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RESEARCH ARTICLE

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Hospitalists staffing levels and hospital performance

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Abstract

Objective (or Study Question): To examine the association between hospitalists staffing levels and contract type with CMS Total Performance Score (TPS).

Data Sources/Study Setting: Total performance scores were obtained from CMS, hospital-level data from the 2015 American Hospital Association Annual Survey Database, and unemployment rates from the Area Resource Health File.

Study Design: We used cluster analysis to classify hospitals based on the distribution of various hospitalist contracts, and we used regression analysis to examine the association between TPS and hospitalist staffing levels and contract distributions. Hospital-level predictors included hospitalists staffing levels, RN staffing levels, and Magnet status. Market-level variables were unemployment rates and competition.

Principal Findings: Higher staffing levels of employed hospitalists or hospitalists with a group contract are associated with higher TPS (with coefficient estimates of 0.85 and 0.83, respectively, and the same standard error of 0.22). Higher staffing levels of hospitalists under individual contract are negatively associated with TPS (with coefficient estimate of −0.43 and standard error of 0.21). Based on the regression analysis using hospital clusters as independent variables, hospitals with individual contracts or without hospitalists providing care had significantly worse TPS compared to hospitals that predominantly employ hospitalists (with coefficient estimate of −1.80 and standard error of 0.61). Magnet status, RN staffing levels, and small and medium size were positively associated with TPS. Medicare share of inpatient days, teaching status, AMCs, and for-profit and public nonfederal ownership were negatively associated with TPS.

Conclusions: Adequate hospitalist staffing level is important for hospitals to achieve better performance. Hospitals need to consider the mix of arrangements or contracts that they have with hospitalists.

KEYWORDS
hospitalists, hospitals, staffing, total performance score, value-based purchasing

1 | INTRODUCTION

Understanding appropriate staffing levels and skill mix is an essential prerequisite in the quest for better quality, patient safety, patient experience, and efficiency. Most of the literature on staffing levels has focused on the nursing staff. Registered nurse (RN) staffing levels are associated with lower readmission rates,[1] lower mortality rates,[2] lower hospital-acquired infections rates,[3] and higher patient satisfaction.[4] Kane et al performed a meta-analysis on RN staffing levels and concluded that higher RN staffing levels are associated with better patient outcomes and quality.[5] Little, however, is known on the association between physician staffing

levels with patient outcomes, patient safety, patient ratings, and hospital efficiency.

There are two medical specialties that focus on hospital care; intensivists and hospitalists. Previous studies have focused on intensivists staffing levels in intensive care units. This was the result of best practices released by the Leapfrog group on full-time intensivists staffing standard.[6] Most hospitals in the United States currently employ or contract with hospitalists who oversee and provide inpatient care.[7,8] According to Welch et al,[8] hospitalists served as the attending physician for more than 25 percent of Medicare hospital admissions in 2011. Based on the available benchmark, hospitalists' workload should be between 10 and 15 patients per day[9]; however, this benchmark is not supported by empirical studies.[10] Previous research indicates that hospitalist staffing levels are associated with lower hospital-wide 30-day readmission rates[10-12] and lower mortality rates.[13] Despite the growth in hospitalists and the number of patients receiving care by hospitalists, little is known about optimal hospitalist staffing levels.

Staffing levels influence workload, which is likely to influence the quality of care provided by hospitalists. As the number of patients under the care of a hospitalist increases, so does the mental and physical workload experienced by the hospitalist. According to Ryu and Myung,[14] under very high levels of mental workload, people "may exhibit delayed information processing, or even not respond at all to incoming information because the amount of information surpasses their capacity to process it" (p.992). Heavy workload causes hospitalists fatigue, which contributes to medical errors.[15] Based on Michtalik et al,[15] more than 20 percent of hospitalists stated that heavy workload contributed to patient morbidity and mortality. Hospitalists with heavy workloads indicate that they have limited time available to communicate with patients, which negatively influences quality and may result in delayed discharges.[15]

Hospitals typically adopt several arrangements with physicians, and these arrangements range from very tight arrangements such as employment or integrated salary model to looser arrangements such as group practice without walls.[16] Recent research on hospital-physician relationships has focused on integration models and did not investigate staffing levels under each model. Scott et al[17] found no association between switching to physician employment models, from other less tight arrangements, with improved hospital performance on key quality measures such as readmission and mortality. Both Baker et al[16] and Scott et al[17] did not examine physician staffing levels. While examining hospital-physician arrangements is important, there is an abundance of research on registered nurse staffing levels and scarcity of research on physician staffing levels for hospital-based physicians such as intensivists and hospitalists. Physician staffing levels influence the workload experienced by physicians and thus their ability to process information and perform tasks. This in turn might influence quality of care and patient experience. Physician-hospital arrangements, on the other hand, influence the alignment level between physician and hospital interests and physician's commitment to and knowledge of hospital resources, processes, policies, and goals and, therefore, might also influence hospital performance. Therefore, it is important to investigate the association between both hospitalists staffing levels, and arrangement types, with hospital performance.

This paper contributes to the literature by examining the association between hospitalists staffing arrangements and levels with hospital performance. We specifically examine the relationship between hospitalist staffing by arrangement type and its association with Total Performance Score (TPS). TPS is calculated by the Center for Medicare and Medicaid Services (CMS) based on hospital performance on the following domains: clinical processes, outcomes, experience, safety, and efficiency. To provider further insight, we examine how staffing levels of various hospitalists' arrangements are associated with each domain used in the calculation of TPS. We also perform a cluster analysis to classify hospitals based on the mix of arrangements they have with hospitalists and compare hospital performance between the various clusters.

2 | THEORETICAL FRAMEWORK

In this paper, we argue that to understand the association between hospital performance and hospitalists, we have to look at hospitalists staffing levels within each hospital-physician arrangement model. A contract has a structure, which specifies "(a) the distribution of income among the participants, and (b) conditions of resource use."[18] Hospitals have a variety of contracts they can deploy with hospitalists. Each of these contracts, and thus relationships or arrangements, differs by the strength of hospital-physician integration and the workload experienced by the hospitalist.

Human reliability is associated with the mental workload an individual is responsible for.[19] Work overload and underload, according to Xie and Salvendy,[20] negatively influence the performance of individuals, and this, in turn, influences the performance of the system as a whole. At higher levels of mental workload, the ability of a person to process all the information provided to them diminishes, and therefore, they are more likely to make an error. Patient-to-provider ratios, such as patient-to-nurse ratio, are measures of the workload experienced by the providers.[21] At higher patient-to-hospitalist ratios, the workload experienced by hospitalists will be higher and so will the probability of committing a mistake, overlooking hospital procedures and policies, not adhering to evidence-based clinical processes, and communicating poorly with other providers and with the patient, all of which influence a hospital's TPS.

As Xie and Salvendy[20] argue, mental workload is not the product of only the number of tasks but also factors related to the individual handling those tasks. More specifically; "different people may experience different mental workloads for the same task."[20] The experience of hospitalists who are employed by the hospital or have a group contract might differ from hospitalists who have an individual contract or no contract at all even when they care for the same number of patients. Employment is the highest level of hospital-physician integration and is therefore the strongest relationship hospitals can have with their hospitalists. Based on the literature, Scott et al[17]

argue that "greater integration between hospitals and physicians, such as through employment models, may improve outcomes by bolstering coordination efforts; increasing continuity of services; improving access to capital, such as electronic health records; boosting physician satisfaction; and augmenting accountability for clinical performance" (p.5). Employment also frees physicians from the task of attracting new clients, developing relationships with other physicians for referrals, and other administrative burdens. At the same time, physician integration helps hospitals through referrals and bargaining power with insurers.[22] This last statement does not apply to hospitalists though since hospitalists do not have a relationship with the patients before they are admitted to the hospital.

We argue that higher staffing levels of employed hospitalists will have the strongest association with hospital performance followed by hospitalists who have a group contract. Physicians in recent years have been moving away from solo practice toward employment at large group practices and hospitals.[23] Hospitals can have three forms of physician integration: noneconomic, economic, and clinical.[24] Physician employment by the hospital incorporates these three levels of integrations and is therefore the strongest. Salaried employed physicians have higher levels of "loyalty, commitment, retention, trust in hospital administrators and citizenship behavior."[24] Hospitalists directly employed by the hospital will have a better knowledge of the hospital's resources, processes, policies, and goals. Their interests will also be better aligned with the hospital, and they can focus their effort on one hospital and the tasks associated with that hospital without the burdens associated with contracting with multiple hospitals. Therefore, we predict that higher staffing levels of employed hospitalists will be associated with higher TPS.

Contracting with physician groups is more efficient for hospitals than individual contracts,[24] and given that hospitalists who are part of a large group are generally employed by the group, group contracts are likely to result in quality and efficiency gains similar to those achieved by directly employed hospitalists. Higher staffing levels of hospitalists under individual contracts or no contract, however, will probably not have a significant association with hospital performance. Physicians who sign an individual contract will be burdened by more administrative tasks than those who sign group contracts or are employed by a hospital. Even if they experience the same workload in terms of the number of inpatient days, their non-hospital-related workload will be higher and their commitment to the hospital is lower. Therefore, higher staffing levels of individual/no contract are less likely to make an impact.

3 | METHODS

3.1 | Data sources

Total Performance Score (TPS) were obtained from CMS for the reporting time periods (2016). Hospital-level data were obtained from the 2015 American Hospital Association (AHA) Annual Survey Database. Finally, unemployment rates were obtained from the 2016 Area Health Resource File. The three datasets were merged to assess the association between hospitalists staffing levels and arrangement types with TPS.

We limit our study to not-for-profit, for-profit, and nonfederal public general hospitals. Veteran Affairs hospitals do not have to report value-based purchasing data to CMS, and specialty hospitals generally have a low number of observations with complete TPS and its subdomain scores. Our final sample consisted of 1817 hospitals; the summary statistics of the key variables are provided in Table 1.

TABLE 1 Summary statistics

Variables	Mean (SD) or Count (%)
Dependent variables	
Total Performance Score (TPS)	33.29 (9.75)
Process score	58.46 (28.03)
Outcomes score	40.16 (21.32)
Experience score	31.03 (15.74)
Safety score	44.90 (18.02)
Efficiency score	14.36 (19.55)
Independent Variables: # of hospitalists per inpatient day under different types of contract	
Employed	1.48×10^{-4} (4.32×10^{-4})
Group contract	1.64×10^{-4} (4.75×10^{-4})
Individual contract	0.19×10^{-4} (0.93×10^{-4})
No contract or employment	0.53×10^{-4} (2.58×10^{-4})
Control variables	
Unemployment rate	2.96 (0.59)
Competition (1-HHI)	0.91 (0.16)
Medicare share of inpatient days	52.36 (12.11)
Medicaid share of inpatient days	20.05 (10.63)
Registered nurse FTE per inpatient day	0.0085 (0.0030)
Teaching hospital	607 (33.41%)
Academic medical center	187 (10.29%)
Belongs to a system	1409 (77.55%)
Magnet recognized	247 (13.59%)
Fully integrated physicians	491 (27.02%)
Hospital in an urban center	1509 (83.05%)
Ownership	
Not-for-profit	1248 (68.68%)
For-profit	370 (20.36%)
Public—local	199 (10.95%)
Hospital size	
Small (<100 beds)	271 (14.91%)
Medium (100-400 beds)	1181 (65.00%)
Large (>400 beds)	365 (20.09%)
Sample size	1817

3.2 | Dependent variables

The dependent variables considered in this study are TPS and the scores of its five subdomains: process, outcomes, experience, safety, and efficiency. TPS in 2016 was a weighted sum of the five subdomains whose weights were 5, 25, 25, 20, and 25 percent, respectively. In reporting, if a hospital received scores in at least three but not all subdomains, it would still receive a TPS calculated based on proportionately reweighting to the scored subdomains.[25] Since we intended to examine the impact of hospitalists on not only TPS, but also its subdomains, we included only hospitals that had received scores in all five subdomains.

The Pearson correlation coefficients between the scores are shown in Appendix S1. The correlation between the five subdomain scores was low (with the highest being 0.19 between experience and efficiency, and between experience and safety), which suggested that a multivariate analysis of the dependent variables was not necessary. Consequently, we performed statistical analyses on the dependent variables separately.

3.3 | Independent variables

The primary objective of this study is to investigate the impact of hospitalists staffing levels and arrangement types on TPS and its subdomains. There are four types of contract reported in the AHA Annual Survey Database for hospitalists: (a) employment, (b) group contract, (c) individual contract, and (d) no employment nor contract (physicians have only admitting privileges). We measure staffing levels as the total number of hospitalists with a given contract type per inpatient day (ie, the total number of hospitalists with a given contract type divided by the total facility inpatient days). We also perform cluster analysis based on the percentage of each contract type that a hospital has, and use cluster assignment as an independent variable to capture the mix of hospitalist arrangement types.

To further understand the composition of different contract types, we examine the usage and exclusive usage of each contract type, as shown in Figures 1 and 2. As can be seen from Appendix S2, employment and group contracts are the two dominant types; they are used by 36.8 and 33.9 percent of hospitals, respectively. In terms of exclusive use (ie, when a hospital uses only one type of contract with all its hospitalists), group contract is used the most (by 23.7 percent of the hospitals) and individual contract is used the least (1.3 percent). Figure 2 breaks down usage and exclusive usage by hospital ownership. For-profit hospitals are much less likely to employ hospitalists (only 7.0 percent of them do) than not-for-profit (45.4 percent) and nonfederal public hospitals (38.2 percent). For-profit hospitals are more likely to use group contract exclusively (28.1 percent) than not-for-profit (22.0 percent) and nonfederal public hospitals (26.6 percent).

These observations prompted us to use cluster analysis to characterize hospitals based on the percentages of each contract type used. We performed *k*-means clustering and used two methods to jointly determine the optimal number of clusters. Appendix S4 shows the total within-cluster sum of squares for the number of clusters from 1 to 20. The Elbow method considers the percentage of variance explained as a function of the number of clusters and chooses the optimal number of clusters by the "elbow criterion"; the first clusters explain the majority of the variance; but as the number of clusters increases, the marginal contribution drops.[26] The most prominent "elbow" in Appendix S4 suggests the optimal number of clusters to be around 5. In order to corroborate the suggestion by the Elbow method, we used the NbClust package[27] of *R*, which identifies the optimal number of clusters to be 4. To be parsimonious, we choose to use $k = 4$ in our *k*-means clustering.

The result is in Appendix S3 where cluster size and the center of each cluster are presented. We name the clusters based on their contract type composition. For example, Cluster E (employment dominant) contains 542 hospitals that primarily employ hospitalists. On average, these hospitals have 92.2 percent of employed hospitalists, 2.1 percent of hospitalists under group contract, 2.7 percent of hospitalists under individual contract, and 3.0 percent hospitalists with no employment nor contract. Hospitals in Cluster G rely mainly on group contract, and 96 percent of hospitalists who practice in hospitals in Cluster G have a group contract. Eighty-six percent of hospitalists in Cluster N are not employed nor have a contract; they do however have admitting privileges. Finally, hospitals in Cluster NI (individual-contract dominant or no hospitalists) mainly contains hospitals with no hospitalists at all, and the rest have more hospitalists under individual contract (7.7 percent) compared to the other types of contract (1.7, 0.7, and 0.4 percent for employment, group contract, and no contract, respectively). Each hospital is uniquely assigned to one cluster.

3.4 | Control variables

For market-level variables, we include unemployment rate and the Herfindahl-Hirschman Index (HHI) that measures market concentration. HHI is calculated by summing the square of the market share of total admissions in a county for each hospital in the county. For ease of interpretation, we report competition instead of concentration. Competition is calculated as 1-HHI. In order to control for individual hospital heterogeneity, we consider the following

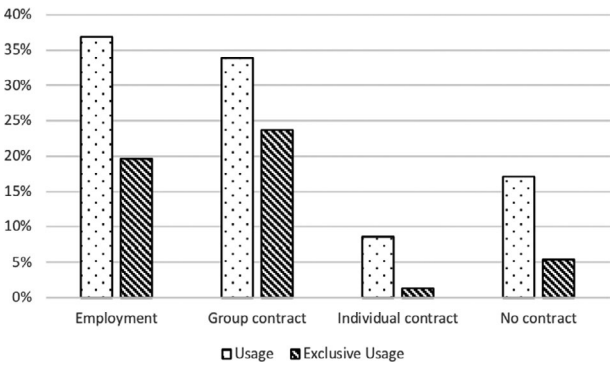

FIGURE 1 Usage and exclusive usage of different types of hospitalist contract

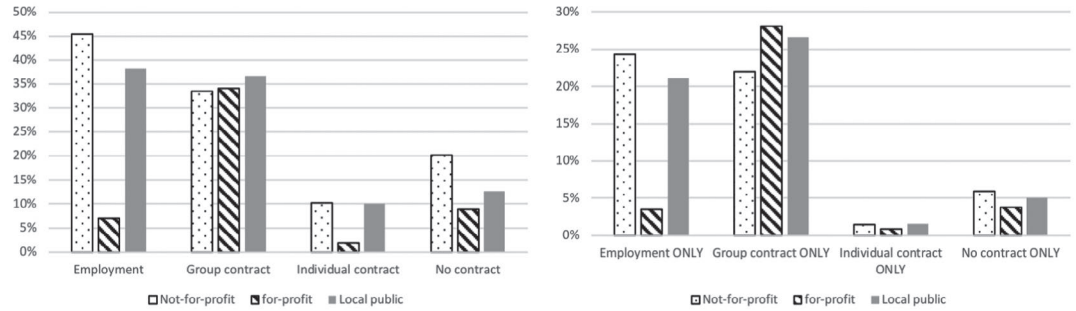

FIGURE 2 Usage and exclusive usage of different types of hospitalist contract by hospital type (left: usage; right: exclusive usage)

organizational-level characteristics: hospital size, hospital location, hospital ownership (not-for-profit, for-profit, and local public hospitals), Medicare and Medicaid share of total inpatient days, registered nurse staffing level (registered nurses FTE divided by the total facility inpatient days), whether a hospital is a teaching (excluding AMCs) hospital, whether a hospital is an academic medical center (AMCs), whether a hospital belongs to a system, and whether a hospital is Magnet recognized.[28] We control for Magnet status since it is an indicator of organizational leadership and culture that fosters high-quality care. Magnet hospitals have attributes that are linked to better patient outcomes.[29,30] These attributes include transformational leadership, decentralized and dynamic structure, greater nurse autonomy and empowerment, and commitment to quality improvement.[5]

We also include a binary variable to control for hospital-physician integration level. Baker et al[16] classify the highest level of integration, that is, full integration, as hospitals with one of the following arrangements with their physicians: integrated salary model, equity model, or foundation model. Even if the hospital has a mix of arrangements, including looser ones such as open physician-hospital organization, a hospital is classified by Baker et al[16] as fully integrated whether the hospital reported that it adopts the tightest form of integration. We adjust this classification since a hospital can have only 10 percent of its physicians under the full integration model and still be classified as fully integrated by Baker et al.[16] We classify a hospital as fully integration if it reported in the AHA that integrated salary, equity, or foundation models were the only models adopted at the hospital.

4 | RESULTS

4.1 | Impact of staffing levels of hospitalist on TPS and its subdomains

We first performed multiple linear regressions of TPS and its five subdomains on the independent and control variables. All numeric variables were centered and scaled. The results are shown in Table 2, where parameter estimates and standard error (in parentheses) are provided and *P*-value ranges are represented as: "**" for *P*-value <.01, "*" for *P*-value <.05, and "." for *P*-value <.1. Based on the diagnostic plots of the regression model, the model assumptions were largely met. All variance inflation factors (VIFs) were less than 2.5, which suggested that multicollinearity was not a concern.

Based on our regression model, staffing levels of employed hospitalists and hospitalists under group contract are positively associated with TPS (*P*-value <.01). The coefficient estimates of employed hospitalists and hospitalists under group contract were 0.85 and 0.83, respectively (with the same standard error values). It provides evidence that although employment and group contract were both positively associated with TPS, employment was slightly more effective. The staffing level of hospitalists under individual contract was negatively associated with TPS (*P*-value <.05). We do not find a significant association between the staffing levels of hospitalists with no contract with TPS. It is worth emphasizing that since we control for the effect of nursing level (which, not surprisingly, is found to be positively correlated with TPS), the effects of hospitalist arrangement levels are isolated from the effect of nursing level.

In regard to the five subdomains of TPS; efficiency was strongly influenced by staffing levels of hospitalists. Specifically, the levels of employed hospitalists and those under group contract were positively correlated with efficiency score. Efficiency score is solely determined by Medicare spending per beneficiary (MSPB); therefore, the result indicated that average Medicare spending per beneficiary during the hospital admission episode (spending on part A and Part B from 3 days before admission through 30 days after discharge) goes down as the staffing levels of employed and/or group contract hospitalists goes up. The coefficient estimates of employed hospitalists and hospitalists under group contract were 2.27 and 1.59, respectively (with the same standard error values). It provides evidence that although employment and group contract were both positively associated with efficiency, employment was more effective in lowering Medicare Spending per Beneficiary. Patient safety score was positively associated with the level of hospitalists staffing under group contract (*P*-value <.01) but not with employed hospitalists. The staffing level of hospitalists with no contract nor employment was negatively associated with efficiency score (*P*-value <.05). Staffing levels of employed hospitalists were also associated with higher patient experience scores, while higher staffing levels of group contracts were associated with higher patient safety scores.

TABLE 2 Regression estimates of Total Performance Score (TPS) and its subdomains using number of hospitalists by contract type

	Dependent variable (N = 1817)					
Variable	**TPS**	**Process**	**Outcomes**	**Experience**	**Safety**	**Efficiency**
Independent Variables: # of hospitalists per inpatient day under different types of contract						
Employed	0.85 (0.22)**	−0.16 (0.68)	−0.02 (0.51)	0.71 (0.35)*	0.60 (0.40)	2.27 (0.43)**
Group contract	0.83 (0.22)**	0.45 (0.69)	0.17 (0.51)	0.48 (0.36)	1.23 (0.41)**	1.59 (0.44)**
Individual contract	−0.43 (0.21)*	−0.14 (0.65)	−0.37 (0.49)	−0.44 (0.34)	−0.66 (0.39).	−0.35 (0.41)
No contract or employment	−0.04 (0.22)	0.83 (0.66)	0.60 (0.50)	−0.29 (0.34)	0.56 (0.39)	−1.07 (0.42)*
Control variables						
Unemployment rate	0.34 (0.22)	1.55 (0.68)*	1.89 (0.51)**	−0.87 (0.35)*	−0.21 (0.40)	0.18 (0.43)
Competition	0.56 (0.22)**	0.22 (0.66)	0.76 (0.49)	0.00 (0.34)	0.27 (0.39)	1.20 (0.42)**
Medicare share of inpatient days	−0.84 (0.29)**	0.21 (0.88)	0.99 (0.66)	−2.08 (0.46)**	−0.06 (0.52)	−2.27 (0.56)**
Medicaid share of inpatient days	−0.52 (0.29).	−1.99 (0.89)*	−1.15 (0.67)	−2.86 (0.46)**	0.11 (0.53)	2.22 (0.57)**
RN FTE per inpatient day	0.94 (0.24)**	0.09 (0.73)	−0.67 (0.54)	2.19 (0.38)**	0.68 (0.43)	1.68 (0.46)**
Teaching hospital	−1.09 (0.50)*	−4.56 (1.52)**	1.43 (1.14)	−1.31 (0.79).	−3.04 (0.90)**	−1.13 (0.97)
Academic medical center	−2.68 (0.90)**	−7.70 (2.76)**	8.76 (2.07)**	−4.80 (1.43)**	−8.60 (1.64)**	−6.27 (1.75)**
Belongs to a system	−0.19 (0.55)	1.53 (1.68)	−1.34 (1.26)	−0.53 (0.87)	−0.05 (1.00)	1.86 (1.07)
Magnet recognized	1.93 (0.67)**	1.22 (2.06)	6.50 (1.54)**	3.91 (1.07)**	−1.22 (1.22)	−1.96 (1.31)
Fully integrated physicians	0.72 (0.49)	−2.95 (1.49)*	−1.20 (1.12)	0.61 (0.77)	0.53 (0.88)	3.65 (0.95)**
Hospital in an urban center	−3.19 (0.62)**	2.67 (1.90)	3.61 (1.42)*	−3.39 (0.99)**	−5.23 (1.13)**	−9.34 (1.21)**
Ownership						
Not-for-profit (reference)						
For-profit	−2.61 (0.58)**	8.42 (1.77)**	−1.44 (1.33)	−6.45 (0.92)**	3.54 (1.05)**	−7.06 (1.13)**
Public—local	−2.22 (0.73)**	0.15 (2.24)	−3.62 (1.68)	−0.33 (1.16)	−1.92 (1.33)	−3.43 (1.43)**
Hospital size						
Small (<100 beds)	6.90 (0.93)**	−0.78 (2.85)	−6.32 (2.13)**	9.58 (1.48)**	14.39 (1.69)**	12.96 (1.81)**
Medium (100-400 beds)	2.68 (0.66)**	1.04 (2.02)	−2.84 (1.51).	2.27 (1.05)*	7.49 (1.20)**	5.10 (1.29)**
Large (>400 beds) (reference)						
Adjusted R^2	.15	.04	.07	.18	.18	.20

Note: Significance levels: **P-value <.01, *P-value <.05, P-value <.01.

Hospital ownership, Magnet status, teaching status, size, and Medicare share of admissions were significant predictors of TPS (Table 2). Magnet status was associated with higher TPS scores, better patient outcomes, and patient experiences (P-value <.05). Not-for-profit hospitals had significantly better TPS than both for-profit and public nonfederal hospitals. Compared to not-for-profit hospitals, for-profit hospitals had lower scores on TPS, patient experience, and efficiency and higher scores on clinical processes and safety. Public nonfederal hospitals had significantly lower TPS and efficiency scores than not-for-profit hospitals. Teaching hospitals had significantly lower TPS and scored lower on process and safety than nonteaching hospitals. Academic medical centers scored higher on outcomes, but lower on TPS and all other subdomains (P-value <.01). Small- and medium-sized hospitals scored higher on TPS, experience, safety, and efficiency than large hospitals, but smaller hospitals perform significantly worse on outcomes than large hospitals. Medicare share of inpatient days was negatively correlated with TPS, experience, and efficiency, while higher Medicaid share of inpatient days was negatively correlated with process and experience, but is positively correlated with efficiency.

Unemployment rates were not significant predictors of TPS. However, hospitals in more competitive markets had better TPS and efficiency scores. Hospitals in counties with higher unemployment rate scored higher on process and outcomes but lower on patient experience. Hospitals in urban settings had better patient outcomes than hospital in nonurban areas but worst TPS, efficiency, safety, and patient experience scores.

4.2 | Impact of arrangement mix of hospitalist on TPS and its subdomains

In addition to examining the impact of staffing levels of hospitalists with different contracts, we were interested in exploring whether their contract type composition also plays a role in TPS and its subdomains. Table 3 provides numbers and percentages (in

TABLE 3 Number of types of hospitalist contract

Hospital ownership	Number of types of hospitalist contract				No hospitalists
	1	2	3	4	
Not-for-profit	668 (67.7%)	263 (26.7%)	51 (5.2%)	4 (0.4%)	262 (21.0%)
For-profit	134 (82.7%)	26 (16.0%)	2 (1.2%)	0 (0.0%)	208 (56.2%)
Public—local	108 (74.0%)	28 (19.2%)	10 (6.9%)	0 (0.0%)	53 (26.6%)
All hospitals	910 (50.1%)	317 (17.4%)	63 (3.5%)	4 (0.2%)	523 (28.8%)

TABLE 4 Regression estimates of Total Performance Score (TPS) and its subdomains using contract type composition of hospitalists

Variable	Dependent variable (N = 1817)					
	TPS	Process	Outcomes	Experience	Safety	Efficiency
Independent variables: cluster and total hospitalists per inpatient day						
Employment dominant (reference)						
Group-contract dominant	−0.02 (0.57)	2.88 (1.74).	0.15 (1.31)	−1.96 (0.91)*	2.92 (1.03)**	−1.16 (1.12)
No-contract dominant	−0.14 (0.82)	6.51 (2.49)**	2.61 (1.86)	−1.88 (1.29)	3.08 (1.48)*	−5.06 (1.59)**
No hospitalists or individual-contract dominant	−1.80 (0.61)**	2.97 (1.85)	−2.55 (1.39).	−3.39 (0.96)**	1.22 (1.10)	−2.82 (1.18)*
Total # hospitalists per inpatient day	0.67 (0.24)*	0.64 (0.73)	−0.13 (0.55)	0.20 (0.38)	1.19 (0.43)**	1.55 (0.47)**
Control variables						
Unemployment rate	0.38 (0.22).	1.46 (0.68)*	1.95 (0.51)**	−0.80 (0.35)*	−0.21 (0.40)	0.26 (0.43)
Competition	0.59 (0.22)**	0.23 (0.66)	0.79 (0.49)	0.00 (0.34)	0.31 (0.39)	1.26 (0.42)**
Medicare share of inpatient days	−0.92 (0.29)**	0.27 (0.88)	0.82 (0.66)	−2.17 (0.46)**	−0.10 (0.52)	−2.31 (0.57)**
Medicaid share of inpatient days	−0.51 (0.29).	−1.88 (0.90)*	−1.17 (0.67).	−2.88 (0.46)**	0.17 (0.53)	2.25 (0.57)**
RN FTE per inpatient day	1.04 (0.24)**	0.09 (0.72)	−0.63 (0.54)	2.24 (0.38)**	0.77 (0.43).	1.91 (0.46)**
Teaching hospital	−1.11 (0.50)*	−4.49 (1.52)**	1.26 (1.14)	−1.39 (0.79).	−2.95 (0.90)**	−1.08 (0.97)
Academic medical center	−2.83 (0.90)**	−7.42 (2.76)**	8.44 (2.07)**	−5.11 (1.43)**	−8.51 (1.64)**	−6.43 (1.77)**
Belongs to a system	−0.19 (0.55)	1.31 (1.68)	−1.38 (1.26)	−0.48 (0.87)	−0.17 (1.00)	0.98 (1.07)
Magnet recognized	1.73 (0.68)*	1.46 (2.07)	6.08 (1.55)**	3.51 (1.07)**	−1.11 (1.23)	−2.08 (1.32)
Fully integrated physicians	0.50 (0.50)	−2.55 (1.51).	−1.59 (1.13)	0.21 (0.78)	0.60 (0.90)	3.41 (0.97)**
Hospital in an urban center	−3.08 (0.62)**	2.58 (1.90)	3.72 (1.42)**	−3.27 (0.98)*	−5.19 (1.13)**	−9.15 (1.21)**
Ownership						
Not-for-profit (reference)						
For-profit	−2.16 (0.59)**	7.89 (1.81)**	−0.84 (1.36)	−5.62 (0.94)**	3.38 (1.07)**	−6.45 (1.16)**
Public—local	−2.11 (0.73)**	−0.25 (2.24)	−3.61 (1.68)*	−0.03 (1.16)	−2.20 (1.33).	−2.98 (1.43)*
Hospital size						
Small (<100 beds)	7.19 (0.93)**	−0.71 (2.85)	−5.92 (2.14)**	9.93 (1.48)**	14.47 (1.69)**	13.30 (1.82)**
Medium (100-400 beds)	2.85 (0.66)**	1.03 (2.02)	−2.63 (1.51).	2.44 (1.05)*	7.48 (1.20)**	5.20 (1.29)**
Large (>400 beds) (reference)						
Adjusted R^2	.15	.04	.08	.18	.18	.19

Note: Significance levels: **P-value <.01, *P-value <.05, P-value <.01.

parentheses) of each hospitalist contract type, broken down by hospital ownership. 28.8 percent of hospitals in our sample did not have hospitalists providing care. Among the ones that had hospitalists, half had only one type of arrangements with hospitalists, 17 percent had two types of arrangements, and only 4 percent had more than two types. A much higher percentage of for-profit hospitals (56.2 percent) did not have hospitalists, compared to not-for-profit (21.0 percent) and local public hospitals (26.6 percent). 82.7 percent of for-profit hospitals where hospitalists provide care offered only one type of contract to their hospitalists compared

to non-for-profit (67.7 percent) and local public hospitals (74.0 percent).

We use cluster assignment as an independent variable and rerun the regression models of TPS and its subdomains. As can be seen from Appendix S3, the four clusters differed in terms of the total number of hospitalists per inpatient day. Therefore, we added an additional independent variable, the total number of hospitalists per inpatient day, to separate the impact of overall hospitalists staffing level and contract type composition. The results are shown in Table 4.

Based on the regression analysis, Cluster NI has significantly lower TPS than Cluster E. Moreover, Cluster NI has higher Medicare spending per beneficiary and worst patient experience. Cluster G has lower scores on patient experience but higher scores on patient safety. Finally, Cluster N had higher spending per Medicare beneficiary and higher scores on clinical processes and patient safety. Hospitalists per inpatient day were a significant predictor and positively associated with TPS, efficiency, and patient safety. This result strengthens the findings that not only higher levels of employed are associated with better hospital performance, but their dominance also helps. Given the interesting findings on Cluster N and its positive association with the processes and safety domains, our findings also shed light on the need to examine further the association between contract type and lack of contracts with quality and efficiency domains.

5 | DISCUSSION

In this study, we found that hospital-physician arrangements and the staffing levels under each arrangement are significant predictors of hospital performance on value-based purchasing domains. Based on our regression model using staffing levels under each contract type as independent variables, higher staffing levels of employed hospitalists and hospitalists with group contracts are associated with higher TPS, while higher staffing levels of hospitalists with individual contracts are associated with lower TPS. Moreover, based on the regression analysis with hospital cluster as an independent variable, higher staffing levels of hospitalists were associated with higher TPS, patient safety, and efficiency levels. Hospitals with predominantly employed hospitalists had higher TPS than hospitals with no hospitalists. Moreover, hospitals with predominantly hospitalists under individual contract or no contract at all had significantly lower efficiency scores than any other cluster. The findings on efficiency are important as they support previous research that found a positive association between hospitalists and efficiency.[31,32] Epané et al[33] also found that hospitals that switched from not having hospitalists to having high staffing levels of hospitalists benefited from an increase in their profitability. A recent review of the literature on physician integration found no evidence that physician employment is associated with better quality and some evidence that it is associated with higher spending.[34] Our findings show that hospitalists' employment and group contract are associated with higher levels of efficiency than any other arrangement. Hospitals with no hospitalists or with hospitalists on individual contracts had lower TPS than hospitals with other arrangements with their hospitalists. Therefore, we can conclude that higher staffing levels of hospitalists are associated with higher TPS as long as these hospitalists are not under individual contract.

Our paper contributes to our knowledge of the association between hospitalists and hospital performance. The number of hospitalists is on the rise and has reached almost 50 000 within the past 20 years, which makes hospitalists the largest specialty in internal medicine.[7] Hospitalists currently deliver inpatient care in around 75 percent of hospitals in the United States.[7] However, since hospitalists, as an internal medicine specialty, have not been around for a long time, questions about the value added by hospitalists remain.[35] Our findings support previous studies that found a positive relationship between hospitalists and lower readmission rates, resource use, and length of stay.[1,31,35,36] Employment ensures hospitalists' commitment to the organization and allows hospitalists to attain leadership roles in the hospital. As Watcher and Goldam[7] explain, "many hospitalists have added value as local leaders in quality improvement, safety, and innovation." Higher staffing levels ensure that hospitalists do not experience heavy workload, which might hinder their ability to process available information, detect early warnings, communicate well with patients, and provide better patient care overall.

Higher RN staffing levels were associated with better patient experience and higher TPS. Moreover, Magnet status was positively associated with TPS, patient outcomes, and experience. This provides further evidence on the importance of nursing practice environment in influencing hospital performance and TPS specifically. As Lake and Friese[37] argue, both staffing levels and practice environment influence quality of care. Magnet status is a product of organizational commitment to creating and sustaining a hospital environment that ensures high-quality nursing care. Magnet hospitals are distinguished by their commitment to fostering an organizational culture that is supportive of nursing staff and a work environment that provides the resources, structures, and governance that encourage nurse development and empowerment and interdisciplinary collaboration.[38] While we lack data on hospital leadership and culture, Magnet status is "steadfast proof" of excellence in patient care as reflected in organizational transformational leadership, exemplary practice environment, and quality improvement.[39]

In both models, for-profit ownership is positively associated with only clinical processes but negatively associated with TPS, patient experience, and Medicare spending per beneficiary (efficiency domain). Jha et al[40] reported that for-profit hospitals had lower patient ratings than not-for-profit hospitals. Moreover, Al-Amin[11] reported that for-profit hospitals had higher readmission rates than not-for-profit hospitals. For-profit hospitals usually outcompete not-for-profit hospitals on efficiency. Therefore, it is surprising that for-profit hospitals had lower efficiency scores. However, it is important to note that efficiency is measured based

on overall spending per Medicare beneficiary. It is therefore not a measure of hospital overall efficiency. It is the average Medicare spending per beneficiary on all claims, including Medicare part A and part B, 3 days through admission till 30 days after the patient is discharged.[41] Accordingly, based on our analysis, for-profits are not as successful as not-for-profit in containing the cost of care for Medicare patients.

Teaching hospitals had significantly lower performance levels on TPS, safety, process, and efficiency than nonteaching hospitals. Academic medical centers (AMC) had lower TPS, patient ratings, clinical process, and efficiency scores than non-AMCs. Interestingly though, they had better outcomes than non-AMCs. Academic medical centers, given their education and research mission, in addition to serving patient with higher complexity, face more challenges in achieving high TPS. However, AMCs might be able to garner their learning culture and apply their capabilities and ability to explore and innovate into improving their scores on the TPS domains.

This study is not without limitations. We examine the association between hospitalists staffing levels of four types of hospital-physician arrangements reported in the AHA dataset. However, these four types of arrangements might not cover the full scope of arrangements that hospitals use to contract with hospitalists. Moreover, our study is cross-sectional, which does not allow us to establish causality and determine how changes in staffing levels over time may influence TPS values. We rely on VBP CMS data to measure performance, specifically on TPS, and other performance domains should be also considered. Another limitation is our measurement of staffing levels as hospitalist per inpatient days, and other staffing measures should be explored in future studies. Finally, another limitation of this study is that the distribution of hospitals included in our sample, with no missing data on any of the variables, differs in terms of location and size from AHA hospitals that have a reported TPS. Eighty three percent of our hospital sample were urban, while 75 percent of AHA hospitals with TPS were urban. Fifteen percent of hospitals in our sample had <100 beds, while 31 percent of hospitals with reported TPS had <100 beds. Sixty five percent of hospitals in our sample had between 100 and 400 beds, while 54 percent of AHA hospitals with TPS had between 100 and 400 beds.

6 | CONCLUSION

This paper contributes to our knowledge of hospitalists in terms of staffing levels and arrangement types. Research on patient safety and patient outcomes has focused on the staffing levels of RNs. However, given their rising numbers and the fact that most hospitals rely on them to provide care, hospitalists are a key component in the delivery of inpatient care, and therefore, future research should incorporate hospitalist staffing levels in addition to RN staffing levels when investigating hospital performance.

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CONFLICT OF INTEREST

None.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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