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Original Article

How Payer Structure and Capital Investment Shape Hospital Utilization and Financial Performance

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Abstract

Background: Hospital utilization and financial performance are shaped by payer incentives, managed care participation, and capital investment decisions.

Objectives: This study aims to evaluate the extent to which variations in managed care exposure, capital expenditures, and outpatient revenue are associated with facility-level changes in service volume and net patient revenue over time.

Methods: This study uses a multi-year panel dataset of hospitals observed over 22 quarters from 2020 to 2025. Outcomes include changes in total patient days and net patient revenue, capturing shifts in service volume and realized earnings. Key explanatory variables include capital expenditures, managed care revenue exposure, teaching-related payment adjustments, and outpatient revenue. Hospital fixed-effects models are used to isolate within-hospital variation over time.

Results: Greater managed care revenue exposure and higher capital investment are associated with faster utilization growth but do not consistently produce proportional revenue gains, suggesting margin pressures under certain reimbursement structures. Teaching-related payment adjustments are associated with slower changes in both utilization and revenue.

Conclusion: These findings highlight how payer mix and investment patterns influence provider behavior and operational outcomes. Aligning reimbursement incentives and capital allocation strategies with sustainable utilization and financial stability is important for population health management and delivery system planning.

Keywords: Hospital Operations, Financial Performance, Fixed-Effect Analysis, Hospital Utilization

1. Background

Hospitals operate in an environment characterized by continuous fluctuations in patient demand, reimbursement structures, and policy adjustments. Understanding the factors that influence changes in hospital activity and financial outcomes is critical for effective management and policymaking. Studies often focus on absolute performance levels, such as total patient volume or annual revenue, yet these static measures may obscure the dynamics of operational and financial adjustment that hospitals experience on a quarterly basis.[1,2] Quarter-to-quarter changes—referred to here as the velocity of hospital outcomes—capture the pace at which hospitals adapt to shifts in demand, payer composition, or internal investment strategies. Analyzing these dynamics provides insight into both operational responsiveness and the short-term effectiveness of financial management.

Facility-level characteristics, including capital investments, payer mix, and policy-driven payment adjustments, are central determinants of hospital performance. Capital expenditures can expand capacity and enable more intensive service delivery, yet they also incur immediate costs that may temporarily constrain financial growth. Payer composition, such as the proportion of revenue derived from Medi-Cal managed care or other third-party payers, can influence both the rate of patient volume growth and realized revenue, particularly under reimbursement structures with fixed or delayed payments. Adjustments such as teaching allowance deductions, designed to support academic missions, may carry unintended operational or financial consequences, potentially affecting short-term changes in service delivery or revenue generation.

2. Objectives

Despite the potential importance, few studies have examined the joint effect of these facility-level factors on the velocity of hospital outcomes. Prior research has largely concentrated on cross-sectional or annual measures, leaving the dynamics of within-hospital adjustment largely unexplored. By focusing on quarter-to-quarter changes in total patient days and net patient revenue, this study aims to fill this gap, providing a nuanced understanding of how hospitals navigate operational and

financial pressures over short intervals. Using publicly available quarterly data from 437 California hospitals spanning 22 quarters, we apply hospital-level fixed effect models to isolate within-hospital variation and examine how investment, payer composition, and policy-related payment adjustments influence the pace of change in hospital utilization and revenue.

Our study contributes to the literature by distinguishing operational adjustments from financial performance adjustments, highlighting instances where factors that accelerate patient volume growth do not translate into faster revenue growth. Understanding these dynamics is critical for hospital administrators seeking to balance utilization, investment, and revenue, as well as for policymakers aiming to design financial and regulatory frameworks that support sustainable hospital performance.

3. Methods

3.1. Data Source

The study dataset was constructed by consolidating 22 separate quarterly files obtained from a single public reporting platform. These files are part of the Hospital Quarterly Financial and Utilization Reports published through the California Health and Human Services Open Data Portal (CalHHS) and released in November 2025.[3] The final panel includes 437 California hospitals observed over 22 consecutive quarters spanning from the first quarter of 2020 to the second quarter of 2025.

Hospitals are required to submit standardized quarterly reports summarizing operational capacity, utilization patterns, and detailed financial flows categorized by payer source. These submissions provide facility-level measures of inpatient service volume and patient care-related earnings. Two primary outcome indicators are drawn from these reports: total patient days, which represents inpatient utilization intensity, and total net patient revenue, which captures realized patient-care revenue after contractual adjustments.

The empirical specification incorporates several time-varying financial indicators drawn from the reports, including capital expenditures, net patient revenue for Medi-Cal Managed Care, deduction for teaching allowance, and gross outpatient revenue for other third-party managed care. Rather than measuring overall balance sheet strength, these variables are used to characterize differences in investment timing, reimbursement composition, and policy-adjusted payment structures across hospitals. Collectively, they provide a multi-dimensional view of how financial and payer structure factors relate to short-term changes in hospital activity and revenue generation.

3.2. Methods

Our analysis is conducted at the hospital facility level and focuses on short-term operational and financial adjustments rather than static performance levels. To capture these dynamics, we construct two outcome measures based on quarter-to-quarter changes: the change in total patient days and the change in total net patient revenue between consecutive reporting periods. These first-differenced outcomes reflect within-hospital shifts over time. Although both dependent variables are derived from the same reporting system, they represent different adjustment margins. The change in total patient days captures variation in inpatient utilization intensity across quarters, reflecting fluctuations in service volume and capacity use. The change in total net patient revenue measures shifts in financial returns from patient care activities, reflecting changes in payer mix, reimbursement, and billing outcomes. Examining both measures jointly allows us to distinguish operational utilization adjustments from financial performance adjustments.

We begin by summarizing the empirical distributions of the two change-based outcomes across hospital-quarter observations. Each hospital-quarter record was treated as an individual observation. Distributional visualizations are used to assess variability, asymmetry, and the frequency of large positive or negative shifts. This descriptive step provides an overview of how stable or volatile hospital utilization and revenue patterns are over time.

We then conduct exploratory analyses to examine how selected financial and payer-related variables are associated with quarter-to-quarter changes in utilization and revenue. The key explanatory variables include capital expenditures, net patient revenue from Medi-Cal managed care, teaching allowance deductions, and gross outpatient revenue from other third-party managed care payers. Graphical comparisons and bivariate summaries are used to evaluate whether movements in these variables tend to coincide with increases or decreases in the outcome measures, helping to guide the multivariate modeling strategy.

These explanatory factors are selected to represent distinct operational and financial channels within hospital management. Capital expenditures capture investment in long-lived assets and infrastructure expansion. Net patient revenue from Medi-Cal managed care reflects exposure to public managed care reimbursement streams. Teaching allowance deductions represent payment adjustments related to academic and training missions. Gross outpatient revenue from other third-party managed care payers reflects the scale and intensity of outpatient activity financed through managed care arrangements outside major public programs.

Because the dataset follows the same hospitals over multiple consecutive quarters, we estimate hospital fixed-effects models using the change-based outcomes. This approach controls for time-invariant facility characteristics and isolates within-hospital variation over time. Separate

regressions are estimated for changes in utilization and changes in revenue to allow the effects of financial and payer-related variables to differ across operational and financial adjustment channels. All analyses were performed using Python 3.12.12 in Google Colab.

4. Results

We started by descriptively examining the distributions of the two hospital outcome measures: the quarterly change in total patient days and total net patient revenue. For simplicity, each hospital quarter was treated as a separate observation, effectively treating the 21 quarterly reports per hospital as distinct entries. This setup enabled us to evaluate the overall variation across all hospital quarter observations before proceeding to multivariate analysis. The distribution of changes in total patient days indicates that most hospital-quarter observations fall within a moderate range, with the majority clustering around 1,000 days (Figure 1), suggesting this interval reflects typical patient volumes during the study period. A similar pattern is observed for total net patient revenue, with most observations reporting revenues below $10 million. Overall, these results suggest that hospital activity and financial outcomes are fairly stable across facility-quarter observations, with most hospitals experiencing moderate patient loads and revenue levels, indicative of broadly comparable operational scale and financial performance in the dataset.

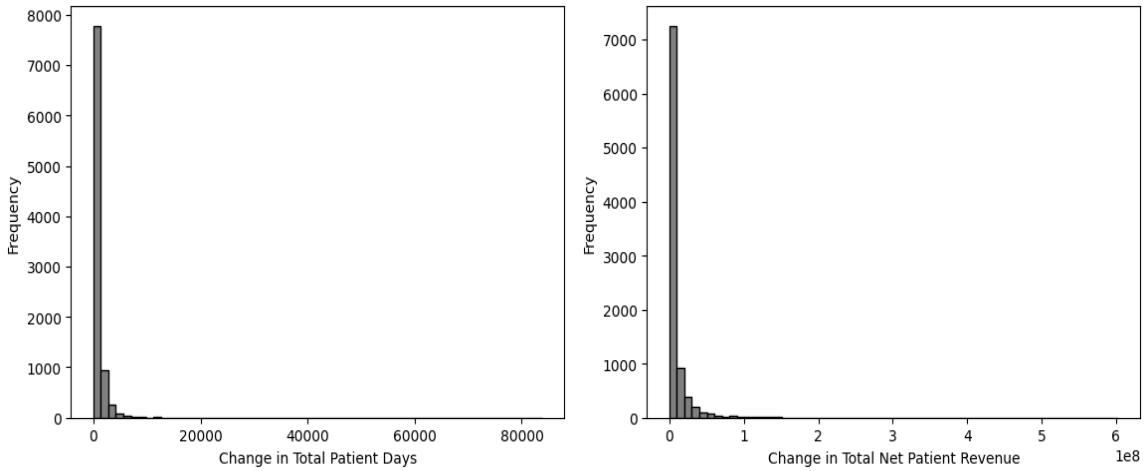

Figure 1. Distributions of Hospital-Level Velocity Measures for Changes in Total Patient Days and Net Patient Revenue.

To explore bivariate relationships, we examined the distributions of key covariates stratified by each hospital outcome, providing insight into how facility-level characteristics vary across different levels of hospital activity and changes in financial performance. Figure 2 illustrates the distributions of selected covariates—capital expenditures, net patient revenue for Medi-Cal managed care, teaching allowance deductions, and gross outpatient revenue for other third-party managed care—by the change in total patient days. A comparable set of distributions was also analyzed for changes in total net patient revenue. Among these covariates, net patient revenue for Medi-Cal managed care and gross outpatient revenue for other third-party managed care show a positive association with both outcomes, suggesting that hospitals with higher revenue from these sources tend to experience greater increases in patient days and overall revenue. Other covariates, such as capital expenditures and teaching allowance deductions, display weaker relationships across the two outcomes, highlighting that not all facility-level characteristics are equally predictive of changes in hospital activity or financial performance.

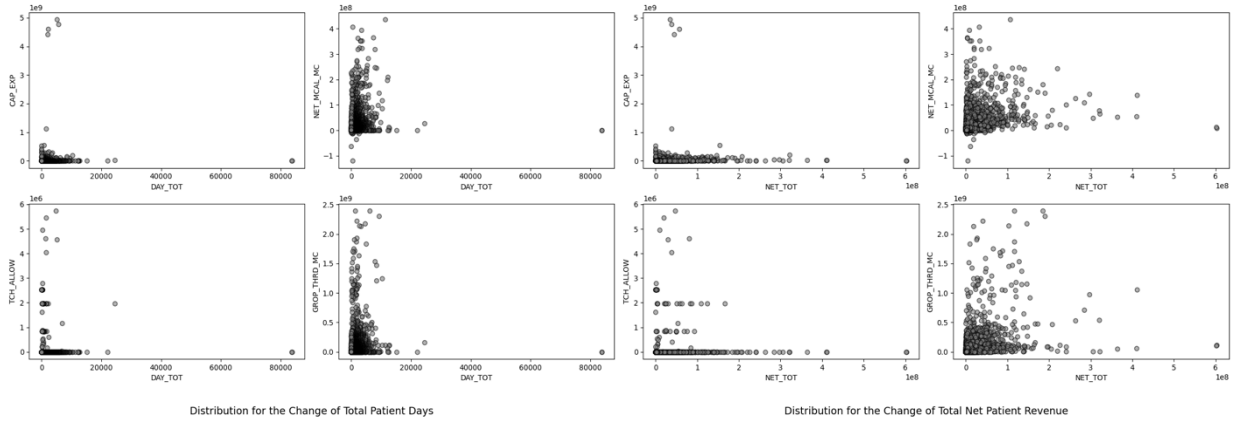

Figure 2. Distributions of Facility-Level Covariates by Hospital Velocity Measures of Changes in Total Patient Days and Net Patient Revenue.

To examine the relationships between facility-level characteristics and hospital velocity outcomes, we estimated hospital-level fixed-effect models, controlling for hospital-specific heterogeneity. Focusing first on the change in total patient days, several covariates exhibit statistically significant positive associations. Capital expenditures are positively associated with the change in total patient days (coefficient = 0.0000002, P = 0.001). Similarly, net patient revenue from Medi-Cal managed care shows a positive relationship (coefficient = 0.000005, P = 0.007), as does gross outpatient revenue from other third-party managed care payers (coefficient = 0.000005, P < 0.001). In contrast, teaching allowance deductions are negatively associated with the change in total patient days (coefficient = -0.0002, P = 0.007).

The patterns differ when considering the change in total net patient revenue. Here, capital expenditures, net patient revenue from Medi-Cal managed care, and teaching allowance deductions all exhibit negative associations (coefficients = -0.009, P < 0.001; coefficients = -0.088, P = 0.021; and coefficients = -4.413, P = 0.032, respectively), indicating that higher spending or adjustments in these categories correspond to smaller increases, or even decreases, in total net patient revenue.

All regression results are summarized in Table 1. Collectively, these findings suggest that facility-level financial and operational characteristics influence hospital activity and revenue in nuanced ways: some factors, such as capital investment and certain revenue streams, are linked to higher patient volumes but not necessarily to revenue growth, while other adjustments, such as teaching allowance deductions, have divergent effects on different outcomes.

Table 1. Fixed Effect Results for Hospital Velocity Outcomes

Covariates	Change of Total Patient Days		Change of Total Net Patient Revenue	
	Coefficients	*P* value	Coefficients	*P* value
Capital Expenditures	0.0000002	0.001	-0.009	<0.001
Net Patient Revenue from Medi-Cal Managed Care	0.000005	0.007	-0.088	0.021
Teaching Allowance Deductions	-0.0002	0.007	-4.413	0.032
Gross Outpatient Revenue from Other Third-party Managed Care Payers	0.000005	<0.001	0.020	0.546

5. Discussion

In this study, we examined how facility-level characteristics influence quarter-to-quarter changes in hospital activity and financial performance, providing insight into the velocity of hospital operations rather than their absolute levels. Overall, the results reveal that factors affecting patient volume growth do not always translate into faster revenue growth, and some operational or financial adjustments can have counterintuitive short-term effects.

One particularly unexpected finding is the divergent effect of payer-specific revenue streams. Net patient revenue from Medi-Cal managed care and gross outpatient revenue from other third-party managed care payers are positively associated with faster increases in patient days but show weaker or negative associations with the change in net patient revenue. This suggests that hospitals experiencing rapid growth in patient volume under these programs may not achieve proportional financial gains. The discrepancy could reflect reimbursement limits, higher marginal costs per additional patient, or delays in revenue recognition, meaning that velocity in utilization does not automatically equate to velocity in revenue.[4,5] It also implies that hospitals with aggressive growth in certain payer populations might face short-term financial strain despite serving more patients, highlighting a tension between operational expansion and financial sustainability.

A second notable point concerns capital expenditures. While higher capital spending accelerates patient day growth, it is associated with slower growth—or even declines—in net patient revenue. This indicates that investments in infrastructure or equipment may quickly increase a hospital's capacity to serve patients, reflecting an immediate operational effect, yet the financial return may lag due to the upfront costs, depreciation, or delayed billing cycles.[6] Moreover, hospitals that expand capacity rapidly might experience higher staffing, maintenance, or supply expenses that temporarily depress revenue growth.[7] These results underscore that capital investments can boost activity velocity but do not guarantee simultaneous financial acceleration, highlighting the importance of strategic timing and cost management in investment decisions.

Third, teaching allowance deductions exhibit negative associations with both patient day and net revenue changes. This finding is somewhat counterintuitive because such allowances are designed to support teaching hospitals. The negative association suggests that adjustments in teaching subsidies may impose administrative burdens, compliance requirements, or cost allocations that slow both operational and financial momentum.[8] Hospitals receiving higher teaching-related deductions may, therefore, experience constrained short-term growth, despite potential long-term benefits such as enhanced training capacity or reputation.[9] This illustrates that well-

intentioned financial policies can have complex, sometimes inhibitory effects on the velocity of hospital performance.

Taken together, these findings highlight that hospital characteristics influence the pace of operational and financial changes in complex and sometimes divergent ways. From a policy perspective, the results suggest that payment structures and incentive designs that emphasize service volume growth alone may not ensure financial sustainability for providers. Policymakers should consider aligning reimbursement mechanisms with both utilization expansion and margin stability, particularly for managed care populations where rapid patient growth may not translate into proportional revenue gains. In addition, capital investment policies should recognize the temporal mismatch between operational expansion and financial return, suggesting the need for financing models or transitional support that mitigate the short-term financial strain associated with infrastructure expansion. Finally, adjustments to teaching-related payment policies should account for potential administrative and operational burdens that may unintentionally slow provider performance. Overall, these findings underscore the importance of designing integrated reimbursement, investment, and subsidy policies that balance access expansion with long-term provider financial viability and system stability.

6. Conclusion

This study demonstrates that facility-level characteristics influence the velocity of hospital performance in complex and sometimes counterintuitive ways. Revenue from specific payer programs and capital investments can accelerate patient volume growth without necessarily increasing short-term revenue, while teaching allowance deductions may slow both operational and financial changes. These findings underscore the importance of distinguishing between operational and financial adjustments when evaluating hospital performance. For hospital managers, this highlights the need to balance strategies that drive patient throughput with careful financial planning to ensure sustainable revenue growth. For policymakers, the results suggest that well-intentioned financial incentives or reimbursement structures may have unintended short-term effects on hospital operations, emphasizing the need for policies that align operational capacity growth with financial sustainability.

Conflict of Interest Disclosures

All authors declared that they have no conflict of interest.

Data Availability Statements

The data that support the findings of this study are openly available in The California Health and Human Services at https://data.chhs.ca.gov/dataset/hospital-quarterly-financial-utilization-report-complete-data-set. Accessed 29 January 2026, reference number 3.

Research Highlights

What Is Already Known?

Capital investment is associated with hospital capacity expansion and service volume, but its financial returns are mixed and context-dependent. Existing evidence is limited on how payer exposure and capital spending jointly affect within-hospital changes in utilization and revenue over time.

What Does This Study Add?

This study provides multi-year panel evidence on how payer structure and capital investment shape within-hospital changes in utilization and net patient revenue. Results show that higher managed care exposure and capital investment are linked to faster utilization growth but not proportional revenue gains. Teaching-related payment adjustments are associated with slower growth in both utilization and revenue.

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