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Banding together to lower the cost of health care? An empirical study of the Peak Health Alliance in Colorado

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Abstract

This paper evaluates the effectiveness of Peak Health Alliance, a public–private initiative in Colorado aimed at lowering health care costs for employers and enrollees by increased bargaining power through the formation of a health care purchasing alliance. Using 2017–2021 plan data provided by the Colorado Department of Regulatory Affairs: Division of Insurance, we use difference-in-differences, event study, and synthetic control methods to compare changes in premiums in counties where Peak operated to other counties in Colorado before and after its implementation. The results suggest that Peak was associated with an increase in insurer market power and led to a 13%–17% decrease in average premiums, depending on the empirical specification. We further assess mechanisms underlying these effects and find evidence that lower prices were the most likely mechanism behind the estimated effect of Peak. Study results provide

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insights about the future of such public–private partnerships and their potential effectiveness.

KEYWORDS
health care pricing, health insurance, market power, purchasing coalition

JEL CLASSIFICATION
I11, I18, L22

1 | INTRODUCTION

The majority of individuals with health insurance in the United States are enrolled in employer-sponsored plans subsidized by their employers (Kaiser Family Foundation, 2021). Over the past two decades, premiums in the employer-sponsored market have increased at a rate surpassing inflation and wage growth (Kaiser Family Foundation, 2022). This increase is primarily attributed to the rapid rise in health care costs (Anderson et al., 2019; Cooper et al., 2015; White & Whaley, 2019). Although insurer concentration has been linked to lower health care prices, it has not effectively counterbalanced the bargaining power of hospitals with high market power (Barrette et al., 2020). In fact, increased hospital concentration has outpaced insurer concentration, leading to ongoing increases in prices (Fulton, 2017).

Many large employers bear the risk in their employee health insurance contracts and are directly impacted by rising prices (Kaiser Family Foundation, 2022). To remain competitive in the labor market, employers may subsidize insurance for their employees and absorb some of the increased prices, resulting in lower profits. Some employers have attempted to lower their health care costs through lobbying for price controls or directly contracting with hospitals and implementing quality improvement initiatives (Koller & Khullar, 2019; Sachdev et al., 2019). However, these initiatives have had limited proven success, as employers often lack bargaining power relative to hospitals and the incentives for insurers to negotiate lower prices are diminished in the self-insured market where they only provide administrative services (Eisenberg et al., 2021).

Frustrated by the lack of success, employers often join "purchasing alliances" to pool employer market power in an attempt to jointly improve the value of their health benefits. Several examples of these initiatives exist across the country, including The Alliance, with over 300 employer members and 100,000 covered lives in the Midwest, and the Purchaser Business Group on Health with nearly 40 employers and more than 21 million covered lives (PBGH, 2023; The Alliance, 2023). Haven Healthcare, a joint initiative between Amazon, Berkshire Hathaway, and JPMorgan Chase to "provide U.S. employees and their families with simplified, high-quality, and transparent health care at a reasonable cost" disbanded after just 2 years (Toussaint, 2021). Despite varying claims of effectiveness in bringing down costs, the evidence-base for purchasing coalitions has been limited.

The economic principles underlying the creation of a health care alliance are clear. The amalgamation of enrollees from otherwise disparate employers, as well as the individual market, is expected to enhance the bargaining power of the alliance in negotiating health care prices. However, pooling market power across various employers and communities to secure

lower health care costs is complicated and may have high transaction and coordination costs at all levels. In the initial stages, alliances must devise a system that grants members of the alliance a representative voice in negotiations while avoiding excessive complexity. Alliance members must also commit to adhering to a mutually agreed upon contract, even if it does not maximize each employer's specific objective function. Additionally, alliances must develop a negotiation framework with hospital and provider systems, a process traditionally exclusive to insurance companies and fraught with intricacies. The effects of such an alliance over time remain an empirical question, as the year one challenge may either diminish over time or necessitate yearly coordination costs to retain all members in the program.

We examined the effect of one such public-private initiative, the Peak Health Alliance ("Peak"), that began in Summit County, Colorado in 2020. The expressed purpose of Peak was to lower health care costs for employers and enrollees in the community by banding together in negotiations and taking control of the negotiations away from administrative service-only insurance companies. Importantly, Peak claims to have saved "more than $16.1 million dollars across the communities it serves" (Peak Health Alliance, 2023). The well-defined geographic focus, timing, and goals of the Peak initiative and its claims of cost-saving make it a promising initiative to evaluate.

In this study, we assessed the impact of Peak on premiums for the average enrollee in Summit County, using 2017–2021 plan data provided by the Colorado Department of Regulatory Affairs: Division of Insurance. Additionally, we separately assessed Peak's impact in seven additional counties that it expanded into in 2021. Finally, we attempt to disentangle the relative contributors to premiums to assess if potential premium reductions are driven by lower health care prices or other factors.

The key empirical challenges inherent to this analysis are the endogeneity of alliance participation and patient level selection concerns. The Peak Health Alliance is a voluntary program, and it is possible that employers who choose to participate in the alliance differ from those who do not in ways that could lead to differential changes in premiums even absent their participation in Peak. Furthermore, if the plans offered by Peak differ significantly from others within the same market, this could lead to differences in the underlying risk of patients enrolled in Peak plans compared to non-Peak plans (e.g., if healthier patients select Peak's plans, this could lead to lower premiums). To mitigate these sources of bias, we use a difference-in-differences, intent-to-treat strategy that estimates the plausibly exogenous effect of Peak entering a market, rather than the endogenous effect of joining the alliance or enrolling in a Peak plan. In essence, we compare changes in premiums for all plans in Summit County to all plans in other counties in Colorado, before and after the implementation of Peak. This approach mitigates both of these forms of bias, as long as the population and enrollment composition of the entire county is not changing in conjunction with the implementation of Peak. While the intent-to-treat approach minimizes bias from participation in the program, the validity of our results depends on finding an adequate control group for Summit County. To estimate the intent-to-treat effect, we use three different methods: difference-in-differences, event studies, and synthetic controls. While each method requires slightly different assumptions for causal inference, the estimated effect of Peak is similar across all three methods, lending confidence to our intent-to-treat approach.

We find that Peak resulted in a substantial increase in insurer market power and between a 13% and 17% decrease in average premiums, depending on the empirical specification. We also find evidence that the program resulted in a 14% reduction in premiums in seven additional counties in 2021. Finally, we find that this effect was likely driven by reductions in the price of

services and that other factors, such as plan benefit design or risk selection, do not fully explain the premium reductions achieved in Summit County plans.

The Peak Health Alliance was not introduced in a vacuum, as there were a number of contemporaneous market and policy changes that complicated the analysis of Peak's effect. We address each of these concerns empirically in the paper. First, Colorado implemented a statewide reinsurance program in 2020 that included differing coinsurance rates across rating areas (Colorado, 2023). In our final regression specifications, we control for the coinsurance rate in each county, thus comparing the changes in premiums in Peak counties relative to other counties that experienced the same coinsurance rate in 2020 and 2021. Second, Kaiser Permanente stopped offering plans in Summit County, where it had previously had a major presence, as well as other counties in Colorado in 2020. We perform two robustness checks to address this concern. We first re-estimate regressions removing all Kaiser plans from the analyses to ensure changes in premiums are not a direct result of individuals switching to non-Kaiser plans in the post-period. We then also examine changes in premiums in other counties that also experienced a Kaiser market exit in 2020, assessing whether these counties experienced a similar change in premiums to Summit County. Finally, the unfolding of the COVID-19 pandemic could have led to differential differences in utilization in 2020 across counties in Colorado, which could be reflected in different 2021 premiums. We directly evaluate this concern by assessing whether there were greater changes in utilization in hospitals in Peak counties compared to other counties concurrent with Peak's implementation.

The remainder of this paper is organized as follows. First, we discuss the institutional background of Peak. Then, we outline our empirical approach and review our findings from difference-in-differences, event study, and synthetic control analyses, as well as an analysis of mechanisms. Finally, we end with a discussion of our findings and their implications for policy and practice.

2 | INSTITUTIONAL BACKGROUND

Summit County, Colorado, is a popular ski-resort town west of Denver. In 2014, the Kaiser Family Foundation published a report showing that Summit County had the highest health insurance premiums in the country (Kaiser Health News, 2014). In 2017, Summit County, Colorado, was identified as one of the most expensive counties in the United States for health care costs, according to a report by The Summit Foundation, a community-based non-profit organization (Peak Health Alliance, 2023). In response to these findings, local leaders formed a task force dedicated to addressing and reducing health care costs in the region. The task force discovered a 1994 law permitting purchases in Colorado that allowed stakeholders to collaborate and negotiate contracts with health care providers (H.B. 94-1193, 1994). Consequently, the Peak Health Alliance, a 501(c) non-profit purchasing cooperative, was established in 2019 with the aim of tackling the high health care costs in Summit County. The goal of the alliance was to pool together employer market power and those on the individual market to negotiate better health care prices than local insurers were negotiating.

From its inception, Peak Health Alliance focused on negotiations with St. Anthony Summit Hospital, the only hospital provider in the county, and commenced offering plans for the 2020 plan year. As a locally managed non-profit organization, Peak Health Alliance provides Affordable Care Act (ACA)-compliant plans in Colorado, operating independently of the state government. The organization's stated mission is to "provide access to comprehensive, more affordable health insurance for employers, families, and individuals in rural Colorado."

The 1994 law prohibits purchasing cooperatives from bearing risk. Consequently, Peak Health Alliance collaborates with insurance carriers to offer ACA-compliant plans on the state exchange. Peak conducts in-depth analyses of local claims data, which informs price negotiations with health care providers and insurance carriers. Utilizing insights gleaned from these analyses, Peak solicits bids from carriers and assists them in negotiating with providers to secure lower health care prices. The contract was ultimately awarded to Bright Health in 2020. In addition to working with Bright Health, Peak offers its negotiated prices to carriers that administer claims for its self-insured members. The cooperative generates its operating income through member access fees, which are included in the listed premiums.

According to Peak Health Alliance's website, the organization claims to have saved "more than $16.1 million" across the communities it serves. Governor Jared Polis, a supporter of the alliance, stated that Peak Health Alliance reduced premiums by 39% to 47% in its first year of operation (Polis, 2019). Beyond merely reducing premiums, Peak is also committed to "expanding access to providers of critical services with innovative plan designs."

In 2021, Peak Health Alliance expanded its reach beyond Summit County, offering plans in several neighboring counties, including Grand, Lake, and Park counties, as well as Dolores, La Plata, Montezuma, and San Juan counties in Southwest Colorado (Peak Health Alliance, 2023).

3 | EMPIRICAL STRATEGY

3.1 | Overview

Our empirical strategy uses an intent-to-treat design that compares changes in health plan premiums in Summit County, where the Peak program first went into effect, to other counties in Colorado where Peak has never been offered (i.e., all other counties in Colorado besides Summit, Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan), before and after the program was put into place for the 2020 plan year. We use three different methods: difference-in-differences, event studies, and synthetic controls. We then estimate similar models evaluating the impact of Peak in the additional counties expanded to in 2021.

3.2 | Data & measures

3.2.1 | Data

For this analysis, we obtained plan data from 2017 to 2021 from the Colorado Department of Regulatory Affairs: Division of Insurance. The data includes information on premiums, enrollment, and detailed benefit design information for all plans in the small group and individual markets in Colorado sold on the Affordable Care Act exchange. Crucially, the data include plan identifiers, which allow us to construct an indicator variable equal to one if the plan was offered by Peak in 2020 and 2021. Insurers are required to report these data to the Colorado Division of Insurance, so the data represent the universe for the small group and individual markets. In total, these data comprise 59,758 plan-county-year observations with over 2.5 million total enrollees across the small group and individual markets representing approximately 43% of Colorado's population.

3.2.2 | Premiums

Our primary outcome of interest is health plan premiums. We specifically examine premiums for a 27-year-old non-smoker due to the community rating by age and smoking status. Our analysis focuses solely on the total cost of enrolling in the plan, without considering individual market subsidies or small-group employer premium contributions. All primary analyses are enrollment-weighted, so the mean of our outcome measure can be interpreted as the premium paid for the average enrollee across Colorado.

3.2.3 | Enrollment

Enrollment data at the plan-county-year level are based on enrollment as of April 1 of the year. All plans provide coverage from January 1 to December 31, with enrollees selecting plans in the fall prior to enrollment. Prior to 2019, plan-year enrollment was reported at the plan-rating area level. For these years, we divide enrollment evenly among all counties in the plan-rating area (there are 9 plan-rating areas in the state of Colorado (Colorado, 2023)). All descriptive statistics and primary regression analyses are enrollment-weighted.

3.2.4 | Model covariates

In our regression models, we include covariates for several plan characteristics. First, we control for the market segment (Individual or Small group). Next, to control for differences observable differences across plans, we include variables for plan benefit characteristics that are determined by insurance carriers. These characteristics include the plan metal tier (Catastrophic, Bronze, Expanded Bronze, Silver, Gold, and Platinum), the plan type (EPO, HMO, Indemnity, PPO, and POS), the benefits package (22 unique categories included as fixed effects, as determined by the Colorado DOI), and the plan actuarial value (i.e., the estimated proportion of expenditures paid by the plan). To adjust for potential differences in enrollee risk in our treatment and control group, we control for the plan liability risk score, which is a measure of the predicted effect of health status and plan cost sharing on the expected liability to insurers. Finally, to control for the presence of other policies that could confound our estimates, we control for the presence of the Colorado state reinsurance program (Colorado, 2023). In 2020, Colorado put into place a program where the state covered a proportion of especially high-cost claims, with the intent of lowering premiums for enrollees. The program offered differing rates of coinsurance across rating areas in Colorado with slight adjustments made year-to-year. Of particular concern, Summit County was one of 22 counties, along with other counties in Rating Areas 5 and 9, to receive the highest coinsurance rates. We, therefore, control for the rate of coinsurance, the only aspect of the reinsurance program that differed across counties, within a rating area-year as a categorical variable.

3.2.5 | Sample characteristics

Table 1 displays the unweighted characteristics of our sample stratified by our intent-to-treat design. The treatment group consists of Summit County, and the control group comprises other untreated counties before and after the initiation of Peak in 2020. There are 459 and 245

TABLE 1 Plan characteristics in Summit County and untreated Colorado counties before and after the implementation of Peak, 2017–2021.

Variable	Summit pre-peak (2017–2019)	Summit post-peak (2020–2021)	Untreated Colorado counties pre-peak (2017–2019)	Untreated Colorado counties post-peak (2020–2021)
N, Plan-Counties	459	245	24,228	9441
Enrollment, mean (SD)	15.5 (29.9)	11.6 (45.1)	53.5 (164.8)	38.2 (164.0)
Monthly premium (27 year-old, non-smoker), mean (SD)	460 (96)	430 (121)	383 (95)	365 (90)
Actuarial value, mean (SD)	71.0 (7.1)	71.6 (6.3)	71.3 (7.2)	72.3 (6.8)
Market segment, *n* (%)				
Individual	161 (35.1%)	103 (42.0%)	7815 (28.6%)	4330 (42.8%)
Small group	298 (64.9%)	142 (58.0%)	19475 (71.4%)	5785 (57.2%)
Plan type, *n* (%)				
EPO	34 (7.4%)	47 (19.2%)	1577 (6.5%)	1308 (13.9%)
HMO	213 (46.4%)	117 (47.8%)	11828 (48.8%)	4657 (49.3%)
Indemnity	0 (0.0%)	0 (0.0%)	9 (<1%)	0 (0.0%)
POS	73 (15.9%)	25 (10.2%)	4401 (18.2%)	1164 (12.3%)
PPO	98 (21.4%)	56 (22.9%)	4777 (19.7%)	1728 (18.3%)
Unknown	41 (8.9%)	0 (0.0%)	1636 (6.8%)	584 (6.2%)
Metal tier, *n* (%)				
Catastrophic	11 (2.4%)	6 (2.4%)	572 (2.4%)	235 (2.5%)
Bronze	74 (16.1%)	2 (0.8%)	4146 (17.1%)	151 (1.6%)
Expanded Bronze	25 (5.4%)	60 (24.5%)	1132 (4.7%)	1805 (19.1%)
Silver	207 (45.1%)	120 (49.0%)	10595 (43.7%)	4159 (44.1%)
Gold	89 (19.4%)	52 (21.2%)	5532 (22.8%)	2127 (22.5%)
Platinum	12 (2.6%)	5 (2.0%)	615 (2.5%)	380 (4.0%)
Unknown	41 (8.9%)	0 (0.0%)	1636 (6.8%)	584 (6.2%)
Plan liability risk score, mean (SD)	0.99 (0.15)	1.07 (0.16)	1.05 (0.28)	1.05 (0.24)
Reinsurance rate for rating area, median (IQR)	0.00 (0.00, 0.00)	80.00 (80.00, 85.00)	0.00 (0.00, 0.00)	45.00 (40.00, 50.00)

Note: Means and standard deviation (SD), in parentheses, are shown for continuous variables. For categorical/binary variables, the number and percent of plan-counties in the column is shown. Untreated Colorado counties include all counties besides Summit County and Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance.

plan-counties in Summit County before and after Peak, respectively, compared to 24,228 before and 9441 after across the other 62 counties in Colorado. On average, Summit County plans are more expensive than the rest of the state, averaging $460 before Peak and $430 after, compared to $383 before and $365 after in other counties. Otherwise, plan characteristics are fairly consistent across the two groups. The average plan has a 71%–72% actuarial value, and roughly one-third of plans are offered in the individual market as opposed to the small group market. Exclusive provider organization (EPO) plans became more prevalent in Summit County and other counties from pre- to post-Peak, while point-of-service (POS) plans became less prevalent.

Table 2 shows a similar set of characteristics, stratified by Peak plans, non-Peak plans in Summit County, and plans in the rest of Colorado in 2020–2021. Peak plans had much higher enrollment and lower premiums compared to non-Peak plans in Summit County and the rest of Colorado. The average Peak plan enrolled 48.7 enrollees with a monthly premium of $295 compared to 5.4 enrollees[1] and a monthly premium of $453 in non-Peak plans in Summit County averaged 36.2 enrollees and $366 in plans offered across the rest of Colorado. Peak plans had lower plan actuarial values and were more likely to be individual and EPO plans. Further, Peak plans had a lower plan liability risk score, which may indicate that healthier enrollees were attracted to the less generous plan design with lower premiums.

3.3 | Empirical approach

3.3.1 | Difference-in-differences analysis

Our difference-in-differences, intent-to-treat design compares health plan premiums in Summit County to untreated Colorado counties before and after 2020. All analyses exclude Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties, which are the counties that Peak expanded into in 2021. Our approach estimates the impact of the program to the average enrollee's premiums in Summit County, regardless of whether they were enrolled in a Peak plan. Specifically, our preferred modeling specification is the following:

$$\text{Premium}_{p,c,t} = \beta_0 + \beta_1 \text{Summit}_c X \text{Post}_t + \gamma X_{p,c,t} + \alpha_c + \delta_t + \varepsilon_{p,c,t}, \quad (1)$$

where our outcome measure, $\text{Premium}_{p,c,t}$, is modeled for a plan p, in county c, in year t. $\text{Summit}_c X \text{Post}_t$ is the interaction between an indicator for Summit County and an indicator for the years 2020 and 2021 after the Peak program went into place. $X_{p,c,t}$ represents a vector of plan-county-year characteristics, including plan benefit characteristics, plan liability risk score, and reinsurance program coinsurance rates. α_c and δ_t are county and year fixed effects, respectively, and $\varepsilon_{p,c,t}$ is the error term. β_1 represents the difference-in-differences estimate of the effect of the Peak program on premiums for the average enrollee in Summit County compared to enrollees in all other untreated counties after the Peak program began compared to prior. We use robust standard errors and all regressions are enrollment weighted. In addition, we also calculated p values via randomization inference, where we estimated a potential treatment effect for untreated observations as if they were in Summit County

[1]Non-Peak plans in Summit County may be plans offered across multiple counties. Given that it is a small county, non-Peak plans garnered low enrollment in Summit County.

TABLE 2 Plan characteristics for Peak Plans, Non-Peak Plans in Summit County, and Untreated Colorado counties after the implementation of Peak, 2020–2021.

Variable	Peak Plans in Summit County	Non-Peak Plans in Summit County	Untreated Colorado counties
N, Plan-Counties	35	210	9441
Enrollment, mean (SD)	48.7 (111.7)	5.4 (8.7)	38.2 (164.0)
Monthly premium (27 year-old, non-smoker), mean (SD)	295 (81)	453 (112)	365 (90)
Actuarial value, mean (SD)	69.0 (5.1)	72.0 (6.4)	72.3 (6.8)
Market segment, *n* (%)			
Individual	25 (71.4%)	78 (37.1%)	3940 (41.7%)
Small group	10 (28.6%)	132 (62.9%)	5501 (58.3%)
Plan type, *n* (%)			
EPO	30 (85.7%)	17 (8.1%)	1308 (13.9%)
HMO	5 (14.3%)	112 (53.3%)	4657 (49.3%)
Indemnity	0 (0.0%)	0 (0.0%)	0 (0.0%)
POS	0 (0.0%)	25 (11.9%)	1164 (12.3%)
PPO	0 (0.0%)	56 (26.7%)	1728 (18.3%)
Unknown	0 (0.0%)	0 (0.0%)	584 (6.2%)
Metal tier, *n* (%)			
Catastrophic	2 (5.7%)	4 (1.9%)	235 (2.5%)
Bronze	0 (0.0%)	2 (1.0%)	151 (1.6%)
Expanded Bronze	12 (34.3%)	48 (22.9%)	1805 (19.1%)
Silver	16 (45.7%)	104 (49.5%)	4159 (44.1%)
Gold	5 (14.3%)	47 (22.4%)	2127 (22.5%)
Platinum	0 (0.0%)	5 (2.4%)	380 (4.0%)
Unknown	0 (0.0%)	0 (0.0%)	584 (6.2%)
Plan liability risk score, mean (SD)	0.96 (0.06)	1.09 (0.17)	1.05 (0.24)
Reinsurance rate for rating area, median (IQR)	85.00 (80.00, 85.00)	80.00 (80.00, 85.00)	45.00 (45.00, 50.00)

Note: Means and standard deviation (SD), in parentheses, are shown for continuous variables. For categorical/binary variables, the number and percent of plan-counties in the column is shown. Untreated Colorado counties include all counties besides Summit County and Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance.

(McDermott, 2022). The test then compares those treatment effects to the estimated true treatment effect and calculates a *p*-value that is the proportion of sampled placebos with a greater treatment effect. We resample with 500 random permutations among other counties to generate a standard error for the *p*-value estimate.

To estimate a causal effect of the Peak program, the key identifying assumption is that premiums in Summit County would have followed a similar trend to untreated Colorado counties had the program not been put in place (i.e., the "parallel trends assumptions"). This assumption cannot be formally tested; however, we perform a series of analyses to examine its potential validity, described in the following sections.

3.3.2 | Event study analysis

We employ an event study analysis to assess the time-varying effects of the Peak program and evaluate if there are differing trends prior to its implementation between Summit and other untreated counties in Colorado. Specifically, we estimate the following specification:

$$\text{Premium}_{p,c,t} = \beta_0 + \sum \beta_t \text{Summit}_c X\delta_t + \gamma X_{p,c,t} + \alpha_c + \delta_t + \varepsilon_{p,c,t}, \quad (2)$$

where, in addition to our earlier difference-in-differences specification, we interact each year fixed effect with Summit_c. Each coefficient, β_t estimates the difference in premiums in Summit relative to other counties for each year t, with 2019 as the reference year. This specification serves two purposes. First, each β_t in the post-2020 period allows us to assess if there is any heterogeneity in the effect of Peak over time. Second, each β_t in the pre-2020 period allows us to assess if there are any differences in trends between Summit and other counties in the leadup to Peak. If so, this may point to a potential violation of the parallel trends assumption.

3.3.3 | Synthetic control analysis

To further give confidence in our results, we employ a synthetic control analysis that comprises a synthetic Summit County from a weighted average of other potential donor counties in Colorado. We selected among donor states based on their premiums in 2017 and 2019 before Peak was implemented, as well as our other model covariates. This approach allows us to match Colorado specifically to other counties with similar trends in premiums prior to Peak. After synthetic control weights are obtained, we estimate difference-in-differences and event study analyses weighted by the synthetic control weights.

3.3.4 | Additional robustness checks

We perform the following additional robustness checks to rule out possible sources of bias. First, because Kaiser Permanente stopped offering plans in Summit County in 2020, we re-estimate our analysis dropping all Kaiser plans from the sample in both treatment and control counties. If Kaiser plans were more expensive than others in Summit, for example, then this could drive down the average premiums in 2020 and 2021 in Summit, biasing our estimate of Peak's effect. A related concern is that Kaiser's exit may have led enrollees in Summit County to more actively price-shop for their plans, which could also lead to concurrent reductions in premiums in Summit County. We also test for this possibility by examining whether Kaiser's 2020 exit from other counties in Colorado where it previously had a market share of over 10%

was associated with a decline in premiums in those counties (Archuleta, Eagle, Hinsdale, Jackson, Moffat, Ouray, and Rio Blanco counties).

Second, we perform a placebo test where Peak plans are removed from the sample to evaluate whether changes in premiums might have been driven by some other unobserved change in Summit County. If Peak plans are responsible for the change in average premiums in Summit County in the post-2020 period, then we hypothesize that the estimated treatment effect should not be negative when Peak is removed (i.e., positive or null).

Third, if the implementation of Peak was associated with major changes to total enrollment in Summit County, then changes in premiums could result from compositional shifts in the population of Summit County, rather than from Peak itself. We perform two additional robustness checks to rule out this concern: we estimate difference-in-differences estimates unweighted by enrollment and also evaluate whether Peak implementation was associated with a total change in enrollment in Summit County.

Finally, one might be concerned that Peak's effect was only the result of its partnership with Bright Health, which ceased its operation in 2023. To address this concern, we estimate difference-in-differences regressions with insurer fixed effects, controlling for differences in Bright's average plan premiums.

3.3.5 | Analysis of peak expansion in 2021

In addition to the above analyses of Peak's effect in Summit County, where the program originated, we also assess the impact of Peak in Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties in 2021. We replicate our main analyses with this new treatment group, including our descriptive tables, difference-in-differences analyses, and event study analyses. The key difference between these analyses and those in Summit County is (1) the treated group is Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties, as opposed to Summit, and (2) the treated year is 2021, as opposed to 2020–2021. Summit County is also excluded from these analyses and is therefore not treated as part of the control group.

In addition to these analyses, we also estimate a difference-in-differences regression that combines the adoption of Peak in Summit County and the additional 2021 counties together. We estimate the average treatment effect on the treated (ATT) from the staggered adoption using the Callaway and Sant'Anna estimator (Callaway & Sant'Anna, 2021). In this analysis, standard errors are estimated using a wild bootstrap procedure with 999 repetitions. From this estimation procedure, we also estimate event study models with time-varying effects for each year relative to treatment.

3.3.6 | Analysis of mechanisms

We investigate potential underlying mechanisms that could explain changes in premiums following Peak. Our prevailing hypothesis is that changes in average premiums in counties where Peak was implemented are likely to be driven by changes in average prices in those counties. However, we also seek to either rule out or account for the role of other potential mechanisms. One possible confounding mechanism is that the COVID-19 pandemic is known to have caused a large reduction in total health care utilization in 2020 (Whaley et al., 2020). If reductions in utilization were greater in Summit County in 2020 than in other counties, then

diminished relative 2020 demand could be reflected in diminished relative 2021 premiums. Another possibility is that changes in average premiums could be driven by changes in plan design, especially given the differences between Peak and non-Peak plans highlighted above. For example, if the implementation of Peak drove enrollees to select into plans that were cheaper simply because of their plan design (e.g., a lower metal tier level), then this could also lead to lower average premiums.

To investigate changes in average prices and utilization, we use 2015-2021 Hospital Cost Report data, a dataset that includes hospital-year level measures of utilization, facility characteristics, and revenue data (CMS, 2023). All Medicare-certified institutional providers are required to submit these data to the Centers for Medicare & Medicaid Services (CMS) Healthcare Provider Cost Reporting Information System. Our analytic sample includes 704 unique hospital CMS certification number-year combinations in Colorado. Using these data, we construct two primary outcome measures at the hospital-year level to explore two of the above-mentioned potential mechanisms: (1) the average inpatient revenue per inpatient discharge to reflect changes in average prices and (2) the total number of inpatient discharges to reflect changes in utilization. Since potential changes in utilization may have primarily occurred in the outpatient setting, we also evaluate changes in total outpatient charges. We use charges to reflect changes in outpatient utilization since the Cost Report data do not include a measure for outpatient visits, specifically, and charges are not directly impacted by negotiated prices (as opposed to a measure based on outpatient revenue). We then estimate hospital-year level difference-in-differences and event study models with hospital and year fixed effects to estimate the Peak effect in Summit County and in the additional 2021 counties, mirroring the methodology used to evaluate premiums data. Since the data are reported at the fiscal year level, we treat the end of the fiscal year as the year of the observation so that we can be confident that no post-treatment data are treated as pre-treatment. Outcomes are log-transformed to account for right skew in hospital costs and utilization.

We investigate the role of plan design in three ways. First, in our main regression tables, we layer adjustment in our difference-in-differences regressions column by column, which allows us to interpret differences in the estimated effect of Peak with and without adjustment for difference in plan design. Second, we descriptively show the extent to which premiums in Peak plans differ from the predicted premiums from a fully-adjusted regression model. Third, we evaluate Peak-driven changes in plan design and enrollee risk profile by estimating difference-in-differences regression where these measures are treated as the outcomes rather than model covariates. Specifically, we estimate the effect of Peak on the average actuarial value, enrollee risk score, and whether people are enrolled in Silver or greater metal tier, Expanded Bronze metal tier, or EPO or HMO plans.

4 | RESULTS: ESTIMATED EFFECT OF PEAK HEALTH ALLIANCE IN SUMMIT COUNTY

4.1 | Raw trends in insurer concentration and premiums

Figure 1a shows the raw trends in insurer concentration in Summit County and other counties in Colorado. Insurer concentration is calculated as a Herfindahl-Hirschman index (HHI), the sum of squared insurer enrollment market shares within a county in our sample scaled by a factor of 10,000. Insurer concentration, on average, was similar in Summit County and the rest

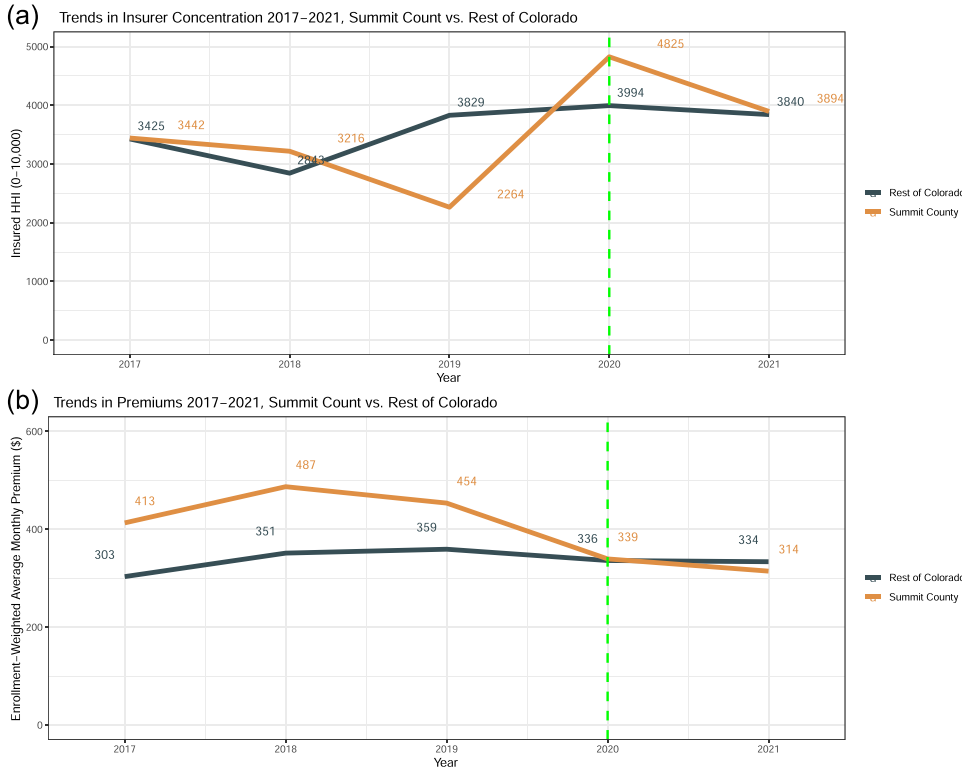

FIGURE 1 Enrollment-Weighted Average Monthly Premium and Insurer Herfindahl-Hirschman Index in Summit County and untreated Colorado counties, 2017–2021. The mean county level insurer Herfindahl Hirschman Index (HHI) in each year is plotted in (a), stratified between Summit and non-Summit counties in Colorado. Insurer HHI was calculated as the sum of squared insurer enrollment shares within the county in each year. The enrollment-weighted mean of county premiums in each year is shown in (b), stratified between Summit and non-Summit counties in Colorado. Untreated Colorado counties include all counties besides Summit County and Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. [Color figure can be viewed at wileyonlinelibrary.com]

of Colorado in 2017 and 2018. In 2019, however, insurer HHI decreased to 2264 in Summit County while rising to 3829 in other Colorado counties. In 2020, when the Peak program was implemented, Summit County saw a substantial increase in insurer concentration. In total, Summit County saw an increase of 1385 in its average insurer HHI per year from 2017 to 2019 to 2020–2021 (a 46.5% increase), while the rest of Colorado saw a modest 165 increase in insurer HHI (a 4.3% increase).

Figure 1b shows the trends in enrollment-weighted average monthly premiums in Summit County compared to other Colorado counties. The trend shows that historically Summit County had much higher premiums than other counties from 2017 to 2019. This is not surprising as high plan premiums relative to the rest of the state was a key driver in the formation of the Peak program. In 2020, however, when the Peak program was implemented, premiums sharply dropped in Summit County while they stayed flat in other counties. Prior to 2020,

Summit County premiums were $114 more expensive on average compared to the rest of Colorado on a monthly basis. After 2020, they were only $9 more expensive.

4.2 | Difference-in-differences analysis

In Table 3, we show the estimated effect of Peak on premiums in Summit County. In all model specifications, we find that the Peak program led to a significant reduction in health plan premiums. The unadjusted estimated effect of Peak in column (1) with only year and county fixed effects is a $113.16 decrease in premiums (robust standard error [SE]: 17.48, randomization inference p-value = 0.026), representing an approximate 34% decrease in premiums over the $336.6 mean premium. As we adjust for plan actuarial value, characteristics, and enrollee risk profile (4), the estimated effect falls to a $98.12 decrease in premiums (SE: 14.58, randomization

TABLE 3 Difference-in-differences analysis of Peak effect on average monthly premiums in Summit County.

	(1)	(2)	(3)	(4)	(5)
Summit*(Year >= 2020)	−113.16***	−123.51***	−98.08***	−98.12***	−43.83***
(Robust standard error)	(17.48)	(18.33)	(14.56)	(14.58)	(15.24)
Randomization inference p-value (standard error)	0.026 (0.007)	0.024 (0.007)	0.036 (0.008)	0.046 (0.009)	0.062 (0.0108)
Observations	41,336	36,962	36,962	36,962	36,962
R-squared	0.32	0.62	0.74	0.74	0.75
Year fixed effects	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes
Actuarial value	No	Yes	Yes	Yes	Yes
Plan characteristics	No	No	Yes	Yes	Yes
Risk adjustment	No	No	No	Yes	Yes
Reinsurance rate	No	No	No	No	Yes
Mean premium	336.6	336.6	336.6	336.6	336.6

Note: Difference-in-differences estimates of the impact of the Peak program on average premiums and robust standard errors are in parentheses. Each column represents estimates with different levels of controls. In addition, p values are calculated using randomization inference with 500 random permutations of the treatment variable among untreated counties, with the standard error for this p-value below in parentheses. Column 1 shows the raw difference-in-differences between Summit County and other counties before and after 2020 with county and year-fixed effects. In Columns 2–5, controls are added for plan actuarial value, plan characteristics, enrollee risk adjustment, and reinsurance rates. The plan actuarial value is the estimated proportion of expenditures paid by the plan, as opposed to the individual (0–100). Plan characteristics include the plan metal tier (Catastrophic, Bronze, Expanded Bronze, Silver, Gold, and Platinum), the plan type (EPO, HMO, Indemnity, PPO, and POS), and the benefits package (22 unique categories included as fixed effects). The plan liability risk score is a measure of the expected liability to insurers based on enrollee health status and cost-sharing. Reinsurance rates are included as a categorical variable at the county-year level based on the Colorado statewide program that began in 2020 (years prior have reinsurance rates of 0). The data are at the plan-year level, with regressions weighted by the number of enrollees in the plan-year. Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

inference p-value = 0.046). When we adjust for the reinsurance program coinsurance rate in column (5), we find that Peak was associated with a $43.83 decrease in premiums (SE: 15.24, randomization inference p-value = 0.062). In this preferred specification, the Peak program is estimated to have reduced premiums by approximately 13% for the average enrollee.

4.3 | Event study analysis

In Table 4, we show the results from an event study analysis of Peak's time-varying treatment effects relative to the reference year of 2019. As in Table 3, we test different specifications with varying levels of controls. In most specifications, we find that Summit County had a higher level of premiums in 2017 and 2018, relative to 2019, and lower premiums in 2020 and 2021, the years that Peak was in place. In our most conservative specification (column (6)), including all controls, we find $44.01 higher premiums in Summit County in 2018 (SE: 1.04, p-value = 0.002) and $45.56 (SE: 17.57, p-value = 0.008) lower premiums in 2021. We cannot reject null time-varying treatment effects in 2017 and 2020. The findings are consistent with Peak having a negative effect on premiums after its implementation; however, the relatively higher premiums in 2018 relative to 2019 might suggest that the downward trend began before the program. In the synthetic control analysis discussed next, we empirically address this issue by selecting weights to match a synthetic control based on 2017 and 2019 premiums.

4.4 | Synthetic control analysis

In Table 5, we display the results from the synthetic control analysis. Based on a match of Summit County to other Colorado counties, on 2017 and 2019 premiums and our model covariates, returned synthetic weights of 0.858 for Eagle County, 0.136 for Mesa County, and 0.006 for Weld County. Eagle County, which received the largest synthetic control weight, borders Summit County and is located in the same insurance rating area. In a difference-in-differences analysis that is weighted by the assigned synthetic control weights, we found that Peak was associated with a $56.51 reduction in premiums (p-value < 0.001), an approximate 17% reduction.

We then estimated an event study analysis using the synthetic control weights. In the weighted regression, we find that Peak was associated with a $41.20 decrease in premiums in 2020 (p-value < 0.001) and a $58.28 decrease in 2021 ($p$-value < 0.001). We display the average monthly premiums in Summit County and the synthetic control over time in Appendix 1. By design, the premiums are roughly equivalent, with nearly identical trends between Summit County and the synthetic control in the pre-period. In 2020, the premiums drop in both groups, but to a much greater degree in Summit County, consistent with the findings in Table 5. Appendix 2 displays the underlying trends of premiums in each county, with Summit County's trend line bolded.

4.5 | Additional robustness checks

We further test the robustness of our difference-in-differences estimates in Table 6. In 2020, Kaiser Permanente stopped offering coverage on the exchange in Summit County. We find that the estimated treatment effect of Peak is not sensitive to the removal of Kaiser plans from the regression ($40.01 decrease in premiums, SE: 14.76, p-value = 0.007) in column (1). We also do

TABLE 4 Event study analysis of Peak effect on average monthly premiums in Summit County.

	(1)	(2)	(3)	(4)	(5)
Pre-years					
Summit*2017	7.62	8.45	1.49	1.42	2.11
	(13.65)	(9.54)	(10.34)	(10.34)	(10.20)
Summit*2018	40.64**	46.84***	43.38***	43.46***	44.01***
	(16.63)	(13.98)	(14.08)	(14.09)	(14.04)
*Omitted Summit*2019*					
Post-Years					
Summit*2020	−89.01***	−84.31***	−60.69**	−60.73**	−13.33
	(24.60)	(28.04)	(23.76)	(23.83)	(24.68)
Summit*2021	−112.27***	−129.86***	−108.58***	−108.62***	−46.56***
	(24.45)	(22.63)	(16.74)	(16.74)	(17.57)
Observations	41,336	36,962	36,962	36,962	36,962
R-squared	0.32	0.62	0.74	0.74	0.76
Year fixed effects	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes
Actuarial value	No	Yes	Yes	Yes	Yes
Plan characteristics	No	No	Yes	Yes	Yes
Risk adjustment	No	No	No	Yes	Yes
Reinsurance rate	No	No	No	No	Yes
Mean premium	336.6	No	No	Yes	Yes

Note: Event study estimates of the impact of the Peak program on average premiums and robust standard errors are in parentheses. Each column represents estimates with different levels of controls. Column 1 shows the raw event study analysis between Summit County and other counties before and after 2020 with county and year-fixed effects. In Columns 2–5, controls are added for plan actuarial value, plan characteristics, enrollee risk adjustment, and reinsurance rates. The plan actuarial value is the estimated proportion of expenditures paid by the plan, as opposed to the individual (0–100). Plan characteristics include the plan metal tier (Catastrophic, Bronze, Expanded Bronze, Silver, Gold, and Platinum), the plan type (EPO, HMO, Indemnity, PPO, and POS), and the benefits package (22 unique categories included as fixed effects). The plan liability risk score is a measure of the expected liability to insurers based on enrollee health status and cost-sharing. Reinsurance rates are included as a categorical variable at the county-year level based on the Colorado statewide program that began in 2020 (years prior have reinsurance rates of 0). The data are at the plan-year level, with regressions weighted by the number of enrollees in the plan-year. Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

not find that Kaiser's exit from other counties in 2020 was associated with a statistically significant change in premiums in column (2). In a placebo analysis shown in column (3), we found that when Peak plans were removed from the analysis, Peak's implementation was not associated with a statistically significant change in plan premiums. In columns (4) and (5), we find that Peak's effect is robust to the exclusion of enrollment weights ($21.72 decrease in premiums, SE: 6.58, p-value < 0.001) and that total enrollment was unaffected by Peak, respectively. In column (6), we show that Peak's effect is also robust to insurer fixed effects ($31.22 decrease in premiums, SE: 10.49, p-value $= 0.003$).

TABLE 5 Synthetic control analysis of Peak effect on average monthly premiums in Summit County.

	(1) Estimated effect	(2) *p*-value
Panel A. Difference-in-differences		
Summit*(Year >= 2020)	−56.51	<0.001
Panel B. Event study		
Summit*2017	7.66	0.148
Summit*2018	12.66	0.044
Summit*2020	−41.20	<0.001
Summit*2021	−58.28	<0.001
Mean premium	336.6	336.6

Note: Difference-in-differences and event study estimates of the impact of the Peak program on average premiums using a synthetic control analysis and *p* values are shown. A synthetic Summit County is comprised of a weighted average of other potential donor counties in Colorado selected based on their premiums in 2017 and 2019 before Peak was implemented, as well as our other model covariates. Donor counties were Eagle (weight = 0.858), Mesa (0.136), and Weld (0.006). Model covariates include controls for plan actuarial value, plan characteristics, enrollee risk adjustment, county and year fixed effects, and reinsurance rates. The plan actuarial value is the estimated proportion of expenditures paid by the plan, as opposed to the individual (0–100). Plan characteristics include the plan metal tier (Catastrophic, Bronze, Expanded Bronze, Silver, Gold, and Platinum), the plan type (EPO, HMO, Indemnity, PPO, and POS), and the benefits package (22 unique categories included as fixed effects). The plan liability risk score is a measure of the expected liability to insurers based on enrollee health status and cost-sharing. Reinsurance rates are included as a categorical variable at the county-year level based on the Colorado statewide program that began in 2020 (years prior have reinsurance rates of 0). We also show randomization inference *p* values, with its standard error in parentheses. Randomization inference is performed with 500 resamples of Summit County as a treatment variable among all other states. The randomization inference *p*-value is the proportion of random samples where the treatment effect is greater than Summit County's estimated treatment effect. The data are at the plan-year level, with regressions weighted by the number of enrollees in the plan-year. Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance.

5 | PEAK EXPANSION IN 2021

We investigate the impact of Peak's expansion in Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties in 2021. We first describe the analytical sample for these analyses in Appendices 3 and 4, where Summit County is dropped, the treated counties are the seven listed counties, and the treatment time period is 2021. The sample includes 3378 plan-counties in the treated counties prior to 2021 and 358 in 2021, compared to 29,048 plan-counties in untreated counties prior to 2021 and 4623 in 2021 (Appendix 3). As we found in Summit County, there was descriptively a larger decrease in premiums in treated counties from 2017 to 2020 to 2021 compared to untreated counties ($59 compared to $17). We also find that Peak plans were of relatively lower actuarial value than non-Peak plans in this sample (70.0 in Peak plans, compared to 70.7 for other plans in the same counties and 72.2 for plans in other counties), though the difference was not as large as it was in Summit County (Appendix 4).

In Table 7, we show the estimated effect of the Peak on premiums in the additional counties it expanded into in 2021. In all model specifications, we find a negative and statistically significant estimated treatment effect. In our preferred specification with adjustment for plan characteristics, risk adjustment, and county reinsurance rates, as well as county and year fixed effects, Peak was estimated to reduce premiums by $46.37 (SE: 8.96, randomization inference

TABLE 6 Additional robustness analysis of Peak effect on average monthly premiums in Summit County.

	(1) Removing Kaiser plans	(2) Impact of 2020 Kaiser Exit Outside Summit	(3) Removing Peak plans	(4) Removing enrollment weights	(5) Outcome = enrollment	(6) Insurer fixed effects
Summit*(Year >= 2020)	−40.01***	–	13.72	−21.72***	−5.10	−31.22***
	(14.76)		(11.04)	(6.58)	(5.04)	(10.49)
Kaiser exit*(Year >= 2020)	–	−10.22	–	–	–	–
		(8.26)				
Observations	33,114	40,545	36,932	36,962	36,962	36,962
R-squared	0.77	0.70	0.76	0.63	0.12	0.81
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Actuarial value	Yes	Yes	Yes	Yes	Yes	Yes
Plan characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Risk adjustment	Yes	Yes	Yes	Yes	Yes	Yes
Reinsurance rate	Yes	Yes	Yes	Yes	Yes	Yes
Insured fixed effects	No	No	No	No	No	Yes

Note: Difference-in-differences estimates are presented and robust standard errors are in parentheses. Each column represents estimates from a different modeling specification. In the first column, Kaiser plans are removed from the analysis. In the second column, the impact of Kaiser exiting Archuleta, Eagle, Hinsdale, Jackson, Moffat, Ouray, and Rio Blanco counties in 2020 is estimated, excluding Summit County. In the third column, Peak plans are removed from the analysis. In the fourth column, no enrollment weights are used. In the fifth, total enrollment is treated as the outcome. In the sixth, insured, fixed effects are included. All models control for plan actuarial value, plan characteristics, enrollee risk adjustment, county fixed effects, and reinsurance rates. The plan actuarial value is the estimated proportion of expenditures paid by the plan, as opposed to the individual (0–100). Plan characteristics include the plan metal tier (Catastrophic, Bronze, Expanded Bronze, Silver, Gold, and Platinum), the plan type (EPO, HMO, Indemnity, PPO, and POS), and the benefits package (22 unique categories included as fixed effects). The plan liability risk score is a measure of the expected liability to insurers based on enrollee health status and cost-sharing. Reinsurance rates are included as a categorical variable at the county-year level based on the Colorado statewide program that began in 2020 (years prior have reinsurance rates of 0). The data are at the plan-year level, with regressions are weighted by the number of enrollees in the plan-year, except for columns 4 and 5. Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded in Summit County analyses. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

p-value < 0.001). The effect amounts to an approximate 14% reduction in premiums relative to an average premium of $337.20. Combining these findings from 2021 with the earlier Summit adoption of Peak using the Callaway and Sant'Anna estimator, we find that Peak led to a $40.44 reduction in premiums (SE: 7.53, p-value < 0.001).

In Appendix 5, we show the results of the event study analysis, with 2020 omitted as the reference year. In the preferred modeling specification, we find no evidence of differences in premium trends between treated and untreated counties but a reduction in premiums of $34.70 (SE: 12.91, p-value = 0.007), the single treated year. Similarly, we find that the time-varying treatment effects estimated using the Callaway and Sant'Anna estimator are consistent with effects being driven by a sharp decline in the post-Peak period.

TABLE 7 Difference-in-differences analysis of Peak effect on average monthly premiums outside of Summit County.

	(1)	(2)	(3)	(4)	(5)		(6)
Treated*(Year >= 2021)	−85.84***	−99.55***	−87.32***	−87.46***	−46.37***	ATT	−40.44***
(Robust standard error)	(12.04)	(12.90)	(9.82)	(9.79)	(8.96)		(7.53)
Randomization inference *p*-value (standard error)	0.000	0.000	0.000	0.000	0.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
Observations	45,427	40,560	40,560	40,560	40,560		
R-squared	0.33	0.63	0.74	0.74	0.76		
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Method:	Callaway and Sant'Anna
County fixed effects	Yes	Yes	Yes	Yes	Yes		
Actuarial value	No	Yes	Yes	Yes	Yes		Yes
Plan characteristics	No	No	Yes	Yes	Yes		Yes
Risk adjustment	No	No	No	Yes	Yes		Yes
Reinsurance rate	No	No	No	No	Yes		Yes
Mean premium	337.2	337.2	337.2	337.2	337.2		337.2

Note: Difference-in-differences estimates of the impact of the Peak program on average premiums and robust standard errors are in parentheses. Each column represents estimates with different levels of controls. Column 1 shows the raw difference-in-differences between treated counties (Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan) and other non-Summit counties before and after 2021 with county and year-fixed effects. In Columns 2–5, controls are added for plan actuarial value, plan characteristics, enrollee risk adjustment, and reinsurance rates, and Summit County is excluded. Column 6 shows the average treatment effect on the treated (ATT), combining the treatment effects from Summit County and the additional 2021 treated counties, estimated using the Callaway and Sant'Anna (2021) estimator. The plan actuarial value is the estimated proportion of expenditures paid by the plan, as opposed to the individual (0–100). Plan characteristics include the plan metal tier (Catastrophic, Bronze, Expanded Bronze, Silver, Gold, and Platinum), the plan type (EPO, HMO, Indemnity, PPO, and POS), and the benefits package (22 unique categories included as fixed effects). The plan liability risk score is a measure of the expected liability to insurers based on enrollee health status and cost-sharing. Reinsurance rates are included as a categorical variable at the county-year level based on the Colorado statewide program that began in 2020 (years prior have reinsurance rates of 0). The data are at the plan-year level, with regressions are weighted by the number of enrollees in the plan-year. data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

6 | THE ROLE OF PRICING IN DRIVING PREMIUM REDUCTIONS

Our prevailing hypothesis is that the mechanism driving lower premiums in Summit County is price negotiation on the part of Peak. By negotiating lower prices for health care services, Peak could drive down total plan expenditures (and thus, premiums), even if the underlying utilization of enrollees did not change. In Table 8, we estimate the effect of Peak on the average inpatient revenue per discharge, a proxy measure for the average price for inpatient services. We find that Peak is associated with a 36% decline in this measure Summit County

TABLE 8 Difference-in-differences and event study analysis of Peak effect on log (inpatient revenue per discharge) in Summit County and Outside of Summit County.

Difference-in-differences	(1) Summit	(2) Summit	(3) Outside Summit	(4) Outside Summit	(5) Staggered Adoption
Treatment*Post	−0.36***		−0.16**		−0.15**
	(0.07)		(0.07)		(0.07)
Event study					
Treatment*2016		0.20***		0.11	
		(0.03)		(0.10)	
Treatment*2017		0.06***		0.04	
		(0.02)		(0.10)	
Treatment*2018		0.16***		0.04	
		(0.02)		(0.10)	
Treatment*2019		–		−0.13	
				(0.09)	
Treatment*2020		−0.16***		–	
		(0.02)			
Treatment*2021		−0.28***		−0.20*	
		(0.03)		(0.10)	
Treatment*2022		−0.35***		−0.02	
		(0.04)		(0.05)	
Observations	680	680	695	695	695
R-squared	0.96	0.96	0.96	0.96	

Note: Difference-in-differences and event study estimates of the impact of the Peak program on the logged inpatient revenue per discharge and robust standard errors are in parentheses. All models include hospital and year-fixed effects. Columns 1 and 2 show difference-in-differences and event study estimates in Summit County in 2020 and 2021, excluding Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties. Columns 3 and 4 show difference-in-differences and event study estimates in Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties in 2021, excluding Summit County. Column 5 shows the average treatment effect on the treated (ATT), combining the treatment effects from Summit County and the additional 2021 treated counties, estimated using the Callaway and Sant'Anna (2021) estimator. The data are at the hospital-year level. The data are 2015–2021 Hospital Cost Report data. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

(p-value < 0.001), a 16% decline in the 2021 expansion counties (p-value = 0.015), as well as a 15% combined decline using the Callaway and Sant'Anna estimator (p-value = 0.038). Event study estimates show that these declines are driven by post-Peak declines in this measure.

We explore the extent to which lower premiums resulted from concurrent or preceding changes in utilization or from Peak's plan design features. In Appendix 6, we examine the association between Peak's implementation and the number of hospital discharges (Panel A), as well as total outpatient charges (Panel B). We do not find evidence that the implementation of Peak was associated with any concurrent or preceding declines in hospital discharges or outpatient charges.

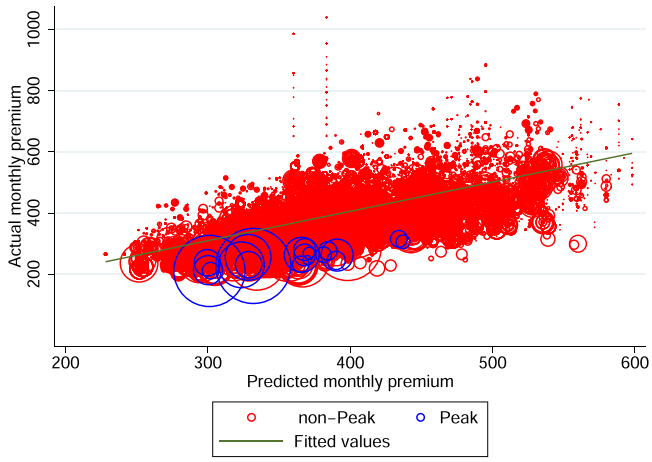

FIGURE 2 Actual versus predicted monthly premium for Peak and non-Peak Plans. Actual monthly premiums are plotted against predicted monthly premiums, where predictions are from the model described in Appendix 8. The predicted linear (1-to-1) relationship between predicted and actual monthly premiums is shown in green. The data are at the plan-year level and sized by the number of enrollees. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. [Color figure can be viewed at wileyonlinelibrary.com]

We perform several analyses to disentangle the relative effect of plan benefit characteristics and enrollee risk. First, in Appendix 7, we investigate the extent to which Peak implementation was associated with changes in plan design and enrollee risk. We find that Peak was not associated with any statistically significant changes in plan design in 2021 expansion counties (Panel B) but was associated with a 25 percentage point increase in enrollment in Expanded Bronze plans in Summit County (Panel A). These findings align with our primary regression estimates in Table 3, where we found that the estimated effect of Peak declined from an unadjusted reduction of $113.16 to $98.12 with the inclusion of plan actuarial value, plan characteristics, and enrollee risk scores in Summit County. Our final regression estimates control for all of these plan and enrollee characteristics, as well as reinsurance rates in 2020 and 2021.

In addition, we predict premiums as a function of all the model covariates (with the exception of Peak implementation), with estimates shown in Appendix 8. We then plot actual premiums against predicted premiums based on these regressions and highlight where Peak plans fall relative to the predicted premium. We show a scatter plot of the actual premiums on the *y*-axis with the predicted premiums on the *x*-axis along with an included linear best-fit line in Figure 2, with points sized by the number of enrollees in the plan-county observation. Graphically, we observe that all blue Peak points fall substantially below the best-fit line, consistent with premium effects even after adjustment for plan characteristics and enrollee risk.

7 | DISCUSSION

In light of the persistent upward trend in health care costs, purchasing alliances have gained popularity as a means to achieve greater value in employer-sponsored health insurance. Despite their pervasiveness, empirical evidence evaluating their efficacy is scarce. The present study

examines the outcome of the Peak Health Alliance in Summit County, Colorado, which claimed to have generated substantial savings of in health care costs for the community (Peak Health Alliance, 2023). Our analysis reveals that Peak was associated with a 13% to 17% decrease in premiums, depending on the empirical specification, for the average enrollee in Summit County during the first 2 years of its inception, and that this effect persisted when Peak expanded into seven additional counties in 2021. Given our intent-to-treat approach and that we saw no evidence that premiums were reduced in non-Peak plans following Peak's implementation, the reduction in premiums was likely even greater for those who actually enrolled in Peak's plans. Additionally, our findings suggest that this impact was primarily driven by lower prices rather than changes in utilization or plan design features.

Our analysis sought to investigate and rule out several threats to the validity of our estimates, including the endogeneity of participation in the Peak Health Alliance, the potential for nonrandom selection of patients into Peak's plans, as well as concurrent changes to the policy and market environment during Peak's implementation. Our intent-to-treat approach was designed to address the endogeneity and selection concerns under the assumption that there was not a major compositional change to the population in Peak's treated counties concurrent with its implementation. In support of this assumption, we saw no evidence that total enrollment was impacted by the Peak program or that controlling for the enrollee risk profile impacted Peak's estimated effect on premiums. Contemporaneous policy and market changes in 2020 included the implementation of Colorado's statewide reinsurance program (Colorado, 2023), the exit of Kaiser Permanente from Summit and other Colorado counties, and the COVID-19 pandemic. We found that our estimates were robust to controlling for variation in the reinsurance program's coinsurance rate, though a regression naïve to this policy change would have overestimated Peak's impact on premiums. We also found no evidence to suggest that Peak's estimated impact was driven by either Kaiser's exit or pandemic-related changes in utilization. Overall, these analyses support the hypothesis that Peak itself drove our observed effects rather than one of these other concerns.

Our findings are consistent with the established literature that suggests that elevated market bargaining power of insurers leads to, or is associated with, decreased prices in the commercial health insurance market (Barrette et al., 2020; Cooper et al., 2019; Craig et al., 2021; Dauda, 2018; McKellar et al., 2014; Scheffler & Arnold, 2017; Trish & Herring, 2015; Wang et al., 2024). In this case, such bargaining power was acquired through a non-profit entity that aggregated enrollment across multiple market segments. However, the empirical evidence for the efficacy of other alliances, which are hypothesized to increase insurer/employer market bargaining power, is limited. The recent failure of Haven Healthcare, which combined the bargaining power of three of the largest employers in the United States (representing 1.2 million employees), serves as an example. One of the key cited reasons for its collapse was the lack of sufficient bargaining power to negotiate lower prices with hospitals. Conversely, there are numerous accounts of smaller initiatives that claim to have reduced costs, such as The Alliance and the Purchaser Business Group on Health. Further research is required to investigate the impact of these initiatives and to discern the characteristics that are predictive of success (as seen in the case of Peak) or failure.

Peak presented several distinctive features. First, the initiative was initiated in a compact and well-defined geographical region. This concentrated approach may have mitigated administrative costs, as Peak could concentrate its price negotiation efforts in a single market dominated by a single hospital system. Second, there was a relatively low level of competition from other insurers in the individual exchange market, coupled with the recent withdrawal of

Kaiser Permanente, which may have facilitated the rapid increase in Peak's bargaining power in Summit County. On the one hand, the apparent success of Peak in Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties in 2021 provides encouraging evidence of the scalability of the program. On the other hand, Peak has continued to focus on primarily on rural markets— whether the model works in more competitive, urban settings will remain an open question. It is notable that Peak has been able to succeed in lowering premiums in these smaller markets, however, where there are often hospital monopolies (e.g., as in Summit County). Third, Peak explicitly negotiated prices for its participating employers and plans, combining market power across multiple market segments. It did so in a relatively narrow geography, which may have furthered its leverage and expertize in the negotiation. This is distinct from many other alliances that often focus primarily on advisory services (e.g., Purchaser Business Group on Health) and/or are spread over a greater area geographically (e.g., Haven Healthcare).

The initial success Peak achieved in 2020–2021 was short-lived, with the Peak Health Alliance ceasing plans in 2023 due to Bright Health. Bright, Peak's key insurance carrier partner in 2020–2021, pulled out of every insurance market in the U.S. in 2022, with the exception of the Medicare Advantage market in California (Ingold, 2022). In early 2024, Bright sold its remaining insurance offerings and rebranded as a care-management tech company. The fact that Bright's 2022 exit from insurance markets was nationwide likely allays the concern that its exit from Colorado was a result of unrealistic long term prices in Peak's plans specifically. In 2024, Peak once again began offering its plans through a partnership with Elevate Health Plans through the Denver Health Medical Plan (Summit Daily Staff, 2023). Further evaluation of Peak's effect on premiums will be crucial in the coming years as the program continues to evolve.

Despite its suggested short-term success in lowering premiums, Peak may not come without costs. First, the emergence of Peak was associated with a 47% increase in insurer market power. While this likely improved Peak's ability to negotiate lower prices, it could also limit choice for enrollees in the market. Additionally, as we highlighted in this paper, Peak plans had greater enrollee cost-sharing arrangements than other plans in and out of Summit County. This could limit access to needed health care, especially for lower-income and higher-need populations.

This study is subject to limitations. First, we did not directly observe negotiated prices in the plan-level data used in this study. The richness of our data allowed us to control for other possible explanations for the association between Peak and lower premiums (e.g., plan design), leading us to conclude that lower prices were the primary explanation for lower premiums. Analyses of hospital-level data were also consistent with this hypothesis, though these data lacked precise measures of prices and utilization. However, future work should compare changes in average negotiated commercial insurance prices over time in the counties that Peak operates in to provide further corroborating evidence of this conclusion. Second, this study did not investigate any changes in access and utilization of specific services following the implementation of Peak. Quantifying the total welfare impact of this initiative requires understanding its impact on health, as well as health insurance premiums. Third, our study focused on the impact of Peak on premiums in small counties in Colorado. While we provide the first empirical evidence of the success of a purchasing alliance, our analysis is unable to establish the level of combined purchasing power necessary to achieve these results, given the small number of counties treated and the limited view of changes to purchaser concentration in the self-funded and large group market. Finally, as with most purchasing alliances, the decision to begin the initiative is non-random. In particular, Peak was founded in response to high health

care costs. This raises the concern that any corresponding decreases in premiums in the years following could represent regression to the mean in premiums in Summit County. We address this concern by checking for differing trends prior to its implementation, as well a synthetic control analysis that matched on premiums in years preceding Peak.

8 | CONCLUSIONS

This study provides empirical evidence of the effectiveness of the Peak Health Alliance in reducing health care costs and premiums for enrollees in Colorado. Our findings suggest that the bargaining power gained through this purchasing alliance lowered spending primarily through reduced prices rather than plan design or other policies. These results are consistent with the literature that highlights the importance of bargaining power in decreasing prices in the commercial health insurance market. However, the success of Peak does not necessarily generalize to other purchasing alliances. Further research is needed to evaluate the efficacy of these initiatives and identify the characteristics that are predictive of success.

CONFLICTS OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data were provided confidentially by the Colorado Division of Insurance and cannot be publicly shared. Reproduction programs will be made available upon publication.

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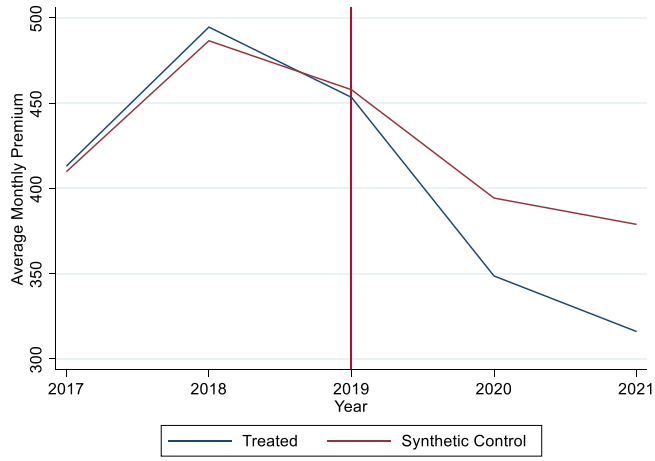
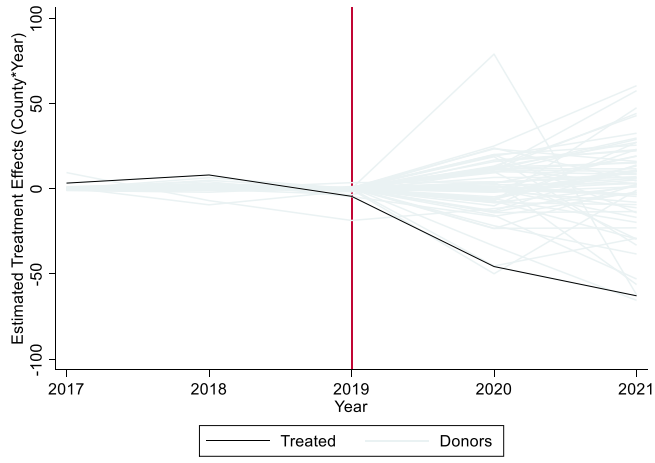
APPENDIX 1: AVERAGE MONTHLY PREMIUMS IN SUMMIT COUNTY AND SYNTHETIC CONTROL, 2017–2021



Note: Trends in average monthly premiums in Summit County and a synthetic control over time are shown. A synthetic Summit County is comprised of a weighted average of other potential donor counties in Colorado selected based on their premiums in 2017 and 2019 before Peak was implemented, as well as our other model covariates. Donor counties were Eagle (weight = 0.865), Mesa (0.126), and Weld (0.01). Model covariates include controls for plan actuarial value, plan characteristics, enrollee risk adjustment, county fixed effects, and reinsurance rates. The plan actuarial value is the estimated proportion of expenditures paid by the plan, as opposed to the individual (0–100). Plan characteristics include the plan metal tier (Catastrophic, Bronze, Expanded Bronze, Silver, Gold, and Platinum), the plan type (EPO, HMO, Indemnity, PPO, and POS), and the benefits package (22 unique categories included as fixed effects). The plan liability risk score is a measure of the expected liability to insurers based on enrollee health status and cost-sharing. Reinsurance rates are included as a categorical variable at the county-year level based on the Colorado statewide program that began in 2020 (years prior have reinsurance rates of 0). Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. [Color figure can be viewed at wileyonlinelibrary.com]

APPENDIX 2: ESTIMATED PLACEBO TREATMENT EFFECTS IN SUMMIT COUNTY AND DONOR COUNTIES FROM SYNTHETIC CONTROL ANALYSIS



Note: Trends in average monthly premiums in Summit County and placebo counties over time are shown. Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. [Color figure can be viewed at wileyonlinelibrary.com]

APPENDIX 3: PLAN CHARACTERISTICS IN TREATED COUNTIES AND UNTREATED COLORADO COUNTIES BEFORE AND AFTER THE IMPLEMENTATION OF PEAK, 2017–2021

Variable	Treated County Pre-Peak (2017–2020)	Treated County Post-Peak (2021)	Rest of Colorado Pre-Peak (2017–2020)	Rest of Colorado Post-Peak (2021)
N, Plan-Counties	3378	358	29,048	4623
Enrollment, mean (SD)	31.9 (106.1)	21.5 (52.0)	62.1 (198.8)	88.8 (240.6)
Monthly premium (27 year-old, non-smoker), mean (SD)	425 (104)	366 (115)	380 (93)	363 (95)
Actuarial value, mean (SD)	71.1 (7.1)	70.6 (5.6)	71.5 (7.2)	72.2 (6.6)
Market segment, *n* (%)				
Individual	1068 (31.6%)	234 (65.4%)	8702 (30.0%)	2143 (46.4%)
Small group	2310 (68.4%)	124 (34.6%)	20,346 (70.0%)	2480 (53.6%)
Plan type, *n* (%)				
EPO	223 (6.6%)	97 (27.1%)	1999 (6.9%)	886 (19.2%)
HMO	1669 (49.4%)	176 (49.2%)	14,476 (49.8%)	2011 (43.5%)
Indemnity	1 (<1%)	0 (0.0%)	9 (<1%)	0 (0.0%)

(Continues)

Variable	Treated County Pre-Peak (2017–2020)	Treated County Post-Peak (2021)	Rest of Colorado Pre-Peak (2017–2020)	Rest of Colorado Post-Peak (2021)
POS	561 (16.6%)	31 (8.7%)	4,990 (17.2%)	575 (12.4%)
PPO	670 (19.8%)	43 (12.0%)	5667 (19.5%)	838 (18.1%)
Unknown	254 (7.5%)	11 (3.1%)	1907 (6.6%)	313 (6.8%)
Metal tier, *n* (%)				
Catastrophic	71 (2.1%)	13 (3.6%)	693 (2.4%)	114 (2.5%)
Bronze	534 (15.8%)	1 (0.3%)	4237 (14.6%)	60 (1.3%)
Expanded Bronze	216 (6.4%)	108 (30.2%)	2024 (7.0%)	913 (19.7%)
Silver	1526 (45.2%)	171 (47.8%)	12,670 (43.6%)	2086 (45.1%)
Gold	689 (20.4%)	50 (14.0%)	6700 (23.1%)	959 (20.7%)
Platinum	88 (2.6%)	4 (1.1%)	817 (2.8%)	178 (3.9%)
Unknown	254 (7.5%)	11 (3.1%)	1907 (6.6%)	313 (6.8%)
Plan liability risk score, mean (SD)	1.02 (0.25)	1.01 (0.07)	1.05 (0.27)	1.04 (0.27)
Reinsurance rate for rating area, median (IQR)	0.00 (0.00, 0.00)	80.00 (80.00, 80.00)	0.00 (0.00, 0.00)	40.00 (40.00, 45.00)

Note: Means and standard deviation (SD), in parentheses, are shown for continuous variables. For categorical/binary variables, the number and percent of plan-counties in the column is shown. Summit County is excluded. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance.

APPENDIX 4: PLAN CHARACTERISTICS FOR PEAK PLANS, NON-PEAK PLANS IN TREATED COUNTY, AND UNTREATED COLORADO COUNTIES AFTER THE IMPLEMENTATION OF PEAK, 2021

Variable	Peak Plans in Treated County	Non-Peak Plans in Treated County	Rest of Colorado
N, Plan-Counties	29	329	4,623
Enrollment, mean (SD)	26.1 (29.1)	21.1 (53.5)	88.8 (240.6)
Monthly premium (27 year-old, non-smoker), mean (SD)	248 (38)	376 (114)	363 (95)
Actuarial value, mean (SD)	70.0 (5.2)	70.7 (5.6)	72.2 (6.6)
Market segment, *n* (%)			
Individual	29 (100.0%)	205 (62.3%)	2143 (46.4%)
Small group	0 (0.0%)	124 (37.7%)	2480 (53.6%)
Plan type, *n* (%)			
EPO	29 (100.0%)	68 (20.7%)	886 (19.2%)
HMO	0 (0.0%)	176 (53.5%)	2,011 (43.5%)
Indemnity	0 (0.0%)	0 (0.0%)	0 (0.0%)

Variable	Peak Plans in Treated County	Non-Peak Plans in Treated County	Rest of Colorado
POS	0 (0.0%)	31 (9.4%)	575 (12.4%)
PPO	0 (0.0%)	43 (13.1%)	838 (18.1%)
Unknown	0 (0.0%)	11 (3.3%)	313 (6.8%)
Metal tier, *n* (%)			
Catastrophic	2 (6.9%)	11 (3.3%)	114 (2.5%)
Bronze	0 (0.0%)	1 (0.3%)	60 (1.3%)
Expanded Bronze	10 (34.5%)	98 (29.8%)	913 (19.7%)
Silver	13 (44.8%)	158 (48.0%)	2086 (45.1%)
Gold	4 (13.8%)	46 (14.0%)	959 (20.7%)
Platinum	0 (0.0%)	4 (1.2%)	178 (3.9%)
Unknown	0 (0.0%)	11 (3.3%)	313 (6.8%)
Plan liability risk score, mean (SD)	1.00 (0.00)	1.01 (0.08)	1.04 (0.27)
Reinsurance rate for rating area, median (IQR)	80.00 (80.00, 80.00)	80.00 (80.00, 80.00)	40.00 (40.00, 45.00)

Note: Means and standard deviation (SD), in parentheses, are shown for continuous variables. For categorical/binary variables, the number and percent of plan-counties in the column is shown. Summit County is excluded. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance.

APPENDIX 5: EVENT STUDY ANALYSIS OF PEAK EFFECT ON AVERAGE MONTHLY PREMIUMS OUTSIDE OF SUMMIT COUNTY

	(1)	(2)	(3)	(4)	(5)		(6)
Pre-years						ATT by year	
Treated*2017	46.56***	51.63***	43.79***	43.51***	9.03	−3	10.24***
	(13.15)	(13.05)	(10.13)	(10.10)	(9.53)		(1.80)
Treated*2018	53.34***	60.31***	51.47***	51.23***	16.56*	−2	−17.80***
	(13.42)	(13.43)	(10.47)	(10.44)	(9.84)		(5.53)
Treated*2019	54.86***	64.20***	57.44***	57.19***	18.86*	−1	7.39
	(14.22)	(13.86)	(11.13)	(11.09)	(10.51)		(14.41)
*Omitted Treated*2020*						1	−38.24***
							(8.64)
						2	−58.02***
Post-years							(6.05)
Treated*2021	−46.16***	−54.48***	−48.13***	−48.43***	−34.70***		
	(17.17)	(18.01)	(13.46)	(13.43)	(12.91)		
Observations	45,427	40,560	40,560	40,560	40,560	Method:	Callaway and Sant'Anna
R-squared	0.33	0.63	0.74	0.74	0.76		
Year fixed effects	Yes	Yes	Yes	Yes	Yes		Yes

(Continues)

	(1)	(2)	(3)	(4)	(5)	(6)
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Actuarial value	No	Yes	Yes	Yes	Yes	Yes
Plan characteristics	No	No	Yes	Yes	Yes	Yes
Risk adjustment	No	No	No	Yes	Yes	
Reinsurance rate	No	No	No	No	Yes	
Mean premium	337.2	337.2	337.2	337.2	337.2	

Note: Event study estimates of the year-by-year impact of the Peak program on average premiums and robust standard errors are in parentheses. Each column represents estimates with different levels of controls. Column 1 shows the raw difference-in-differences between treated counties (Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan) and other non-Summit counties before and after 2021 with county and year-fixed effects. In Columns 2–5, controls are added for plan actuarial value, plan characteristics, enrollee risk adjustment, and reinsurance rates. Column 6 shows the ATT by year relative to treatment, combining the treatment effects from Summit County and the additional 2021 treated counties, estimated using the Callaway and Sant'Anna (2021) estimator. The plan actuarial value is the estimated proportion of expenditures paid by the plan, as opposed to the individual (0–100). Plan characteristics include the plan metal tier (Catastrophic, Bronze, Expanded Bronze, Silver, Gold, and Platinum), the plan type (EPO, HMO, Indemnity, PPO, and POS), and the benefits package (22 unique categories included as fixed effects). The plan liability risk score is a measure of the expected liability to insurers based on enrollee health status and cost-sharing. Reinsurance rates are included as a categorical variable at the county-year level based on the Colorado statewide program that began in 2020 (years prior have reinsurance rates of 0). The data are at the plan-year level, with regressions are weighted by the number of enrollees in the plan-year. Summit County is excluded. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. Statistical significance indicated by $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

APPENDIX 6: DIFFERENCE-IN-DIFFERENCES AND EVENT STUDY ANALYSIS OF PEAK RELATIONSHIP WITH ON LOG(INPATIENT DISCHARGES) AND LOG(OUTPATIENT CHARGES) IN SUMMIT COUNTY AND OUTSIDE OF SUMMIT COUNTY

Difference-in-differences	(1) Summit	(2) Summit	(3) Outside Summit	(4) Outside Summit	(5) Staggered adoption
Panel A. Inpatient discharges					
Treatment*Post	0.05		0.10*		0.01
	(0.05)		(0.06)		(0.04)
Event study					
Treatment*2016		−0.06		0.02	
		(0.05)		(0.10)	
Treatment*2017		0.00		−0.04	
		(0.03)		(0.09)	
Treatment*2018		0.09***		−0.05	
		(0.03)		(0.10)	
Treatment*2019		–		0.07	
				(0.09)	
Treatment*2020		0.06**		–	
		(0.03)			

Difference-in-differences	(1) Summit	(2) Summit	(3) Outside Summit	(4) Outside Summit	(5) Staggered adoption
Treatment*2021		0.00		0.11	
		(0.03)		(0.10)	
Treatment*2022		0.10		0.07	
		(0.06)		(0.06)	
Observations	682	682	697	697	695
R-squared	0.98	0.98	0.98	0.98	
Panel B. Outpatient charges					
Treatment*Post	0.05		0.12		0.07
	(0.09)		(0.09)		(0.11)
Event study					
Treatment*2016		−0.28***		0.01	
		(0.08)		(0.11)	
Treatment*2017		−0.06		0.15	
		(0.09)		(0.10)	
Treatment*2018		−0.02		0.09	
		(0.05)		(0.08)	
Treatment*2019		–		0.11	
				(0.09)	
Treatment*2020		−0.04		–	
		(0.07)			
Treatment*2021		−0.03		0.22*	
		(0.09)		(0.12)	
Treatment*2022		−0.05		−0.00	
		(0.12)		(0.13)	
Observations	662	662	677	677	677
R-squared	0.97	0.97	0.97	0.97	

Note: Difference-in-differences and event study estimates of the impact of the Peak program on the logged number of discharges and robust standard errors are in parentheses. All models include hospital and year-fixed effects. Columns 1 and 2 show difference-in-differences and event study estimates in Summit County in 2020 and 2021, excluding Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties. Columns 3 and 4 show difference-in-differences and event study estimates in Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties in 2021, excluding Summit County. Column 5 shows the average treatment effect on the treated (ATT), combining the treatment effects from Summit County and the additional 2021 treated counties, estimated using the Callaway and Sant'Anna (2021) estimator. The data are at the hospital-year level. The data are 2015-2021 Hospital Cost Report data. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

APPENDIX 7: DIFFERENCE-IN-DIFFERENCES ANALYSIS OF PEAK EFFECT ON PLAN CHARACTERISTICS IN SUMMIT AND OUTSIDE OF SUMMIT COUNTY

	(1) Actuarial value	(2) Risk score	(3) Silver or greater metal tier	(4) Expanded Bronze metal tier	(5) EPO or HMO
Panel A. In Summit County					
Summit*(Year >= 2020)	0.01	−0.06**	−0.07	0.25***	0.10
	(0.01)	(0.02)	(0.09)	(0.09)	(0.07)
Observations	36,962	41,336	41,336	41,336	41,336
R-squared	0.05	0.04	0.02	0.13	0.04
Year fixed effects	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes
Mean *Y*	0.712	1.029	0.600	0.138	0.584
Panel B. Outside of Summit County					
Treated*(Year >= 2021)	0.01	−0.09***	−0.05	0.08	0.05
	(0.01)	(0.02)	(0.06)	(0.07)	(0.03)
Observations	40,560	45,427	45,427	45,427	45,427
R-squared	0.05	0.04	0.02	0.14	0.04
Year fixed effects	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes
Mean Y	0.712	1.029	0.600	0.138	0.584

Note: Difference-in-differences estimates of the impact of the Peak program on plan characteristics and robust standard errors are in parentheses. Panel A shows the impact of Peak in Summit County from 2020 to 2021, and Panel B shows the impact of Pak in Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan in 2021. Each column represents estimates for the analysis of a distinct plan characteristic outcome variable. The plan liability risk score is a measure of the expected liability to insurers based on enrollee health status and cost-sharing. The data are at the plan-year level, with regressions are weighted by the number of enrollees in the plan-year. Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded in Panel A analyses, and Summit County is excluded in Panel B analyses. All data are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

APPENDIX 8: PREDICTED MONTHLY PREMIUMS WITH MODEL COVARIATES

	(1) Average monthly premium
Actuarial value (0–100)	1.568***
	(0.179)
Plan type (ref = EPO)	
HMO	3.488***
	(1.182)

	(1) Average monthly premium
Indemnity	235.3***
	(18.31)
POS	33.80***
	(1.337)
PPO	59.67***
	(1.303)
Metal tier (ref = Bronze)	
Expanded bronze	4.380***
	(1.352)
Silver	108.7***
	(3.418)
Gold	164.6***
	(5.145)
Platinum	47.57***
	(1.861)
Market segment (ref = Individual)	
Unknown	−4.964***
	(1.153)
Small group	−40.42***
	(0.969)
Adults-only plan (ref = allows children)	1.701*
	(0.929)
Plan liability risk score	12.24***
	(1.265)
Coinsurance rate (ref = 85%)	
40%	18.00***
	(3.092)
45%	7.278***
	(2.185)
50%	−20.18***
	(2.279)
80%	12.00***
	(3.074)
Observations	36,962
R-squared	0.681

Note: Coefficient estimates with standard errors in the parentheses are shown from a regression analysis of monthly premiums. The regression model includes all of the shown variables in the table, in addition to county and year fixed effects and plan benefits package fixed effects (22 unique categories). The data are at the plan-year level and are sourced from the Colorado Department of Regulatory Affairs: Division of Insurance. Dolores, Grand, Lake, La Plata, Montezuma, Park, and San Juan counties are excluded. Statistical significance indicated by ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.