusted costs and comparable cost growth compared to non-ACO beneficiaries. For ACO members covered by Medicaid, risk-adjusted 2019 costs and cost growth were lower than for non-ACO members.

- Statistical results showed contrasting results regarding the ACO's effect on costs. Difference-in-differences results showed risk-adjusted cost savings among the commercial and Medicaid ACO populations relative to the non-ACO population but showed cost growth among the Medicare ACO population relative to the non-ACO population. Regression results suggested that the ACO contributed $26 in Medicaid per-member-per-month (PMPM) growth and $3 in commercial PMPM growth, but that the ACO contributed to $22 PMPM savings among the Medicare population.

- Descriptive results for HEDIS measures, ***which are <u>not</u> adjusted for patient risk***, show greater improvements among the all-payer ACO population for the following measures: IET1, IET2, FUA, and FUM. Among specific payer groups:

  – commercial ACO members show greater improvement on EDU, IET2, FUA, and FUM than commercial non-ACO members;

  – Medicaid ACO members show greater improvement on IET2 and FUM than Medicaid non-ACO members; and

  – Medicare ACO members show greater improvement on IET1, FUM, and AAB than Medicare non-ACO members.

- Descriptive results for PQI measures, ***which are <u>not</u> adjusted for patient risk***, show greater reductions in hypertension admissions among the all-payer ACO population relative to non-ACO population. Among specific payer groups:

  – commercial ACO members show greater reductions in admissions for diabetes short-term complications, hypertension, and heart failure than commercial non-ACO members;

  – Medicaid ACO members show greater reductions in admissions for hypertension, heart failure, urinary tract infections (UTI), and young adult asthma than Medicaid non-ACO members; and

     – Medicare ACO members show greater reductions in admissions for hypertension and UTI than Medicare non-ACO members.

- Difference-in-differences and regression analysis results also yielded mixed evidence on the effectiveness of the ACO to improve quality. However, differences in outcomes between ACO and non-ACO members are relatively small.

Table ES.1 summarizes the findings from difference-in-differences and regression analyses for all outcomes by payer. We color coded the table according to findings of favorable or unfavorable ACO effects in both types of analyses or findings of mixed evidence.

Table ES.1. Summary of difference-in-differences and regression findings (2016–2019)[1]

Measure type	Measures	Payers			
		All-Payer	Medicaid	Medicare	Commercial
Cost	Total cost PMPM	D: Unfav R: Unfav	D: Fav R: Unfav	D: Unfav R: Fav	D: Fav R: Not SS
HEDIS	Emergency department utilization (EDU)	D: Unfav R: Unfav	D: Fav R: Unfav	D: Unfav R: Unfav	D: Unfav R: Fav
	Initiation of alcohol and other drug abuse or dependence treatment IIET1)	D: Unfav R: Unfav	D: Unfav R: Unfav	D: Unfav R: Fav	D: Fav R: Unfav
	Engagement of alcohol and other drug abuse or dependence treatment (IET2)	D: Unfav R: Unfav	D: Unfav R: Unfav	D: Unfav R: Not SS	D: Unfav R: Unfav
	30-day follow-up after discharge from the ED for alcohol and other drug abuse or dependence (FUA)	D: Fav R: Fav	D: Fav R: Fav	D: Fav R: Fav	D: Fav R Fav
	30-day follow-up after discharge from the ED for mental health (FUM)	D: Fav R: Fav	D: Fav R: Fav	D: Unfav R: Fav	D: Fav R: Unfav
	Avoidance of antibiotic use for acute bronchitis (AAB)	D: Unfav R: Fav	D: Unfav R: Unfav	D: Unfav R: Fav	D: Fav R: Unfav
PQI – Admissions per 1,000 members	Diabetes short-term complications (PQI-90-1)	D: Unfav R: Unfav	D: Unfav R: Unfav	D: Unfav R: Unfav	D: Fav R: Fav
	Diabetes long-term complications (PQI-90-3)	D: Unfav R: Unfav	D: Unfav R: Unfav	D: Unfav R: Unfav	D: Unfav R: Unfav
	Chronic obstructive pulmonary disease or asthma in older adults (PQI-90-5)	D: Unfav R: Unfav	D: Unfav R: Unfav	D: Unfav R: Unfav	D: Unfav R: Unfav
	Hypertension (PQI-90-7)	D: Fav R: Fav	D: Unfav R: Unfav	D: Fav R: Fav	D: Fav R: Fav
	Heart failure (PQI-90-8)	D: Unfav R: Unfav	D: Unfav R: Fav	D: Unfav R: Unfav	D: Fav R: Unfav
	Community-acquired pneumonia (PQI-90-11)	D: Unfav R: Unfav	D: Unfav R Unfav	D: Unfav R: Unfav	D: Unfav R: Unfav
	Urinary tract infection (PQI-90-12)	D: Unfav R: Fav	D: Fav R: Fav	D: Unfav R: Unfav	D: Fav R: Fav
	Uncontrolled diabetes (PQI-90-14)	D: Unfav R: Fav	D: Unfav R: Unfav	D: Unfav R: Fav	D: Fav R: Fav
	Asthma in younger adults (PQI-90-15)	D: Unfav R: Unfav	D: Fav R: Fav	D: Unfav R: Fav	D: Unfav R: Unfav
	Lower extremity amputation for patients with diabetes (PQI-90-16)	D: Unfav R: Fav	D: Unfav R: Unfav	D: Fav R: Fav	D: Unfav R: Unfav

Notes: Green indicates favorable ACO effect in both difference-in-differences and regression analyses; red indicates unfavorable ACO effect in both difference-in-differences and regression analyses; and yellow indicates favorable ACO effect in difference-in-differences and unfavorable ACO effect in regression

analyses or unfavorable ACO effect in difference-in-differences and favorable ACO effect in regression analyses. Only statistically significant regression results are considered favorable.

[1] 2016 in only applicable to Medicaid; commercial and Medicare results are based on claims for 2017 through 2019.

D = Difference-in-differences result; Fav = favorable; R = regression results; Unfav = unfavorable; SS = statistically significant.

I.   Overview

The purpose of this analysis is to evaluate the Vermont All-Payer Accountable Care Organization (ACO) Model, comparing cost and quality between ACO and non-ACO participants, controlling for patient risk and other factors. Specifically, we assessed whether the ACO was associated with lowered costs and improved quality for its attributed members using three methodological approaches: (1) a descriptive analysis, (2) a difference-in-differences calculation, and (3) a regression analysis. We did not estimate the causal impact of the ACO on cost and quality measures but rather assessed differences between members who were aligned with the ACO and those who were not aligned.

First, we describe methods, including the construction of the analytic file, risk adjustment, and methods for descriptive and statistical analyses. Then we summarize descriptive results. Additional descriptive results can be found in the attachment: ACO Evaluation Visualization Tables. Finally, we display and interpret results from the difference-in-differences and regression analyses.

II. Methods

A. Study population

Using the Vermont Health Care Uniform Reporting and Evaluation System (VHCURES), OnPoint Health Data created an analytic file with records unique at the member-year-payer level. Namely, for each year, the file contains one record per member for each primary payer.[2] This file includes members who switched payers during a calendar year and members whose ACO alignment status changed during the year. The population includes all members included in Total Cost of Care (TCOC) reporting, such as Medicare end-stage renal disease beneficiaries and beneficiaries dually eligible for Medicaid and Medicare (whom we assign to Medicare). Per the All-Payer Model ACO Agreement, Medicare Advantage beneficiaries are assigned to the commercial non-ACO population. We also included grouping variables such as age group,[3] gender, hospital service area (HSA),[4] and ACO designation. The values for age, gender, and HSA are uniform for a given member within a year even if they switch payers; however, ACO designation is payer specific.[5] For each member-payer-year record, the file contains a count of member months and of months aligned with the ACO. The former variable indicates the number of months during the year that the member was attributed to a specific payer. For members aligned with the ACO, ACO months show how many months of a given year the member was aligned with the ACO for that payer. The file also includes unscaled risk scores, allowed and paid amounts, Medicaid capitated payments and Medicare population-based payments, and encounter counts.[6] Allowed amounts and encounter counts are displayed in total and disaggregated by major service category (inpatient, outpatient emergency room [ER], outpatient non-ER, professional, and other[7]) and by the state where the care was provided (Vermont, New Hampshire, Other States, and Unknown). To determine the state where care was provided, OnPoint used a hierarchy approach that considers billing provider location first, rendering provider second, and attending provider third.

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[2] For example, the file contains one 2017 record for a member enrolled in a commercial plan all year. If a member transitioned from commercial to Medicare during the year, the file includes two records for that member, each with a count of the number of months assigned to the respective payer and the number of months enrolled in the ACO for each respective payer.

[3] Age was grouped into 00<01, 01 – 04, 05 – 11, 12 – 17, 18 – 34, 35 – 44, 45 – 54, 55 – 64, 65 – 74, 75 – 84, and 85+.

[4] HSA is based on members' residence. HSAs in Vermont are Barre, Bennington, Brattleboro, Burlington, Middlebury, Morrisville, Newport, Randolph, Rutland, Springfield, St. Albans, St. Johnsbury, and White River Junction.

[5] For example, if a patient is in the Medicaid ACO from January to July and then switches to a commercial plan that is not participating in the ACO, only the Medicaid record will reflect ACO alignment.

[6] Encounter counts are structured as counts of unique discharges for inpatient, skilled nursing facility (SNF), and intermediate care facility (ICF) services, and unique claim header counts for other service categories. Please note that a single episode of inpatient care can include multiple unique discharges; for example, if patients are transferred to a different facility or department within the same facility. Outpatient facility encounters may also include multiple claims per encounter. Therefore, inpatient counts might be overstated relative to other utilization analyses that focus on inpatient episodes and outpatient counts might be overstated relative to other utilization analyses that focus on outpatient facility encounters.

[7] The "other" service category includes home health, hospice, durable medical equipment, skilled nursing facility (SNF), intermediate care facility (ICF), and other categories of care. SNF and ICF are excluded from Medicaid costs and encounter counts.

The total cost calculation varies by payer.[8] For Medicare members, total cost equals the sum of allowed amount and population-based payments. For Medicaid members, total cost equals the sum of allowed amount and capitated payments multiplied by a year-specific repricing adjustment factor. For commercial members, total cost simply equals total allowed amount. [9] We then calculated total cost per-member-per-month (PMPM) by dividing total cost by the number of member months.

The analytic file also contains numerator and denominator variables for the measures of interest. *Specifically, the analytic file includes the following Health Effectiveness Data and Information Set (HEDIS) measures:*

1. Emergency department utilization (EDU)

2. Initiation of alcohol and other drug abuse or dependence treatment (IET1)

3. Engagement of alcohol and other drug abuse or dependence treatment (IET2)

4. 30-day follow-up after discharge from the ED for alcohol and other drug abuse or dependence (FUA)

5. 30-day follow-up after discharge from the ED for mental health (FUM)

6. Avoidance of antibiotic use for acute bronchitis (AAB)

and the following Prevention Quality Indicator (PQI) measures from the Agency for Healthcare Research and Quality (AHRQ):

1. Diabetes short-term complications (PQI-90-1)

2. Diabetes long-term complications (PQI-90-3)

3. Chronic obstructive pulmonary disease or asthma in older adults (PQI-90-5)

4. Hypertension (PQI-90-7)

5. Heart failure (PQI-90-8)

6. Community-acquired pneumonia (PQI-90-11)

7. Urinary tract infection (PQI-90-12)

8. Uncontrolled diabetes (PQI-90-14)

9. Asthma in younger adults (PQI-90-15)

10. Lower extremity amputation for patients with diabetes (PQI-90-16)

Most HEDIS measures calculate receipt of desired services across the population; hence higher scores indicate better performance. However, the EDU measure calculates a non-desired outcome, and therefore a lower score indicates better performance. Similarly, PQI measures calculate admission rates for specific

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[8] For descriptive results, we added non-claims costs that are not available at the person-level, such as incentive program payments and Medicare shared savings, and added these to results in tables showing total cost of care by payer and ACO designation. These additional non-claims costs are estimates from total cost of care reporting and represent a small portion of total costs. We do not include non-claims in descriptive results showing costs by service category or location of care because we are unable to estimate non-claims costs at these levels.

[9] We did not include Medicare shared savings adjustments, commercial non-claims payments, or Medicaid incentive program payments, because these are not available in VHCURES. However, we did append estimates of all non-claims amounts to descriptive data and these costs are included in the visualization tables and descriptive results unless otherwise noted.

diagnoses; hence lower scores indicate better performance. Appendix A shows the layout of the VHCURES analytic file.

B. Risk adjustment

We used the Johns Hopkins Adjusted Clinical Groups® (ACG) System grouper to calculate concurrent risk scores and scaled to the population average in 2017. A risk score above 1.0 implies that a member has a higher risk than the average member in the analytical file in 2017. By using 2017 as the base year for scaling, we account for possible changes in health risk over time. The ACG risk score is calculated using members' demographic information and claims experience. To mitigate against artificially low scores due to insufficient claims experience, we required 9 months or more of continuous enrollment to generate a risk score. (Note that continuous enrollment may span years.) We excluded members with no risk score from all analyses. Table II.1 shows the percentage of total excluded costs associated with members' missing risk scores by year, payer, and ACO alignment. (Tables II.3, II.4, and II.6 show frequencies of member months excluded from each respective analysis).

Table II.1. Percentage of total costs excluded due to members' missing risk scores, by payer and ACO alignment

	2017		2018		2019	
Payer	**ACO**	**Non-ACO**	**ACO**	**Non-ACO**	**ACO**	**Non-ACO**
Commercial	n/a	5.9	2.2	5.6	3.2	6.5
Medicaid	2.9	10.4	2.9	9.8	3.8	15.2
Medicare	n/a	6.7	6.5	6.7	6.8	7.7

Source: VHCURES, John Hopkins ACG algorithm

ACO = Accountable Care Organization; n/a = not applicable; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

We risk adjusted cost, utilization, and quality measures by dividing the variable by the average rescaled risk score within the group of interest. Table II.2 summarizes average rescaled risk scores by payer and year. The table shows that Medicare and Medicaid members who are aligned with the ACO have higher risk scores, on average, than members who are not aligned with the ACO. Among commercially insured members, the average risk score is slightly lower for ACO members.

Table II.2. Mean rescaled risk scores by payer and ACO alignment

	2017		2018		2019	
Payer	**ACO**	**Non-ACO**	**ACO**	**Non-ACO**	**ACO**	**Non-ACO**
Commercial	n/a	0.60	0.60	0.63	0.62	0.65
Medicaid	0.78	0.73	0.77	0.78	0.80	0.78
Medicare	n/a	1.78	2.05	1.73	2.07	1.65

Source: VHCURES, John Hopkins ACG algorithm

ACO = Accountable Care Organization; n/a = not applicable; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

We Winsorized risk scores to reduce the influence of extremely small and large rescaled risk scores. That is, we set risk scores that were smaller than the first percentile to the value of the first percentile and we set risk scores that were larger than the 99th percentile to the 99th percentile.[10]

C. Descriptive statistics

To produce descriptive statistics, we aggregated data in the analytic file up from the year-payer-member level to the year-payer level, summing member months, ACO months, cost variables, scaled risk scores, and measure numerators and denominators. We added estimates of non-claims costs and applied a repricing adjustment to 2018 and 2019 Medicaid claims. Aggregated data are available in the attached Excel workbook, "ACO Evaluation Key Stats.xlsx." We then used the data to produce visualizations by payer type in the attached Excel workbook "ACO Evaluation Visualization Tables,"[11] including tables showing results by category of service and by the state where care was provided. Users can filter these tables to observe specific populations of interest, such as results among a particular age group or HSA. Table II.3 shows the number and percentages of member-month records that are included in the descriptive analyses, by payer and overall. ***Note, that most descriptive results are not risk adjusted: PMPM costs are risk adjusted while quality measure results are not risk adjusted.***

Table II.3. Step down of member months exclusions, descriptive statistics (2017-2019)

Exclusion step	All Payers		Commercial		Medicaid		Medicare	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Base member months	16,470,867	100	7,304,906	100	4,777,241	100	4,388,720	100
Missing risk score	728,894	4.4	338,758	4.6	315,068	6.6	75,068	1.7
Final member months	15,741,973	95.6	6,966,148	95.4	4,462,173	93.4	4,313,652	98.3

Source: VHCURES

VHCURES = Vermont Health Care Uniform Reporting and Evaluation System

D. Statistical analyses

We performed two types of statistical analyses to assess how total costs and quality measures differed between ACO members and non-ACO members: (1) difference-in-differences analyses and (2) regression analyses. Although the difference-in-differences and regression analyses control for observed member characteristics, estimated effects should not be interpreted as the causal impact of alignment with the ACO on total cost or quality measures.

1. Difference-in-differences analyses

The difference-in-differences analysis compares total costs and quality measures for ACO-aligned and unaligned members before and after the ACO was established. Specifically, we first divided members into two categories: (1) those who were attributed to the ACO at any time since its inception (based on PCP) and (2) those who were never attributed to the ACO. The first category includes members attributed to the ACO for only part of the intervention period. Therefore, our difference-in-differences results somewhat understate the effect of the ACO. We then split the analysis population into pre- and post-ACO years

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[10] The lower Winsorization threshold value was 0.000043 and the upper Winsorization threshold value was 10.5094.
[11] Because this evaluation is limited to members who meet nine or more months of continuous enrollment criteria with risk scores, results will differ from TCOC reporting.

depending on members' payers. For Medicaid, the pre-ACO period was 2016 and the post-ACO period was 2017 to 2019. For Medicare and commercial, the pre-ACO period was 2017 and the post-ACO period was 2018 to 2019. ***For the payer-specific analyses, we restricted the sample to members who were attributed to the same payer during the entire time they were included in the analysis sample, but we included all members in the overall (all-payer) analysis.*** That is, we excluded members who switched payers during the analysis period from the payer-specific analyses. Although we required continuous enrollment with the same payer, we did not require ACO alignment throughout the entire period. Table II.4 shows the number and percentages of member-month records that are included in this analysis, by payer and overall. The difference-in-differences analyses use aggregate risk-adjusted outcomes and therefore considers population-level risk as opposed to individual members' risk. In contrast, the regression analyses use member-level data, and controls for individual characteristics.

Table II.4. Step down of member month exclusions, difference-in-differences analysis (2017-2019)

	All Payers		Commercial		Medicaid		Medicare	
Exclusion step	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Base member months	16,470,867	100	7,304,906	100	4,777,241	0	4,388,720	100
Missing risk score	728,894	4.4	338,758	4.6	315,068	6.6	75,068	1.7
Switched payers[1]	0	0	799,310	10.9	557,242	11.7	419,887	9.6
Final member months	15,741,973	95.6	6,166,838	84.4	3,904,931	81.7	3,893,765	88.7

Source: VHCURES

[1] Excluded from payer specific analyses only.

VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

Formally, we calculated the difference-in-differences effect as

$$\Delta = \left(\bar{Y}_{ACO,post} - \bar{Y}_{ACO,pre} \right) - \left(\bar{Y}_{non-ACO,post} - \bar{Y}_{non-ACO,pre} \right) \qquad (1)$$

In this expression, $\bar{Y}_{ACO,post}$ is the average outcome (total cost or quality measure) for members who were ever aligned with the ACO in the post-period (2017 and onwards for Medicaid and 2018 and onwards for Medicare and commercial) and $\bar{Y}_{ACO,pre}$ is the average outcome for members who were ever aligned with the ACO in the baseline period (2016 for Medicaid and 2017 for Medicare and commercial). In other words, $\bar{Y}_{ACO,pre}$ is the average outcome for members who would later be aligned with ACO but before the ACO was established. $\bar{Y}_{non-ACO,post}$ and $\bar{Y}_{non-ACO,pre}$ are defined similarly for members who were never aligned with the ACO. The difference-in-differences effect Δ can be interpreted as the difference in the change in outcomes from before the ACO was established to after the ACO was established between members who were and were not attributed to the ACO. Table II.5 shows the method in a tabular form.

Table II.5. Difference-in-differences calculation

	Before ACO	After ACO	Difference
ACO-attributed	$\bar{Y}_{ACO,pre}$	$\bar{Y}_{ACO,post}$	$\Delta_{ACO} = \bar{Y}_{ACO,post} - \bar{Y}_{ACO,pre}$
Non-ACO attributed	$\bar{Y}_{non-ACO,pre}$	$\bar{Y}_{non-ACO,post}$	$\Delta_{non-ACO} = \bar{Y}_{non-ACO,post} - \bar{Y}_{non-ACO,pre}$
Difference			$\Delta = \Delta_{ACO} - \Delta_{non-ACO}$

Notes: The $\bar{Y}$s are population-level risk-adjusted measure scores.

ACO = Accountable Care Organization.

We constructed outcomes as follows:

- For the total cost measure, we summed total costs separately in each of the four cells shown in Table II.5 (ACO/post, ACO/pre, non-ACO/post, and non-ACO/pre) and divided each by the sum of the scaled ACG score in the same cell.

- For the HEDIS and PQI measures, we divided the sum of the numerator by the sum of the denominator for each cell. We weighted each member-level observation by the number of member months to give higher importance to members who were included in the population longer.

- For the ACO/post cell, we weighted by the number of ACO months instead of the number or member months to give higher importance to those with more exposure to ACO services. We then calculated the difference-in-differences effect according to equation (1). We performed these calculations separately for each payer and for the entire sample.

2. Regression analyses

For the regression analyses we used the member-year-payer level file described in Section II.A. We estimated how each outcome of interest (total spending and HEDIS and PQI quality measures) differs between ACO and non-ACO members, controlling for member characteristics. For the HEDIS and PQI measures, we used the respective numerator as the outcome variable and converted regression estimates to measure rates per 1,000 members. The numerator of each measure counts the number of relevant events (such as inpatient admissions due to hypertension) except for the HEDIS measures initiation of and engagement in alcohol and other drug dependence treatment where the numerator equals zero or one. To control for member characteristics, we included age group, gender, HSA, and scaled ACG risk score as regression covariates. In addition, we controlled for year and, for regressions that pooled observations across all payers, for payer. The covariate of interest is the ACO variable, which equals one if a member-year-payer observation was affiliated with the ACO and zero if an observation was not affiliated with the ACO. We interpreted the regression coefficient on the ACO variable (δ in the equation below) as the regression-adjusted differences in outcomes between ACO members and non-ACO members. For example, this coefficient measures by how much total spending PMPM differs on average between ACO and non-ACO members when holding member characteristics, payer type, and year constant. We estimated these regressions separately for each payer group and for a pooled sample that included observations for all three payer groups.

The following equation illustrates our regression model:

$$Y_{itp} = \delta ACO_{itp} + X_{itp}\beta + \alpha_p + \gamma_t + u_{itp}$$

In this regression model, Y_{itp} is the outcome of member i in year t when attributed to payer p, ACO_{itp} is a binary variable indicating ACO membership, X_{itp} contains member characteristics (age group, gender, HSA, and scaled ACG risk score), and α_p and γ_t are indicators for payer group and year, respectively. (We only included α_p in regressions that pooled observations across all payer types.) By controlling for year, we can account for the fact that we only include Medicaid members for 2017. We weighted the regression by member months, so members who were enrolled longer in a given year received more importance. We used appropriate regression models depending on the outcome. Specifically, we used linear regression models for spending PMPM, logistics regression models for binary measures (the HEDIS measures initiation of and engagement in alcohol and other drug dependence treatment), and the Poisson regressions model for measures that represent counts of service use per 1,000 members (the remaining HEDIS measures and all PQI measures). For ease of interpretation, we reported the marginal effects instead of raw coefficients. Thus, our results can directly be interpreted as the regression-adjusted difference between ACO members and non-ACO members in units of the respective outcome. We also reported 95 percent confidence intervals to show how precisely these differences are estimated. To assess how well the regressions predicted outcomes for ACO members and non-ACO members, we compared unadjusted outcome means to mean predicted outcomes separately for each group.

To obtain more meaningful estimates of the difference in outcomes between ACO members and non-ACO members, we restricted the sample for the regression analyses to members that had some contact with the health care system in a given year; that is, we only included observations where total spending exceeded zero. Table II.6 shows the number and percentage of member months that are included in this analysis, by payer and overall.

Table II.6. Step down of member month exclusions, regression analysis (2017-2019)

	All Payers		Commercial		Medicaid		Medicare	
Exclusion step	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Base member months	16,470,867	100	7,304,906	100	4,777,241	100	4,388,720	100
Missing risk score	728,894	4.4	338,758	4.6	315,068	6.6	75,068	1.7
Zero spending	1,674,635	10.2	819,783	11.2	377,221	7.9	477,631	10.9
Final member months	14,067,338	85.4	6,146,365	84.1	4,084,952	85.5	3,836,021	87.4

Source: VHCURES

VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

The percentage of members having positive spending differs by payer and ACO status (Table II.7). Specifically, ACO-members are more likely to have at least one service use per year as reflected by lower percentages with zero spending. Almost all Medicaid ACO members have positive spending while only 80 percent of Medicaid non-ACO members have positive spending. We also restricted the analytic population for each HEDIS and PQI measure to members who satisfied the inclusion criteria for the respective measure. For example, the HEDIS FUA measure is limited to members with an emergency department visit with a principal diagnosis of alcohol or other drug (AOD) abuse or dependence. Therefore, the number of members included for each outcome differed across regressions. (See Appendix C.1 for quality measure population sizes).

Table II.7. Percentage of records with zero spending by payer and ACO alignment

Payer	Non-ACO-aligned	ACO-aligned
Medicare	15.5%	2.2%
Medicaid	19.7%	0.2%
Commercial	16.5%	10.2%

Source: VHCURES data.

ACO = Accountable Care Organization; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

It is important to note that the difference-in-differences effects or the estimated regression coefficients on the ACO variable should not be interpreted as the causal impact of alignment with the ACO on total cost or quality measures. Although we controlled for observed characteristics, such as age, gender, and risk score, there could be unobserved characteristics that affect cost or quality outcomes. For example, if unobserved member characteristics are associated with their primary care provider's alignment with the ACO, this would lead to selection bias, and ACO alignment alone would not necessarily cause observed differences in costs and outcomes.

III. Results

A. Descriptive results

Below are descriptive cost and measure results for all payer groups. Note that descriptive results are similar to results displayed in TCOC reports. However, the population included here is limited to those with nine or more months of continuous enrollment for whom risk scores were generated, which accounts for differences from TCOC results. We also risk-adjust PMPM costs, which we do not show in TCOC reports.

Growth in Risk Adjusted PMPM TCOC by ACO alignment. Table III.1 displays risk adjusted PMPM costs and 2018 to 2019 cost growth by payer type and ACO alignment. Accounting for patient risk, PMPM costs went down among the ACO-aligned Medicaid population, which also caused risk-adjusted PMPM to decrease among the all-payer ACO population. Risk adjusted 2019 PMPM costs were higher and increased more among the commercial ACO population than the commercial non-ACO population. Risk adjusted Medicare ACO PMPM costs were lower than Medicare non-ACO costs, and 2019 cost growth was similar between the Medicare ACO and non-ACO populations.

Table III.1. Risk Adjusted PMPM growth rate (2017–2019) by payer and ACO alignment

Payer	ACO alignment	2019 average risk score	Risk adjusted PMPM*			
			2017	2018	2019	Percentage change (2018–2019)
All payers	ACO-aligned	1.19	$368.24	$474.17	$465.22	-1.9%
	Non-ACO-aligned	0.92	$518.93	$528.67	$571.35	8.1%
Commercial	ACO-aligned	0.62		$796.60	$856.82	7.6%
	Non-ACO-aligned	0.65	$757.98	$735.46	$750.03	2.0%
Medicare	ACO-aligned	2.07		$443.11	$456.12	2.9%
	Non-ACO-aligned	1.65	$449.66	$465.59	$478.25	2.7%
Medicaid	ACO-aligned	0.80	$368.24	$360.41	$349.49	-3.0%
	Non-ACO-aligned	0.78	$333.16	$341.20	$358.88	5.2%

* PMPM amounts include non-claim payments.

ACO = Accountable Care Organization; PMPM = per member per month.

In-state and out-of-state claims costs by ACO alignment. Table III.2 shows the percentage of costs incurred in Vermont over time and by payer group. The share of costs incurred in Vermont decreased steadily between 2017 and 2019, particularly among commercial ACO members. Among Medicare beneficiaries, ACO-aligned residents incurred a higher portion of claims costs in the state compared to non-ACO-aligned residents. Conversely, among Medicaid members, a higher portion of costs were incurred in other states, particularly New Hampshire, among ACO-aligned members than among non-ACO-aligned members.

Table III.2. Percent of claims costs incurred in Vermont by payer group and ACO alignment (2017–2019)

Payer group	ACO alignment	Percentage of claims costs incurred in Vermont			Percentage point difference (2018–2019)
		2017	2018	2019	
All payer	Total	77.8	75.5	71.9	**-3.6**
	ACO-aligned	88.0	79.0	73.1	**-5.9**
	Non-ACO-aligned	77.7	74.8	71.5	**-3.3**
Commercial	Total	81.6	80.5	75.0	**-5.5**
	ACO-aligned	-	88.1	77.7	**-10.4**
	Non-ACO-aligned	81.6	79.2	74.6	**-4.6**
Medicare	Total	73.2	69.6	68.3	**-1.3**
	ACO-aligned	-	75.4	73.3	**-2.1**
	Non-ACO-aligned	73.2	68.0	65.9	**-2.1**
Medicaid	Total	82.0	78.5	71.9	**-6.6**
	ACO-aligned	88.0	68.1	65.0	**-3.1**
	Non-ACO-aligned	81.3	80.5	76.1	**-4.4**

ACO = Accountable Care Organization. Results are not adjusted for patient risk.

HEDIS measure scores by ACO alignment. Table III.3 shows HEDIS measure scores by ACO alignment. ***These results are not adjusted for patient risk***; for results adjusted for patient risk, see difference-in-differences and regression results in Sections III.B and III.C, respectively. For HEDIS measures, a higher score indicates better performance, except for the EDU measure. Across all years and payers, ACO-aligned members were more likely than non-ACO-aligned members to use the ED, but also were more likely to receive desired services included in the FUA, FUM, and AAB measures. In 2019, commercial ACO members scored better than non-ACO members on three measures (EDU, FUA, and AAB); however, the FUA measure score among the commercial ACO-aligned population is based on a relatively small population (N<50; Appendix C.1). Medicaid ACO members scored better than non-ACO members on two measures (FUA, and FUM) and Medicare ACO members scored better than non-ACO members on four measures (IET Initiation, FUA, FUM, and AAB).

Table III.3. Overall HEDIS measure scores by payer group and ACO alignment (2018–2019)

Payer group	HEDIS measures	Desired score	2018			2019			Percentage point difference (2018–2019)	
			ACO	Non-ACO	Difference	ACO	Non-ACO	Difference	ACO	Non-ACO
All payers	HEDIS EDU	Lower	43.7%	33.7%	10.0%	47.5%	30.4%	17.1%	3.8	–3.3
	HEDIS IET1	Higher	36.7%	37.9%	-1.2%	38.9%	38.4%	0.5%	2.2	0.5
	HEDIS IET2	Higher	13.3%	16.4%	-3.1%	16.8%	17.0%	-0.2%	3.5	0.6
	HEDIS FUA	Higher	28.0%	24.0%	4.0%	28.3%	23.5%	4.8%	0.3	–0.5

Payer group	HEDIS measures	Desired score	2018			2019			Percentage point difference (2018–2019)	
			ACO	Non-ACO	Difference	ACO	Non-ACO	Difference	ACO	Non-ACO
	HEDIS FUM	Higher	84.3%	82.4%	1.9%	90.3%	84.7%	5.6%	6.0	2.3
	HEDIS AAB	Higher	42.3%	36.1%	6.2%	42.5%	41.8%	0.7%	0.2	5.7
Commercial	HEDIS EDU	Lower	17.3%	20.9%	-3.6%	17.2%	21.7%	-4.5%	−0.1	0.8
	HEDIS IET1	Higher	32.1%	34.6%	-2.5%	29.3%	33.5%	-4.2%	−2.8	−1.1
	HEDIS IET2	Higher	12.0%	16.6%	-4.6%	13.6%	14.7%	-1.1%	1.6	−1.9
	HEDIS FUA	Higher	14.0%	15.7%	-1.7%	19.0%	12.8%	6.2%	5.0	−2.9
	HEDIS FUM	Higher	77.5%	82.6%	-5.1%	79.4%	80.6%	-1.2%	1.9	−2.0
	HEDIS AAB	Higher	47.2%	35.8%	11.4%	47.0%	41.3%	5.7%	−0.2	5.5
Medicaid	HEDIS EDU	Lower	66.6%	59.2%	7.4%	68.3%	53.9%	14.4%	1.7	−5.3
	HEDIS IET1	Higher	36.9%	40.6%	-3.7%	39.3%	44.4%	-5.1%	2.4	3.8
	HEDIS IET2	Higher	16.1%	21.0%	-4.9%	20.6%	24.2%	-3.6%	4.5	3.2
	HEDIS FUA	Higher	30.1%	27.3%	2.8%	29.9%	27.2%	2.7%	−0.2	−0.1
	HEDIS FUM	Higher	89.6%	86.0%	3.6%	91.7%	87.8%	3.9%	2.1	1.8
	HEDIS AAB	Higher	45.9%	42.6%	3.3%	42.8%	51.4%	-8.6%	−3.1	8.8
Medicare	HEDIS EDU	Lower	48.3%	40.5%	7.8%	47.9%	38.3%	9.6%	−0.4	−2.2
	HEDIS IET1	Higher	38.5%	37.3%	1.2%	42.0%	38.0%	4.0%	3.5	0.7
	HEDIS IET2	Higher	9.0%	8.2%	0.8%	10.1%	10.3%	-0.2%	1.1	2.1
	HEDIS FUA	Higher	26.1%	19.8%	6.3%	23.7%	23.0%	0.7%	−2.4	3.2
	HEDIS FUM	Higher	69.7%	74.0%	-4.3%	88.0%	83.3%	4.7%	18.3	9.3
	HEDIS AAB	Higher	32.2%	26.5%	5.7%	38.9%	30.7%	8.2%	6.7	4.2

Notes: Green highlight indicates favorable change in HEDIS measure score among ACO population relative to non-ACO population. Higher scores are favorable on all measures except HEDIS EDU. EDU rates are the number of ED visits among eligible members. IET1, IET2, FUA, and FUM rates are the percentage of eligible members who received the desired service. AAB rates are the percentage of episodes where the desired service was received. Results are not adjusted for patient risk.

AAB = adults with acute bronchitis; ACO = Accountable Care Organization; EDU = emergency department utilization; FUA = follow-up after ED visit for alcohol and other drug abuse or dependence; FUM = follow-up after ED visit for mental illness; IET = initiation and engagement.

PQI measure rates by ACO alignment. Across all payers, the PQI admission rates for most conditions were higher for ACO-aligned members than non-ACO-aligned members in 2018 and 2019, except for hypertension admissions, which were lower among the ACO population in 2019 (Table III.4). In 2019, a higher portion of Medicaid ACO members were hospitalized for all PQI conditions than their non-ACO-aligned counterparts. Likewise, a higher portion of Medicare ACO-aligned members were hospitalized in 2019 for all PQI indicators except hypertension. However, commercial ACO-aligned members had fewer

hospitalizations in 2019 than their non-ACO-aligned counterparts on 8 of the 10 PQI conditions. Note, however, that these results are not adjusted for patient risk. See sections III.B and III.C for risk-adjusted results.

Table III.4. Overall PQI admission rates by ACO alignment (2018–2019)

Payer group	PQI indicator: admissions per 1,000 members	2018		2019		Percentage change (2018–2019)	
		ACO	Non-ACO	ACO	Non-ACO	ACO	Non-ACO
All payer	PQI01: Diabetes short-term complications	8.8	6.0	12.1	5.0	37.5%	−16.7%
	PQI03: Diabetes long-term complications	13.6	9.5	18.2	9.6	33.8%	1.1%
	PQI05: COPD or asthma[1]	52.0	46.5	63.1	39.0	21.3%	−16.1%
	PQI07: Hypertension	6.2	3.1	3.8	4.0	−38.7%	29.0%
	PQI08: Heart failure	59.4	35.2	68.8	33.7	15.8%	−4.3%
	PQI11: Community acquired pneumonia	34.3	29.6	45.1	24.3	31.5%	−17.9%
	PQI12: UTI	21.2	15.4	20.8	14.7	−1.9%	−4.5%
	PQI14: Uncontrolled diabetes	3.7	2.8	5.5	3.6	48.6%	28.6%
	PQI15: Asthma[2]	4.0	2.6	6.3	2.7	57.5%	3.8%
	PQI16: Lower extremity amputations	4.2	3.5	5.8	2.6	38.1%	−25.7%
Commercial	PQI01: Diabetes short-term complications	2.7	2.5	2.6	3.2	−3.7%	28.0%
	PQI03: Diabetes long-term complications	1.6	3.2	3.1	4.0	93.8%	25.0%
	PQI05: COPD or asthma[1]	5.5	17.0	9.2	17.3	67.3%	1.8%
	PQI07: Hypertension	1.6	1.7	0.5	2.4	−68.8%	41.2%
	PQI08: Heart failure	6.9	10.9	4.2	14.5	−39.1%	33.0%
	PQI11: Community acquired pneumonia	5.3	10.4	6.8	9.4	28.3%	−9.6%
	PQI12: UTI	1.1	4.3	1.6	5.0	45.5%	16.3%
	PQI14: Uncontrolled diabetes	0.0	0.8	0.0	1.6	-	100.0%
	PQI15: Asthma[2]	1.6	0.7	3.2	1.2	100.0%	71.4%
	PQI16: Lower extremity amputations	0.0	0.8	1.6	0.6	-	−25.0%
Medicaid	PQI01: Diabetes short-term complications	17.2	12.7	22.5	12.8	30.8%	0.8%
	PQI03: Diabetes long-term complications	18.5	9.6	20.7	7.2	11.9%	−25.0%
	PQI05: COPD or asthma[1]	62.6	63.0	85.8	49.9	37.1%	−20.8%
	PQI07: Hypertension	4.5	2.3	2.1	1.6	−53.3%	−30.4%
	PQI08: Heart failure	16.6	10.2	16.4	11.5	−1.2%	12.7%
	PQI11: Community acquired pneumonia	10.8	13.3	23.2	10.5	114.8%	−21.1%
	PQI12: UTI	8.3	5.0	6.4	4.9	−22.9%	-2.0%
	PQI14: Uncontrolled diabetes	1.3	2.1	3.6	3.0	176.9%	42.9%
	PQI15: Asthma[2]	6.1	4.6	6.7	6.1	9.8%	32.6%
	PQI16: Lower extremity amputations	7.0	3.5	6.4	2.3	−8.6%	−34.3%
Medicare	PQI01: Diabetes short-term complications	8.2	7.5	9.5	4.7	15.9%	−37.3%
	PQI03: Diabetes long-term complications	19.0	20.1	23.7	22.0	24.7%	9.5%
	PQI05: COPD or asthma[1]	70.7	76.1	73.5	66.9	4.0%	−12.1%

Payer group	PQI indicator: admissions per 1,000 members	2018		2019		Percentage change (2018–2019)	
		ACO	Non-ACO	ACO	Non-ACO	ACO	Non-ACO
	PQI07: Hypertension	10.4	5.9	6.5	8.3	−37.5%	40.7%
	PQI08: Heart failure	119.1	91.5	136.5	82.9	14.6%	−9.4%
	PQI11: Community acquired pneumonia	67.1	71.8	78.7	60.9	17.3%	−15.2%
	PQI12: UTI	42.0	40.5	40.1	38.8	−4.5%	−4.2%
	PQI14: Uncontrolled diabetes	7.5	6.6	9.5	8.0	26.7%	21.2%
	PQI15: Asthma[2]	0.0	11.0	17.8	4.7	-	−57.3%
	PQI16: Lower extremity amputations	5.4	8.1	7.5	6.8	38.9%	−16.0%

Notes: Lower scores are favorable. Green highlight indicates decreased admission rates among ACO participants, or larger decreases in admission rates than among the ACO population. Results are not adjusted for patient risk.

[1] Restricted to adults ages 40 years and older.

[2] Restricted to younger adults ages 18 through 39 years.

ACO = Accountable Care Organization; COPD = chronic obstructive pulmonary disease; PQI = Preventive Quality Indicator; UTI = urinary tract infection.

B. Difference-in-differences results

Table III.5 displays the difference-in-differences effects overall and by payer.[12] Note that these results are adjusted for patient risk. We found that the difference-in-differences effect for total cost PMPM is positive overall, indicating that ACO members' PMPM spending increased by about $27 more between the pre- and post-ACO periods compared to non-ACO members. However, for Medicaid and commercial members, this effect was negative indicating that Medicaid and commercial ACO members have a lower cost increase between the pre- and post-ACO periods compared to non-ACO members. There is mixed evidence on how quality outcomes changed among ACO members relative to non-ACO members. Some measures showed an improvement among the ACO population (a positive difference-in-differences effect for most HEDIS measures and a negative effect for HEDIS EDU and PQI measures), but other measures showed a worsening. The measures that showed an improvement were not always consistent across payers. For example, Medicaid ACO members reduced ED utilization more than their non-ACO counterparts, but ED utilization grew more in the Medicare and commercial ACO populations than among non-ACO-aligned members. ACO members across all payers were more likely to receive follow-up care after an emergency department visit for alcohol or other drug use; though the eligible population for this measure was relatively small, particularly in the commercial ACO population (Appendix C.1). Conversely, admission rates were higher among the non-ACO population across all payers for members with the following diagnoses: Long-term diabetes, COPD or asthma in older adults, and community acquired pneumonia.

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[12] Appendix B contains detailed results for the cost and quality outcomes in the four cells pre/post and ACO/non-ACO.

Table III.5. Difference-in-differences effects of the ACO

Outcome	Desired ACO result	All payers	Medicaid	Medicare	Commercial
Total cost PMPM	Negative	$26.72	−$21.54	$29.72	−$18.56
ED utilization (HEDIS EDU)	Negative	11.7	−75.1	45.4	8.8
Initiation of AOD treatment (HEDIS IET1)	Positive	−37.5	−42.9	−2.1	14.0
Engagement in AOD treatment (HEDIS IET2)	Positive	−10.7	−3.7	−6.0	−14.1
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	58.4	53.1	71.4	135.7
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	12.9	29.8	−17.2	7.0
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	−47.9	−126.0	−5.5	36.9
Diabetes short-term complications admission rate (PQI 1)	Negative	0.25	0.54	0.36	−0.29
Diabetes long-term complications admission rate (PQI 3)	Negative	0.43	0.82	0.46	0.08
COPD or asthma in older adults admission rate (PQI 5)	Negative	1.65	4.06	3.83	0.46
Hypertension admission rate (PQI 7)	Negative	−0.06	0.26	−0.27	−0.08
Heart failure admission rate (PQI 8)	Negative	1.94	0.074	5.67	−0.16
Community acquired pneumonia admission rate (PQI 11)	Negative	1.01	0.78	2.56	0.14
Urinary tract infection admission rate (PQI 12)	Negative	0.07	−0.04	0.39	−0.15
Uncontrolled diabetes admission rate (PQI 14)	Negative	0.67	0.05	2.01	−0.05
Asthma admissions in younger adults (PQI 15)	Negative	0.12	−0.01	0.75	0.13
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.05	0.32	−0.11	0.03

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

C. Regression results

Table III.6 shows regression results for a pooled sample that includes members attributed to all payers. The table contains raw (that is, not regression-adjusted) means for ACO members and non-ACO members and the estimated regression-adjusted differences (marginal effect) between the two groups along with their 95 percent confidence intervals. We found that the unadjusted means of total cost PMPM are the same for ACO members and non-ACO members ($432). However, when adjusting for member

characteristics, total cost PMPM is about $12 dollars higher among ACO members, or about 3 percent of the mean total cost PMPM. Evidence on differences in quality measures between ACO members and non-ACO members is mixed. For HEDIS measures except for emergency department (ED) use, a higher value is better; for PQI measures, a lower value is better. Among the all-payer ACO population relative to the non-ACO population, we found:

1. Higher ED use
2. Lower initiation of and engagement in treatment for alcohol and other drug (AOD) dependence
3. Higher follow-up rates for AOD dependence and mental health following ED discharges
4. More avoidance of antibiotic use for acute bronchitis.

For the PQI measures, four had lower (better) rates among ACO members and six had higher (worse) rates.

Table III.6. Regression results, all payers (2016–2019)

Outcome	Desired ACO marginal effect	Average		Marginal effect	95 percent confidence interval
		ACO	Non-ACO		
Total cost PMPM	Negative	$432.29	$432.71	$12.36***	($9.60, $15.13)
ED utilization (HEDIS EDU)	Negative	488.9	405.8	18.2***	(18.2, 18.3)
Initiation of AOD treatment (HEDIS IET1)	Positive	378.8	392.8	−24.8***	(−29.2, −20.3)
Engagement in AOD treatment (HEDIS IET2)	Positive	158.5	166.9	−18.2***	(−21.6, −14.9)
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	365.9	300.0	44.3***	(44.0, 44.)
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	1,071.3	970.4	35.0**	(34.6, 35.5)
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	455.0	400.3	5.3*	(5.1, 5.5)
Diabetes short-term complications admission rate (PQI 1)	Negative	1.00	0.57	0.19*	(0.186, 0.189)
Diabetes long-term complications admission rate (PQI 3)	Negative	1.37	0.84	0.15*	(0.149, 0.152)
COPD or asthma in older adults admission rate (PQI 5)	Negative	5.11	4.69	0.01*	(0.009, 0.018)
Hypertension admission rate (PQI 7)	Negative	0.39	0.32	−0.04*	(−0.045, −0.043)
Heart failure admission rate (PQI 8)	Negative	5.32	3.44	0.36*	(0.357, 0.363)
Community acquired pneumonia admission rate (PQI 11)	Negative	3.35	2.62	0.15*	(0.145, 0.151)
Urinary tract infection admission rate (PQI 12)	Negative	1.74	1.43	−0.04*	(−0.041, −0.037)
Uncontrolled diabetes admission rate (PQI 14)	Negative	0.38	0.34	−0.03*	(−0.029, −0.027)
Asthma admissions in younger adults (PQI 15)	Negative	0.41	0.28	0.02*	(0.023, 0.026)

Outcome	Desired ACO marginal effect	Average		Marginal effect	95 percent confidence interval
		ACO	Non-ACO		
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.44	0.27	–0.02*	(–0.023, –0.021)

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

  * Significantly different from zero at the 0.10 level, two-tailed test.

 ** Significantly different from zero at the 0.05 level, two-tailed test.

*** Significantly different from zero at the 0.01 level, two-tailed test.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

Next, we estimated the same regressions separately for each payer type. Table III.7 shows our regression results for Medicaid. We found a larger total cost PMPM difference between ACO members and non-ACO members among the Medicaid population. Specifically, the total cost PMPM is $26 higher among Medicaid ACO members when controlling for patient risk factors, which corresponds to 11 percent of mean total cost PMPM among non-ACO members. Evidence regarding quality measures was mixed, with some favorable and some unfavorable differences. Medicaid ACO members performed significantly better than their non-ACO counterparts on the following five HEDIS and PQI measures: (1) 30-day follow-up after alcohol or drug related ED visits, (2) 30-day follow-up after mental health related ED visits, (3) heart failure admission rate, (4) UTI admission rate, and (5) young adult asthma admission rate.

Table III.7. Regressions results, Medicaid (2016–2019)

Outcome	Desired ACO marginal effect	Unadjusted means		Marginal effect	95 percent confidence interval
		ACO	Non-ACO		
Total cost PMPM	Negative	$249.45	$245.10	$26.45***	($23.60, $29.29)
ED utilization (HEDIS EDU)	Negative	716.6	774.7	10.5*	(10.4, 10.6)
Initiation of AOD treatment (HEDIS IET1)	Positive	387.1	423.2	–36.5***	(–42.8, –30.3)
Engagement in AOD treatment (HEDIS IET2)	Positive	192.8	212.4	–31.2***	(–36.3, –26.0)
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	386.3	332.6	43.9**	(43.5, 44.3)
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	1,083.4	1,007.4	25.4*	(24.8, 26.0)
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	480.5	481.4	–2.7*	(–3.0, –2.3)
Diabetes short-term complications admission rate (PQI 1)	Negative	1.91	1.22	0.51*	(0.508, 0.515)
Diabetes long-term complications admission rate (PQI 3)	Negative	1.58	0.71	0.50**	(0.496, 0.502)

Outcome	Desired ACO marginal effect	Unadjusted means		Marginal effect	95 percent confidence interval
		ACO	Non-ACO		
COPD or asthma in older adults admission rate (PQI 5)	Negative	6.52	6.35	0.57*	(0.552, 0.580)
Hypertension admission rate (PQI 7)	Negative	0.24	0.18	0.03*	(0.024, 0.027)
Heart failure admission rate (PQI 8)	Negative	1.30	1.05	−0.03*	(−0.030, −0.023)
Community acquired pneumonia admission rate (PQI 11)	Negative	1.45	1.29	0.01*	(0.010, 0.017)
Urinary tract infection admission rate (PQI 12)	Negative	0.20	0.34	−0.09*	(−0.095, −0.090)
Uncontrolled diabetes admission rate (PQI 14)	Negative	0.61	0.63	0.11*	(0.105, 0.110)
Asthma admissions in younger adults (PQI 15)	Negative	0.47	0.43	−0.04*	(−0.043, −0.037)
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.48	0.26	0.11*	(0.110, 0.113)

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

  * Significantly different from zero at the 0.10 level, two-tailed test.

 ** Significantly different from zero at the 0.05 level, two-tailed test.

*** Significantly different from zero at the 0.01 level, two-tailed test.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

For Medicare members, we found that regression-adjusted total cost PMPM was about $22 lower among ACO members than non-ACO members (see Table III.8), or about three percent of the average total cost PMPM of non-ACO members. Evidence on quality of care is mixed. Medicare ACO members performed significantly better than their non-ACO counterparts on the following eight HEDIS and PQI measures: (1) initiation of alcohol or other drug dependence treatment, (2) 30-day follow-up after alcohol or drug related ED visits, (3) 30-day follow-up after mental health related ED visits, (4) antibiotic avoidance for acute bronchitis, (5) hypertension admission rate, (6) uncontrolled diabetes admission rate, (7) young adult asthma admission rate, and (8) lower-extremity amputation among patients with diabetes.

Table III.8. Regressions results, Medicare (2017–2019)

Outcome	Desired ACO marginal effect	Unadjusted means		Marginal effect	95 percent confidence interval
		ACO	Non-ACO		
Total cost PMPM	Negative	$736.51	$731.12	−$22.46***	(−$29.71, −$15.21)
ED utilization (HEDIS EDU)	Negative	488.5	471.7	34.8***	(34.8, 34.9)
Initiation of AOD treatment (HEDIS IET1)	Positive	406.8	381.5	13.9*	(3.9, 24.0)

Outcome	Desired ACO marginal effect	Unadjusted means		Marginal effect	95 percent confidence interval
		ACO	Non-ACO		
Engagement in AOD treatment (HEDIS IET2)	Positive	93.2	81.4	–0.4	(–6.1, 5.2)
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	323.1	259.8	76.6*	(75.8, 77.5)
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	1,086.2	937.1	65.5*	(64.5, 66.6)
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	360.1	295.0	18.0*	(17.5, 18.4)
Diabetes short-term complications admission rate (PQI 1)	Negative	0.69	0.56	0.09*	(0.085, 0.089)
Diabetes long-term complications admission rate (PQI 3)	Negative	1.85	1.77	0.26*	(0.256, 0.264)
COPD or asthma in older adults admission rate (PQI 5)	Negative	6.20	8.45	0.24*	(0.229, 0.247)
Hypertension admission rate (PQI 7)	Negative	0.74	0.72	–0.15*	(–0.148, –0.143)
Heart failure admission rate (PQI 8)	Negative	11.52	9.99	1.26*	(1.254, 1.273)
Community acquired pneumonia admission rate (PQI 11)	Negative	6.38	7.11	0.30*	(0.293, 0.310)
Urinary tract infection admission rate (PQI 12)	Negative	0.76	0.72	0.10*	(0.098, 0.103)
Uncontrolled diabetes admission rate (PQI 14)	Negative	3.58	4.28	–0.27*	(–0.280, –0.268)
Asthma admissions in younger adults (PQI 15)	Negative	1.13	0.33	–0.33*	(–0.344, –0.324)
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.54	0.64	–0.24*	(–0.245, –0.240)

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

  * Significantly different from zero at the 0.10 level, two-tailed test.

 ** Significantly different from zero at the 0.05 level, two-tailed test.

*** Significantly different from zero at the 0.01 level, two-tailed test.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

For members attributed to commercial payers, we did not find a statistically significant difference in total cost PMPM between ACO members and non-ACO members (Table III.9). As with Medicaid and Medicare members, the evidence on quality is mixed. Commercial ACO members showed significantly better performance on the following six measures: (1) ED utilization, (2) 30-day follow-up after alcohol related ED visits, (3) diabetes short-term complications admission rate, (4) hypertension admission rate, (5) UTI admission rate, and (6) uncontrolled diabetes admission rate.

Table III.9. Regressions results, commercial (2017–2019)

Outcome	Desired ACO marginal effect	Unadjusted means		Marginal effect	95 percent confidence interval
		ACO	Non-ACO		
Total cost PMPM	Negative	$401.02	$397.53	$2.71	(–$3.20, $8.61)
ED utilization (HEDIS EDU)	Negative	181.4	213.6	–2.4*	(–2.4, –2.3)
Initiation of AOD treatment (HEDIS IET1)	Positive	308.9	321.8	–13.3*	(–25.6, –1.1)
Engagement in AOD treatment (HEDIS IET2)	Positive	129.1	145.1	–22.6*	(–31.9, –13.2)
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	200.0	122.5	80.8*	(79.9, 81.6)
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	814.4	867.1	–88.8*	(–90.8, –86.9)
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	489.3	391.3	–5.5*	(–6.0, –5.0)
Diabetes short-term complications admission rate (PQI 1)	Negative	0.17	0.18	–0.01*	(–0.014, –0.011)
Diabetes long-term complications admission rate (PQI 3)	Negative	0.19	0.22	0.001*	(–0.000, 0.003)
COPD or asthma in older adults admission rate (PQI 5)	Negative	0.60	1.21	0.09*	(0.082, 0.094)
Hypertension admission rate (PQI 7)	Negative	0.06	0.14	–0.05*	(–0.054, –0.051)
Heart failure admission rate (PQI 8)	Negative	0.42	1.02	0.12*	(0.102, 0.112)
Community acquired pneumonia admission rate (PQI 11)	Negative	0.50	0.73	0.30*	(0.299, 0.306)
Urinary tract infection admission rate (PQI 12)	Negative	0.00	0.09	–1.13***	(–2.142, –0.122)
Uncontrolled diabetes admission rate (PQI 14)	Negative	0.11	0.34	–0.07*	(–0.073, –0.067)
Asthma admissions in younger adults (PQI 15)	Negative	0.09	0.12	0.04*	(0.036, 0.040)
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.06	0.03	0.02*	(0.016, 0.017)

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

 * Significantly different from zero at the 0.10 level, two-tailed test.

 ** Significantly different from zero at the 0.05 level, two-tailed test.

*** Significantly different from zero at the 0.01 level, two-tailed test.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

IV. Discussion and Conclusion

We used the following three approaches to assess the relationship between members' ACO alignment and their cost/quality outcomes: (1) a descriptive analysis, (2) a difference-in-differences analysis, and (3) a regression analysis. Overall, our analyses found mixed evidence. Comparing outcomes of ACO and non-ACO members, we found that ACO members performed better on some measures and worse on others. These differences also varied by payer. One relatively stable finding is lower admission rates for hypertension among the commercial and Medicare ACO populations compared to their non-ACO aligned counterparts.

The findings from difference-in-differences and regression analyses did not always align. For example, in the difference-in-differences analysis, we found PMPM savings among the Medicaid ACO population relative to the non-ACO population, but we observed the opposite effect for Medicare. However, in the regression analysis, we observed significant savings among Medicare ACO members compared to non-ACO members, whereas Medicaid showed greater savings among the non-ACO population. This is possibly because these two sets of analyses measure slightly different effects. The regressions estimate the difference in outcomes between ACO-members and non-ACO members in a given year whereas the difference-in-differences analysis calculate the difference in changes in outcomes over time. The fact that we do not always draw the same conclusions from these analyses highlights the mixed nature of the overall evidence on the ACO's effectiveness.

The findings in this report should not be interpreted as causal impacts of the ACO on TCOC and quality. Without a more rigorous research design (for example, randomly assigning members to the ACO or identifying an appropriate comparison group), we cannot rule out that some unobserved factors influence whether members become attributed to the ACO and likewise influence their cost and quality outcomes.

Appendix A

Member Analytic File Layout

Table A.1. Member analytic file layout

Variable #	Variable name	Variable description	Values
1	REPORT_DATE	Report date	Date of file
2	MEMBER_ID	Member identification number	Alphanumeric
3	YEAR	Year	Medicaid: 2016, 2017, 2018, 2019 Medicare and commercial: 2017, 2018, 2019
4	PAYER_GROUP	Payer group – Primary payer (may change within a year)	Medicare Medicaid Commercial
5	AGE_GROUP	Age group – logic choosing one per year when they change (e.g., last available)	00<01 01 – 04 05 – 11 12 – 17 18 – 34 35 – 44 45 – 54 55 – 64 65 – 74 75 – 84 85 Plus
6	GENDER	Gender	Male Female
7	has	Member Health service area – logic choosing one per year when they change (e.g., last available)	Barre Bennington Brattleboro Burlington Middlebury Morrisville Newport Randolph Rutland Springfield St. Albans St. Johnsbury White River Junction
8	ACG_UNSCALED	Raw concurrent ACG risk score	Numeric
9	ACO_PARTICIPATION	ACO participation	Yes No
10	MEMBER_MONTHS	Number of months patient was enrolled	0 –12
11	ACO_MONTHS	Number of months patient was enrolled in ACO	0 –12

Variable #	Variable name	Variable description	Values
12	TOTAL_AA	Total allowed amount	Currency
13	TOTAL_AA_VT	Total allowed amount from Vermont (VT) providers	Currency
14	TOTAL_AA_OOS	Total allowed amount from out-of-state providers (not including New Hampshire [NH])	Currency
15	TOTAL_AA_NH	Total allowed amount from NH	Currency
16	TOTAL_CC	Total number of encounters during the month. For non-inpatient, an encounter equals a claim; for inpatient, encounters or "stays" may include multiple claims	Numeric
17	TOTAL_CC_VT	Total number of encounters that occurred in VT during the month	Numeric
18	TOTAL_CC_OOS	Total number of encounters that occurred out of state (not including NH) during the month	Numeric
19	TOTAL_CC_NH	Total number of encounters that occurred at NH during the month	Numeric
20	INP_ACUTE_AA	Allowed amount – inpatient acute	Currency
21	INP_ACUTE_AA_VT	Allowed amount from VT providers – inpatient acute	Currency
22	INP_ACUTE_AA_OOS	Allowed amount from out-of-state providers (not including NH – inpatient acute)	Currency
23	INP_ACUTE_AA_NH	Allowed amount from NH – inpatient acute	Currency
24	INP_ACUTE_CC	Number of inpatient stays (distinct count of discharge_Id)	Numeric
25	INP_ACUTE_CC_VT	Number of inpatient stays that occurred in VT (distinct count of discharge_Id)	Numeric
26	INP_ACUTE_CC_OOS	Number of inpatient stays that occurred out-of-state (not NH) (distinct count of discharge_Id)	Numeric
27	INP_ACUTE_CC_NH	Number of inpatient stays that occurred at NH (distinct count of discharge_Id). *Note: if there are multiple billing_id's in a discharge, use most recent*	Numeric
28	OUTP_NONER_AA	Allowed amount – outpatient non- emergency room (ER)	Currency
29	OUTP_NONER_AA_VT	Allowed amount from VT providers – outpatient non-ER	Currency
30	OUTP_NONER_AA_OOS	Allowed amount from out-of-state providers (not including NH – outpatient non-ER	Currency
31	OUTP_NONER_AA_NH	Allowed amount from NH – outpatient non-ER	Currency
32	OUTP_NONER_CC	Number of outpatient non-ER claims (distinct count of claim_header_id)	Numeric
33	OUTP_NONER_CC_VT	Number of outpatient non-ER claims that occurred in VT (distinct count of claim_header_id)	Numeric
34	OUTP_NONER_CC_OOS	Number of outpatient non-ER claims that occurred out-of-state (not NH) (distinct count of claim_header_id)	Numeric
35	OUTP_NONER_CC_NH	Number of outpatient non-ER claims that occurred at NH (distinct count of claim_header_id)	Numeric
36	OUTP_ER_AA	Allowed amount – outpatient ER	Currency
37	OUTP_ER_AA_VT	Allowed amount from VT providers – outpatient ER	Currency
38	OUTP_ER_AA_OOS	Allowed amount from out-of-state providers (not including NH – outpatient ER	Currency

Variable #	Variable name	Variable description	Values
39	OUTP_ER_AA_NH	Allowed amount from NH – outpatient ER	Currency
40	OUTP_ER_CC	Number of outpatient ER claims (distinct count of claim_header_id)	Numeric
41	OUTP_ER_CC_VT	Number of outpatient ER claims that occurred in VT (distinct count of claim_header_id)	Numeric
42	OUTP_ER_CC_OOS	Number of outpatient ER claims that occurred out-of-state (not NH) (distinct count of claim_header_id)	Numeric
43	OUTP_ER_CC_NH	Number of outpatient ER claims that occurred at NH (distinct count of claim_header_id)	Numeric
44	PROF_AA	Allowed amount – professional	Currency
45	PROF_AA_VT	Allowed amount from VT providers – professional	Currency
46	PROF_AA_OOS	Allowed amount from out-of-state providers (not including NH) – professional	Currency
47	PROF_AA_NH	Allowed amount from NH – professional	Currency
48	PROF_CC	Number of professional claims (distinct count of claim_header_id)	Numeric
49	PROF_CC_VT	Number of professional claims that occurred in VT (distinct count of claim_header_id)	Numeric
50	PROF_CC_OOS	Number of professional ER claims that occurred out-of-state (not NH) (distinct count of claim_header_id)	Numeric
51	PROF_CC_NH	Number of professional claims that occurred at NH (distinct count of claim_header_id)	Numeric
52	OTHER_AA	Allowed amount – other (other category includes SNF, ICF, home health, hospice, DME, and other categories of service). Note: SNF and ICF not applicable to Medicaid.	Currency
53	OTHER _AA_VT	Allowed amount from VT providers – other	Currency
54	OTHER _AA_OOS	Allowed amount from out-of-state providers (not including NH) – other	Currency
55	OTHER _AA_NH	Allowed amount from NH – other	Currency
56	OTHER _CC	Number of other claims (other category includes SNF [distinct count of discharge_id], ICF [distinct count of discharge_id], home health [distinct count of claim_header_id], hospice [distinct count of claim_header_id], DME [distinct count of claim_header_id], and other categories of service [distinct count of claim_header_id]). Note: SNF and ICF not applicable to Medicaid.	Numeric
57	OTHER _CC_VT	Number of other claims that occurred in VT (other category includes SNF [distinct count of discharge_id], ICF [distinct count of discharge_id], home health [distinct count of claim_header_id], hospice [distinct count of claim_header_id], DME [distinct count of claim_header_id], and other categories of service [distinct count of claim_header_id]). Note: SNF and ICF not applicable to Medicaid.	Numeric
58	OTHER _CC_OOS	Number of other claims that occurred out-of-state (not NH) (other category includes SNF [distinct count of discharge_id], ICF [distinct count of discharge_id], home health [distinct count of claim_header_id], hospice [distinct count of claim_header_id], DME [distinct count of claim_header_id], and other categories of service [distinct count of claim_header_id]). Note: SNF and ICF not applicable to Medicaid.	Numeric

Variable #	Variable name	Variable description	Values
59	OTHER _CC_NH	Number of other claims that occurred at NH (other category includes SNF [distinct count of discharge_id], ICF [distinct count of discharge_id], home health [distinct count of claim_header_id], hospice [distinct count of claim_header_id], DME [distinct count of claim_header_id], and other categories of service [distinct count of claim_header_id]). Note: SNF and ICF not applicable to Medicaid.	Numeric
60	TOTAL_PAID	Total paid amount (excludes patient responsibility and non-claims payments)	Currency
61	TOTAL_PAID_VT	Total paid amount to VT providers	Currency
62	TOTAL_PAID_OOS	Total paid amount to out-of-state providers (not NH)	Currency
63	TOTAL_PAID_NH	Total paid amount to NH providers	Currency
64	TOTAL_PBP	Per beneficiary non-claim payments for Medicare ACO members	Currency
65	HEDIS_EDU_DEN	Indicates if patient met HEDIS EDU denominator for the year	1, 0
66	HEDIS_EDU_NUM	Indicates if patient met HEDIS EDU denominator for the year	1, 0
67	HEDIS_IET_DEN	Indicates if patient met HEDIS IET denominator for the year	1, 0
68	HEDIS_IET_NUM	Indicates if patient met HEDIS IET denominator for the year	1, 0
69	HEDIS_FUA_DEN	Indicates if patient met HEDIS FUA denominator for the year	1, 0
70	HEDIS_FUA_NUM	Indicates if patient met HEDIS FUA denominator for the year	1, 0
71	HEDIS_FUM_DEN	Indicates if patient met HEDIS FUM denominator for the year	1, 0
72	HEDIS_FUM_NUM	Indicates if patient met HEDIS FUM denominator for the year	1, 0
73	HEDIS_AAB_DEN	Indicates if patient met HEDIS AAB denominator for the year	1, 0
74	HEDIS_AAB_NUM	Indicates if patient met HEDIS AAB denominator for the year	1, 0
75	PQI90_DEN	Indicates if patient is in denominator of composite measure based on age	1, 0
76	PQI90_NUM_ PQI1	Diabetes short-term complications. Number of discharges for patient year meeting numerator criteria for PQI 1, first component of PQI 90	#
77	PQI90_NUM_ PQI3	Diabetes long-term complications. Number of discharges for patient year meeting numerator criteria for PQI 3, second component of PQI 90	#
78	PQI90_DEN_PQI5	Chronic obstructive pulmonary disease or asthma in older adults. Indicates if patient is in component denominator based on age	1,0
79	PQI90_NUM_ PQI5	Chronic obstructive pulmonary disease or asthma in older adults. Number of discharges for patient year meeting numerator criteria for PQI 5, third component of PQI 90	#
80	PQI90_NUM_ PQI7	Hypertension. Number of discharges for patient year meeting numerator criteria for PQI 7, fourth component of PQI 90	#
81	PQI90_NUM_ PQI8	Heart failure. Number of discharges for patient year meeting numerator criteria for PQI 8, fifth component of PQI 90	#
82	PQI_NUM_ PQI11	Community acquired pneumonia. Number of discharges for patient year meeting numerator criteria for PQI 11, sixth component of PQI 90	#
84	PQI_NUM_PQI12	Urinary tract infection. Number of discharges for patient year meeting numerator criteria for PQI 12, seventh component of PQI 90	#
85	PQI_NUM_ PQI14	Uncontrolled diabetes. Number of discharges for patient year meeting numerator criteria for PQI 14, eighth component of PQI 90	#

Variable #	Variable name	Variable description	Values
86	PQI90_DEN_ PQI15	Asthma in younger adults. Indicates if patient is in component denominator based on age	1/0
87	PQI90_NUM_ PQI15	Asthma in younger adults. Number of discharges for patient year meeting numerator criteria for PQI 15, ninth component of PQI 90	#
88	PQI90_NUM_ PQI16	Lower extremity amputation for patients with diabetes. Number of discharges for patient year meeting numerator criteria for PQI 16, tenth component of PQ I90	#

ACG = Johns Hopkins Adjusted Clinical Groups®; ACO = Accountable Care Organization; DME = durable medical equipment; ICF = intermediate care facility; PQI = Prevention Quality Indicators; SNF = skilled nursing facility.

Appendix B

Detailed Difference-in-Differences Results

Table B.1. Detailed difference-in-differences results for all payers

Outcome	Desired effect	Pre/ACO	Pre/non-ACO	Post/ACO	Post/non-ACO	Diff-in-diff effect
Total cost PMPM	Negative	$381.33	$496.66	$174.94	$263.56	$26.72
ED utilization (HEDIS EDU)	Negative	474.2	322.6	478.1	314.7	11.7
Initiation of AOD treatment (HEDIS IET1)	Positive	430.0	397.0	379.5	384.0	-37.5
Engagement in AOD treatment (HEDIS IET2)	Positive	154.6	156.8	159.4	172.4	-10.7
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	242.1	254.4	285.7	239.6	58.4
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	838.8	804.7	881.7	834.7	12.9
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	422.5	319.8	432.3	377.6	-47.9
Diabetes short-term complications admission rate (PQI 1)	Negative	0.70	0.39	0.98	0.42	0.25
Diabetes long-term complications admission rate (PQI 3)	Negative	0.75	0.59	1.33	0.74	0.43
COPD or asthma in older adults admission rate (PQI 5)	Negative	4.64	4.82	4.93	3.46	1.65
Hypertension admission rate (PQI 7)	Negative	0.40	0.23	0.38	0.27	-0.06
Heart failure admission rate (PQI 8)	Negative	3.80	3.24	5.22	2.71	1.94
Community acquired pneumonia admission rate (PQI 11)	Negative	2.56	2.38	3.28	2.08	1.01
Urinary tract infection admission rate (PQI 12)	Negative	0.35	0.30	0.38	0.26	0.07
Uncontrolled diabetes admission rate (PQI 14)	Negative	1.21	1.36	1.72	1.19	0.67
Asthma in younger adults admission rate (PQI 15)	Negative	0.32	0.20	0.40	0.15	0.12
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.30	0.16	0.40	0.21	0.05

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

Table B.2. Detailed difference-in-differences results, Medicaid

Outcome	Desired effect	Pre/ACO	Pre/non-ACO	Post/ACO	Post/non-ACO	Diff-in-diff effect
Total cost PMPM	Negative	$247.83	$259.75	$94.67	$128.13	-$21.54
ED utilization (HEDIS EDU)	Negative	816.5	601.0	716.5	576.0	-75.1
Initiation of AOD treatment (HEDIS IET1)	Positive	454.6	449.6	387.1	425.0	-42.9
Engagement in AOD treatment (HEDIS IET2)	Positive	190.4	225.3	193.2	231.8	-3.7
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	262.3	288.0	301.2	273.9	53.1
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	860.4	860.9	905.3	876.0	29.8
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	491.3	360.4	454.6	449.8	-126.0
Diabetes short-term complications admission rate (PQI 1)	Negative	1.34	0.77	1.92	0.81	0.54
Diabetes long-term complications admission rate (PQI 3)	Negative	0.45	0.27	1.59	0.58	0.82
COPD or asthma in older adults admission rate (PQI 5)	Negative	4.80	6.66	6.55	4.34	4.06
Hypertension admission rate (PQI 7)	Negative	0.00	0.18	0.24	0.15	0.26
Heart failure admission rate (PQI 8)	Negative	1.04	0.68	1.30	0.86	0.07
Community acquired pneumonia admission rate (PQI 11)	Negative	0.97	1.15	1.45	0.86	0.78
Urinary tract infection admission rate (PQI 12)	Negative	0.33	0.30	0.21	0.20	-0.04
Uncontrolled diabetes admission rate (PQI 14)	Negative	0.48	0.47	0.61	0.55	0.05
Asthma in younger adults admission rate (PQI 15)	Negative	0.47	0.18	0.48	0.20	-0.01
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.15	0.18	0.47	0.18	0.32

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

Table B.3. Detailed difference-in-differences results, Medicare

Outcome	Desired effect	Pre/ACO	Pre/non-ACO	Post/ACO	Post/non-ACO	Diff-in-diff effect
Total cost PMPM	Negative	$410.96	$473.42	$223.38	$256.12	$29.72
ED utilization (HEDIS EDU)	Negative	449.5	408.5	479.1	392.8	45.4
Initiation of AOD treatment (HEDIS IET1)	Positive	421.2	377.8	405.7	364.5	-2.1
Engagement in AOD treatment (HEDIS IET2)	Positive	93.3	74.7	93.4	80.8	-6.0
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	195.6	217.4	244.2	194.6	71.4
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	778.3	712.2	819.1	770.1	-17.2
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	327.0	250.9	347.4	276.8	-5.5
Diabetes short-term complications admission rate (PQI 1)	Negative	0.40	0.55	0.69	0.48	0.36
Diabetes long-term complications admission rate (PQI 3)	Negative	1.17	1.51	1.81	1.68	0.46
COPD or asthma in older adults admission rate (PQI 5)	Negative	6.20	10.49	6.01	6.46	3.83
Hypertension admission rate (PQI 7)	Negative	0.82	0.46	0.72	0.63	-0.27
Heart failure admission rate (PQI 8)	Negative	7.64	10.56	11.08	8.33	5.67
Community acquired pneumonia admission rate (PQI 11)	Negative	4.86	7.28	6.21	6.07	2.55
Urinary tract infection admission rate (PQI 12)	Negative	0.52	0.76	0.74	0.59	0.39
Uncontrolled diabetes admission rate (PQI 14)	Negative	2.24	4.68	3.47	3.90	2.01
Asthma in younger adults admission rate (PQI 15)	Negative	0.00	0.00	1.06	0.31	0.75
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.52	0.42	0.52	0.53	-0.11

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

Table B.4. Detailed difference-in-differences results, commercial

Outcome	Desired effect	Pre/ACO	Pre/non-ACO	Post/ACO	Post/non-ACO	Diff-in-diff effect
Total cost PMPM	Negative	$785.80	$752.98	$436.81	$422.54	-$18.55
ED utilization (HEDIS EDU)	Negative	156.1	192.6	163.3	191. 0	8.8
Initiation of AOD treatment (HEDIS IET1)	Positive	284.2	315.3	309.2	326.3	14.0
Engagement in AOD treatment (HEDIS IET2)	Positive	122.3	128.8	132.4	153.0	-14.1
30-day follow-up after discharge from ED for AOD (HEDIS FUA)	Positive	108.1	150.9	193.5	100.6	135.7
30-day follow-up after discharge from ED for mental health (HEDIS FUM)	Positive	754.7	805.3	776.6	820.2	7.0
Avoidance of antibiotic use for acute bronchitis (HEDIS AAB)	Positive	378.9	340.6	463.0	387.8	36.9
Diabetes short-term complications admission rate (PQI 1)	Negative	0.35	0.09	0.16	0.18	-0.29
Diabetes long-term complications admission rate (PQI 3)	Negative	0.09	0.19	0.18	0.20	0.08
COPD or asthma in older adults admission rate (PQI 5)	Negative	0.26	1.26	0.58	1.11	0.46
Hypertension admission rate (PQI 7)	Negative	0.13	0.14	0.04	0.13	-0.08
Heart failure admission rate (PQI 8)	Negative	0.40	0.86	0.37	0.99	-0.16
Community acquired pneumonia admission rate (PQI 11)	Negative	0.31	0.66	0.45	0.66	0.14
Urinary tract infection admission rate (PQI 12)	Negative	0.13	0.06	0.00	0.08	-0.15
Uncontrolled diabetes admission rate (PQI 14)	Negative	0.13	0.29	0.12	0.33	-0.05
Asthma in younger adults admission rate (PQI 15)	Negative	0.00	0.13	0.08	0.08	0.13
Lower-extremity amputation among patients with diabetes rate (PQI 16)	Negative	0.00	0.01	0.05	0.03	0.03

Source: VHCURES

Note: For the HEDIS and PQI measures, measure rates are expressed per 1,000 members who were included in the denominator of the respective measure.

ACO = Accountable Care Organization; AOD = alcohol and other drugs; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; PMPM = per member per month; PQI = Prevention Quality Indicators; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.

Appendix C

HEDIS and PQI Measure Denominators

Table C.1. HEDIS and PQI measure denominators by year, ACO participation, and payer group

Payer Group	Measure	2018		2019	
		ACO Participation	Non-ACO Participation	ACO Participation	Non-ACO Participation
All Payer	HEDIS EDU	71,033	257,308	99,214	227,256
	HEDIS IET Initiation (IET1) and Engagement (IET2)	2,147	7,076	3,372	5,464
	HEDIS FUA	533	1,915	1,258	1,496
	HEDIS FUM	1,100	2,926	2,074	2,229
	HEDIS AAB	1,662	6,630	2,369	4,540
	PQI-90	74,889	301,059	104,942	266,267
	PQI-90-05: COPD or Asthma in older adult	56,788	213,916	78,344	191,255
	PQI-90-15: Asthma in younger adults	18,101	87,143	26,598	75,012
Commercial	HEDIS EDU	20,869	129,906	21,612	131,570
	HEDIS IET Initiation (IET1) and Engagement (IET2)	308	2,147	396	2,239
	HEDIS FUA	43	274	42	281
	HEDIS FUM	71	507	63	532
	HEDIS AAB	341	2,897	338	2,412
	PQI-90	22,605	152,044	23,109	153,219
	PQI-90-05: COPD or Asthma in older adult	15,203	101,736	15,696	102,476
	PQI-90-15: Asthma in younger adults	7,402	50,308	7,413	50,743
Medicaid	HEDIS EDU	17,424	42,928	30,395	25,146
	HEDIS IET Initiation (IET1) and Engagement (IET2)	1,171	3,099	2,009	1,914
	HEDIS FUA	379	1,207	963	871
	HEDIS FUM	778	1,680	1,428	1,022
	HEDIS AAB	852	2,286	1,496	1,190
	PQI-90	18,829	57,564	33,653	36,610
	PQI-90-05: COPD or Asthma in older adult	9,006	23,993	15,813	14,898
	PQI-90-15: Asthma in younger adults	9,823	33,571	17,840	21,712
Medicare	HEDIS EDU	32,740	84,474	47,207	70,540
	HEDIS IET Initiation (IET1) and Engagement (IET2)	668	1,830	967	1,311
	HEDIS FUA	111	434	253	344
	HEDIS FUM	251	739	583	675
	HEDIS AAB	469	1,447	535	938
	PQI-90	33,455	91,451	48,180	76,438
	PQI-90-05: COPD or Asthma in older adult	32,579	88,187	46,835	73,881
	PQI-90-15: Asthma in younger adults	876	3,264	1,345	2,557

Source: VHCURES

Note: The PQI 90 denominator applies to the following hospitalization rates: PQI-90-01, -03, -07, -08, -11, -12, and -14. The PQI-90-05 population is restricted to adults ages 40 years and older. The PQI-90-15, population is restricted to younger adults ages 18 through 39 years. Denominator sizes are restricted to records with risk scores; additional exclusions apply to difference-in-differences and regression results (Tables II.4 and II.6).

ACO = Accountable Care Organization; HEDIS = Healthcare Effectiveness Data and Information Set; PQI = Prevention Quality Indicators; EDU = ED utilization; IET = Initiation of AOD treatment; FUA = Follow-Up After Emergency Department Visit for Alcohol and Other Drug Abuse or Dependence; FUM = Follow-Up After Emergency Department Visit for Mental Illness; AAB = Avoidance of Antibiotic Treatment in Adults With Acute Bronchitis; COPD = Chronic Obstructive Pulmonary Disease; VHCURES = Vermont Health Care Uniform Reporting and Evaluation System.