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Hospital System Taxonomy and Hospital Efficiency: A Data Envelopment Analysis Model

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Abstract

This study aimed to evaluate the economic efficiency of five different hospital system structures across the United States, with particular attention to the contrast between centralized and decentralized healthcare models. Using 2017 AHA survey data and a Data Envelopment Analysis (DEA) framework, we assessed hospital performance by examining production inputs—such as full-time physicians, nurses, beds, and operating expenses—and outputs including the number of discharged inpatients and outpatients as well as operating revenue. The DEA results indicate that centralized hospital systems achieve higher technical and financial efficiency relative to decentralized systems. We analyzed five system types—Centralized, Centralized Physician & Insurance, Moderately Centralized, Decentralized, and Independent Health Systems—revealing substantial differences in efficiency and economic performance. Overall, our findings suggest that centralized organizational models improve resource allocation, enhance operational efficiency, and strengthen the financial sustainability of healthcare systems.

JEL classification: C12, C44, I11, I19, M10, M19.
Keywords: Centralized Physicians & Insurance System, Centralized System, Decentralized System, Hospital Efficiency, Independent Health System.

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1. Introduction

Hospital systems play an essential role in the U.S. healthcare industry and continue to present one of the most significant management challenges of the twenty-first century. The scale and trajectory of national health expenditures illustrate the urgency of addressing system-wide inefficiencies. Ozcan (2014) reported that U.S. healthcare spending exceeded $3.6 trillion in 2013, averaging roughly $11,000 per person. By 2016, expenditures were projected to surpass $4 trillion, or about $12,000 per person, representing 16 percent of the nation's gross domestic product (GDP). This upward trend has not slowed. According to the most recent National Health Expenditure Accounts (NHEA) data, total U.S. healthcare spending reached $4.5 trillion in 2022—approximately $13,500 per person—and accounted for 17.3 percent of GDP (CMS, 2024). This level of spending is nearly double the average across OECD (Organization for Economic Co-operation and Development) countries (Gunja et al., 2023), highlighting the uniquely high-cost structure of the American healthcare system.

A major factor driving rising healthcare costs is the increasing expenditure on labor and medical supplies. Labor constitutes the largest share of a hospital's operating budget, placing continuous pressure on administrators to reduce staffing costs while maintaining operational efficiency (Lee et al., 2023). Supply chain expenses represent the second-highest cost category. Hospitals must negotiate prices for physician preference items (PPI), which are often expensive and vary significantly among providers. These costs are further intensified by distribution challenges, including shipping and handling fees for medical equipment and supplies. As a result, efficient supply chain management has become a critical organizational priority, as highlighted in recent studies (Lee et al., 2023; Tiehi & Coulibaly, 2022).

Inefficiencies in healthcare delivery can arise in several forms. Rosko (1999) identifies technical, allocative, scale, scope, and cost inefficiency, each representing a different way hospitals may fail to maximize output from available inputs. Diarrassouba et al. (2025) further note that inefficiency occurs when hospitals do not achieve the highest possible level of production given their resources. Rosko's concept of cost inefficiency—defined as the gap between a hospital's current performance and the best-practice cost frontier—underscores the considerable potential for improvement. Because inefficiencies operate at multiple levels of healthcare delivery, evaluating hospital system structures is critical for guiding reform and managerial decisions. Accordingly, this study examines how varying hospital system configurations affect operational efficiency and identifies which models perform most effectively.

This study focuses on five major types of hospital systems: Centralized Health Systems, Centralized Physician & Insurance Systems, Moderately Centralized Systems, Decentralized Health Systems, and Independent Hospital Systems. Each represents a unique organizational approach to coordinating hospital services, physician arrangements, and insurance product development: A Centralized Health System features strong central coordination, with delivery of hospital services, physician management, and insurance development organized under a unified system. The variety of services offered across the system is moderate; A Centralized Physician & Insurance System maintains centralized control over physician arrangements and insurance development but allows individual hospitals autonomy in determining service offerings; A Moderately Centralized System incorporates elements of both centralization and decentralization, centralizing highly specialized services while permitting local flexibility for routine care; A Decentralized Health System is marked by extensive local autonomy, producing a high degree of variation in services and products. Coordination across the system is limited, often constrained to administrative or informational support; and an Independent Hospital System consists of loosely affiliated, autonomous hospitals with minimal differentiation in service offerings or structured coordination.

Understanding the distinctions among these system types is critical because prior research suggests that organizational structure influences overall hospital performance. This study builds on earlier findings by reassessing whether current healthcare systems operate effectively within today's resource-constrained environment and how their structural components interact (Chuang & Inder, 2009). Many traditional organizational models may now be outdated or insufficient for managing modern healthcare demands (Rosko, 1999). As inefficiency persists—whether in cost, scale, or allocation—identifying strategies for improvement becomes increasingly important, especially as healthcare spending continues to climb (CMS, 2024).

To evaluate efficiency across hospital systems, this study draws on the 2017 U.S. Hospital Survey dataset from the American Hospital Association (AHA). Selected inputs and outputs from the dataset are used to build data envelopment analysis (DEA) models (Lee et al., 2023), which generate efficiency scores for individual hospitals. Each hospital, treated as a decision-making unit (DMU), is then assigned to one of the five system types outlined earlier. Using IBM SPSS, we conduct hypothesis testing to assess whether significant differences exist in efficiency among these groups. The findings will help identify which hospital systems operate most efficiently and may serve as performance benchmarks. By clarifying how structural variations influence operational outcomes, this study provides insights that can inform managerial decision-making and guide broader healthcare policy efforts aimed at enhancing cost-effectiveness within the U.S. healthcare system.

2. Literature Review

2.1 Five Different Hospital Systems

Our goal is to determine which of the five hospital system types operates most efficiently and assess the significance of these differences. A centralized health system features centrally organized hospital services, physician arrangements, and insurance product development (Magnussen et al., 2007). Rosko et al. (2007) note that such systems coordinate these functions at a central level, enabling greater consistency and oversight. Hospitals in centralized systems are typically located in urban areas, often include teaching institutions, and provide a larger share of services across the system. They also offer a moderate range of products and services and are commonly clustered in close geographic proximity.

A centralized physician and insurance health system is defined by strong centralization of physician arrangements and insurance product development, paired with moderate centralization of hospital service delivery. Although these core functions are centrally managed, hospitals maintain autonomy in determining the services they offer, creating moderate diversity across the system. Such systems usually consist of fewer hospitals, are less likely to be investor-owned, and tend to have geographically close affiliates. Rosko et al. (2007) found these systems to be the most efficient, largely because centralized bargaining power enhances coordination in physician and insurance-related decisions.

A moderately centralized health system blends centralized and decentralized approaches in organizing hospital services, physician arrangements, and insurance product development. In this model, certain high-cost or high-technology services, such as open-heart surgery, are centrally coordinated, while individual hospitals maintain autonomy to provide additional services based on local needs. The system typically offers a moderate range of products and services across its network. According to Rosko et al. (2007), these systems grant member hospitals greater flexibility in structuring their services, physician arrangements, and insurance activities, while still maintaining moderate centralization in each area. They also commonly include a significant number of church-affiliated hospitals.

A decentralized health system is characterized by extensive local authority over hospital services, physician arrangements, and insurance product development (Magnussen et al., 2007). Without a strong centralized coordinating structure, these systems often exhibit significant variation in services and products, making systemwide integration challenging. Central organizations typically provide limited functions—mainly information sharing and administrative support—while hospitals operate as independent, community-focused delivery units. Decision-making for hospital operations, physician arrangements, and insurance activities is largely handled at the local level. Many decentralized hospitals are affiliated with religious organizations and spread across wide geographic areas. Research indicates that decentralization can affect equity, efficiency, and system resilience (Abimbola et al., 2019). Rosko et al. (2007) also noted that financial performance within decentralized and independent systems varies depending on their membership composition.

Finally, an independent hospital system is characterized as a delivery system with minimal differentiation in hospital services, physician arrangements, and insurance product development (Büchner et al, 2016;

Levitz et al., 1985). These systems primarily consist of horizontal affiliations of autonomous hospitals. Independent hospital systems demonstrate minimal centralization of services, with limited physician arrangements or insurance products. Typically, these hospitals are smaller, situated in rural areas, and more likely to be owned by investors.

2.2 Hospital Systems and Hospital Efficiency

Evaluating the efficiency of a hospital system requires examining the five distinct organizational structures rather than treating the healthcare system as a single, uniform entity. Comparing the Centralized Health System, Centralized Physician & Insurance Health System, Moderately Centralized Health System, Decentralized Health System, and Independent Hospital System is essential for understanding how structural differences influence performance. Benchmarking these systems allows us to identify the characteristics that contribute to superior operational outcomes and to determine which models serve as effective examples for others. A study by Mhatre et al. (2014) illustrates the value of benchmarking by analyzing income elasticity of demand in the retail industry and assessing the performance of individual department stores. Although retail and healthcare operate in different sectors, both belong to the service industry and share similarities in customer interaction, resource allocation, and operational complexity. As a result, their benchmarking approach provides meaningful insights for our analysis. The primary method used in both their study and ours is data envelopment analysis (DEA), which evaluates efficiency by comparing decision-making units (DMUs) with similar operational structures. DEA uses frontier methodology through linear programming to identify the efficiency frontier and measure each unit's relative performance. Its ability to distinguish efficient from inefficient DMUs makes DEA a powerful tool for benchmarking hospitals, systems, and other service organizations.

Healthcare benchmarking has become increasingly common across many studies. Ozcan (2014) notes that while industries in general have moved toward more objective performance evaluation and data-driven decision-making, the healthcare sector has historically lagged behind. This delay presents challenges, as modern healthcare reforms—both in the United States and internationally—have reshaped expectations for performance, accountability, and quality. Programs such as the Centers for Medicare & Medicaid Services (CMS) initiatives and Hospital Value-Based Purchasing (HVPB) further heighten the pressure on healthcare organizations to perform at higher levels. As a result, benchmarking has emerged as a key approach for assessing the performance of hospitals and health systems. Traditional benchmarking methods relied heavily on ratio analysis, which often lacked precision and reliability. Consequently, the field has shifted toward more sophisticated analytical tools. Among these, Data Envelopment Analysis (DEA) has become a leading methodology for evaluating performance and efficiency. DEA provides an optimization-based approach that identifies best-practice frontiers and allows for meaningful comparisons across units with similar characteristics. This method has been widely adopted to create benchmarks for hospitals, physician group practices, and other healthcare delivery organizations, offering a more accurate and contemporary framework for performance evaluation.

Benchmarking is widely used to identify best practices at optimal costs, and its application in evaluating healthcare systems has grown significantly. Ettorchi-Tardy et al. (2012) describe benchmarking as a process traditionally focused on identifying and implementing best practices and improving cost efficiency; however, in healthcare, the concept carries additional complexity. Within this sector, benchmarking functions as both a performance measurement tool and a comparative framework that enables organizations to evaluate their standing relative to peers. Over the past decade, concerns about healthcare performance have intensified due to rising costs, increasing demands for quality and risk management, and heightened patient expectations. As a result, benchmarking has gained substantial attention at both national and international levels. Ellis (2006) emphasizes that benchmarking initiatives often aim to incorporate best practices that enhance patient satisfaction and clinical outcomes. An example is the Committee for Clinical and Quality Evaluation in Aquitaine (CCEQA), which developed a benchmarking method now being tested across 32 organizations in the region. Benchmarking represents an essential component of a continuous quality improvement approach, relying on active and voluntary collaboration among organizations. It fosters healthy competition and supports the adoption of superior practices. Effective benchmarking requires thorough preparation, systematic monitoring of indicators, staff engagement, and cross-organizational learning through structured visits.

Benchmarking is rapidly gaining momentum in healthcare, drawing on data-gathering practices long used in retail and department stores. Although not entirely new, its application in healthcare represents a relatively recent and innovative development. Its strength lies in its versatility, providing a clearer assessment of effectiveness and efficiency without relying on traditional ratios, which have often proven inadequate. Benchmarking enables meaningful comparisons across different sectors of a healthcare system and can be implemented through models such as Data Envelopment Analysis (DEA), enhancing its value as a comparative tool. As an emerging approach for evaluating performance, benchmarking is becoming increasingly popular across industries. Its growing adoption highlights its usefulness in improving organizational efficiency and reinforces its role as a valuable and effective management resource.

2.3 Hypothesis

Bazzoli et al. (2000) examined the financial performance of hospitals operating within various health networks and systems. Using an established taxonomy, they tested hypotheses related to how organizational structure influences financial outcomes. Their findings supported these predictions: hospitals in systems characterized by unified ownership achieved stronger financial performance than those in contractually based networks. They also reported that hospitals within highly centralized networks performed better financially than those in decentralized arrangements. In contrast, networks or systems with limited differentiation or centralization demonstrated the weakest financial results. These outcomes align with resource dependence theory, transaction cost economics, and institutional perspectives on organizational behavior. Building on this foundation, our study hypothesizes that hospital efficiency differs significantly across the five hospital system groups analyzed. Overall, Bazzoli et al. (2000) suggest that unified ownership and greater centralization enhance financial efficiency compared to loosely affiliated networks with minimal coordination. Accordingly, our research tests whether efficiency varies meaningfully among the five system categories.

Research Hypothesis: Hospitals with a more centralized approach to healthcare tend to operate more efficiently.

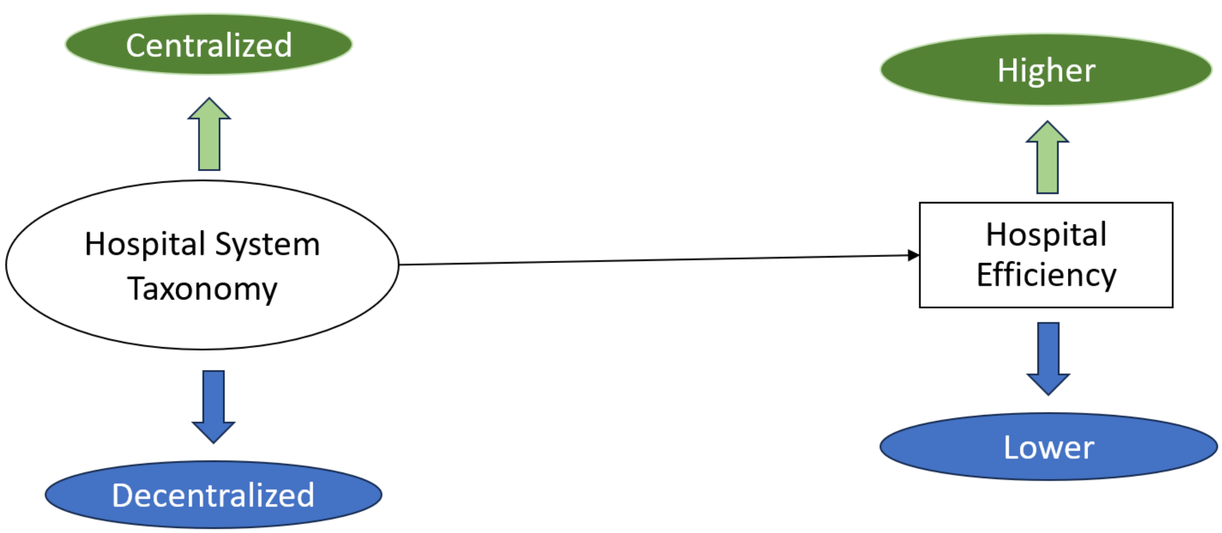

Figure 1: Hypothesized research framework

3. Methodology

We use data envelopment analysis (DEA) to evaluate the comparative efficiencies of health systems. DEA, a specialized form of linear programming, is grounded in Farrell's (1957) frontier methodology and was later advanced by Charnes et al. (1978) and Banker et al. (1984). It is widely applied to assess relative efficiency among comparable organizations. Numerous studies have used DEA to measure hospital performance (Williams et al., 2016; Yang et al., 2015; Lee et al., 2023). In DEA, each entity evaluated is termed a decision-making unit (DMU); in this study, the DMUs are hospitals across five different system types. Because DEA identifies relatively efficient units within a group, it provides a strong foundation for comparative analysis and benchmarking (Mhatre et al., 2014).

$$\text{Maximize } E_0 = \frac{\left\{\sum_{r=1}^{R} u_{r0} y_{r0}\right\}}{\left\{\sum_{i=1}^{I} v_{i0} x_{i0}\right\}} \tag{1}$$

subject to

$$\frac{\left\{\sum_{r=1}^{R} u_{r0} y_{rk}\right\}}{\left\{\sum_{i=1}^{I} v_{i0} x_{ik}\right\}} \leq 1 \text{ for all } k \tag{2}$$

$$u_{r0},\ v_{i0} \geq \delta \text{ for all } r,\ i, \tag{3}$$

y_{rk}: the observed quantity of output r generated by unit $k = 1, 2, ..., N$,
x_{ik}: the observed quantity of input i consumed by unit $k = 1, 2, ..., N$,
u_{r0}: the weight to be computed given to output r by the base unit 0,
v_{i0}: the weight to be computed given to input i by the base unit 0,
δ: a very small positive number.

The fractional programming model can be converted to a common linear programming (LP) model without much difficulty. A major assumption of LP is a linear relationship among variables. Accordingly, an ordinary LP for solving DEA utilizes constant returns to scale, allowing all observed production combinations to be scaled up or down proportionally (Charnes et al., 1978). However, by using piecewise LP, we can model non-proportional returns to scale, such as increasing, decreasing, or variable returns to scale (Banker et al., 1984). Depending on returns to scale and various modeling approaches, different types of DEA models are available (Mhatre et al., 2014).
Sherman and Ladino (1995) summarize the capability of DEA in the following manner:

- Identifies the best practice DMU that uses the least resources to provide its products or services at or above the quality standard of other DMUs.
- Compares the less efficient DMUs to the best practice DMU.
- Identifies the number of excess resources used by each of the less efficient DMUs.
- Identifies the amount of excess capacity or ability to increase outputs for less efficient DMUs, without requiring added resources.

In this study, involving comparative measures of operational efficiencies for DMUs, we employ a Charnes-Cooper-Rhodes (CCR) model, a Banker, Charnes, and Cooper (BCC) model, and a slack-based measure of efficiency (SBM). First, we measure the efficiency of DMUs using the CCR and BCC models. Next, we apply SBM to the data to evaluate the efficiency of variables with non-radial properties. Finally, we try to identify the sources of inefficiency by contrasting the results of the three models (Mhatre et al., 2014). In this study, these DEA models are run using DEA-Solver software, and statistical analyses are run in SPSS.

3.1 Sample Data

We use American Hospital Association (AHA) 2017 Annual Hospital Survey data consisting of survey responses from 6,284 hospitals. We then connect hospital data with financial information and select the data that fit our needs. We group the hospital systems using the corresponding cluster code for each system. Next, we looked at the variables that go into the DEA model, such as (I)FTED (full-time equivalent doctors), (I)FTEN (full-time equivalent registered nurses), (I)BDTOT (total number of beds), (I)EXPETOT (total expenses), (O)IPDTOT (total inpatient days), (O)VTOT (total outpatient visits), and (O)TPR (total patient revenue). We remove hospital data with any missing values, as the DEA models cannot be made with these missing values. After data cleansing, 2,257 hospitals remain in the data set.

3.2 Variables

In the AHA Survey data, we use four input variables and three output variables for the DEA models: (I)FTED (full-time equivalent doctors), (I)FTEN (full-time equivalent registered nurses), (I)BDTOT (total number of beds), (I)EXPETOT (total expenses), (O)IPDTOT (total inpatient days), (O)VTOT (total outpatient visits), and (O)TPR (total patient revenue).

Full-Time Equivalent (FTE) Physicians: To analyze the effect of health information technology on hospital performance, Williams et al. (2016) used FTE physicians as input in the DEA model to measure each hospital's efficiency. Another research by Helmig and Lapsley (2001) also used the DEA model to determine FTE physicians' efficiency in hospitals and how this variable input measured hospital efficiency.

Full-Time Equivalent Nurses: We include registered nurses as one of the variables for the DEA model. This is one of the labor inputs that estimates hospital efficiency. Clement et al. (2008) used FTE registered nurses as an input to measure the quality of care, which resulted in hospital efficiency and better patient care outcomes. Additionally, Bjorkgren et al. (2001) used the DEA model to measure FTE nurses as an input to represent the average staff levels over the study year, reflecting nursing care efficiency across several units.

Number of Beds: One of the variable inputs was the number of beds in hospitals, focusing on optimizing bed usage. Kališ and Stracová (2019) discussed how to reduce the number of beds in hospital care, and we use this input to build a DEA model, determining how to adjust bed numbers according to patient needs. Bjorkgren et al. (2001) used the DEA model to measure the number of beds as an input variable, including it as a proxy for capital.

Total Operating Expenses: Harrison and Lambiase (2007) used total operating expenses as an input variable to study hospital efficiency by examining cost, productivity, and technical efficiency. We measure cost efficiency by comparing actual to expected costs. Gandhi and Sharma (2018) used total operating expenses to assess the relative efficiency of hospitals in using their labor costs, net fixed assets, current assets, and other operating expenses to generate total income and profit after tax.

Inpatients: One variable we are evaluating for operational efficiency is the number of inpatients, based on the 2017 AHA data sets. Yang et al. (2015) used an output to create a dynamic benchmarking system to evaluate the health stage of an inpatient ready to be discharged. We use this output in our DEA method to provide new insights into the causes of medical resource shortages and how to treat inpatients more effectively based on discharge categories. Araujo et al. (2014) also used the inpatient output variable in their DEA model to test for significant differences in efficiency levels and to identify potential improvements.

Outpatients: Using the 2017 AHA data set, we measure the outpatient output for hospital efficiency. Clement et al. (2008) measured the number of outpatient services, such as outpatient surgeries, emergency room visits, and outpatient visits, to build their DEA method. We use this output to measure the number of patients being discharged and emergency visits to gauge hospital efficiency. Hofmarcher et al. (2002) used the DEA model for outpatient output variables to determine the cost per outpatient treatment.

Total Revenue: To determine the efficiency performance of a hospital for total revenue output, Clement et al. (2008) used the total revenue output for the DEA model. We use this output to indicate total revenue for hospital efficiency and examine how hospitals can increase revenues. Vitezić et al. (2017) also used the DEA model to determine the total revenue output variable. We use this output to estimate the relative efficiency of hospitals.

4. Results

4.1 Descriptive Statistics

A total of 2,257 hospitals remain in the data set. Among five health systems, Decentralized Health Systems are the largest group (40.2 %), followed by Moderately Centralized Health Systems (21.8%) and Independent Hospital Systems (17.5%). Only 11.5 percent and 6.2 percent of the hospitals are classified as Centralized Health Systems and Centralized Physician/Insurance Health Systems, respectively (Table 1).

Table 1: Sample Data Distribution to Health Systems

	Frequency	Percent
Centralized	260	11.5
Central P & I	140	6.2
Moderate	491	21.8
Decentralized	908	40.2
Independent	395	17.5
Missing Value	63	2.8
Total	2,257	100.0

On average, these hospitals have 194.4 beds with 43.2 full-time equivalent doctors and 355.2 full-time equivalent registered nurses, approximately 9 times as many nurses as doctors. Total operating expenses range from $2.9 million to $5.5 billion, with an average of $237 million. On average, there are 47,357.3 total inpatient days and 179,364.9 total outpatient visits. Total patient revenue ranges from $0.5 million to $16.9 billion, with an average of $918 million (Table 2).

Table 2: Descriptive Statistics of Inputs and Outputs

	N	Min	Max	Mean	SD
(I)FTED	2,257	1	2,669	43.2	161.6
(I)FTEN	2,257	4	7,517	355.2	591.3
(I)BDTOT	2,257	4	2,877	194.4	220.0
(I)EXPTOT	2,257	2,872,521	5,543,477,948	237,190,609.2	416,548,403.5
(O)IPDTOT	2,257	67	761,889	47,357.3	62,028.6
(O)VTOT	2,257	1	6,297,877	179,364.9	295,791.8
(O)TRP	2,257	510,769	16,863,431,079	918,219,392.2	1,554,539,682.9
N	2,257				

4.2 Correlations

We ran a correlation analysis using Spearman's rho. The results are shown in Table 3. The DEA score is significantly correlated with FED, FTEN, BDTOT, EXPTOT, IPDTOT, VTOT, and TPR ($p<0.01$). The number of full-time doctors shows the highest correlation with the DEA score (0.51). The data shows that all the input and output variables are significantly correlated with each other ($p<0.01$). There is a high correlation between the number of beds and the total inpatient days (0.979), between the number of full-time RNs and the total operating expenses (0.944), between the number of full-time RNs and the total inpatient days (0.922), and between the number of full-time RNs and the number of beds (0.912).

Table 3: Spearman's Rho Correlation Analysis

	DEA	(I) FTED	(I) FTEN	(I) BDTOT	(I)	(O)	(O) VTOT	(O) TPR
DEA score	1							
(I) FTED	.051**	1						
(I) FTEN	.214**	.633**	1					
(I) BDTOT	.254**	.478**	.912**	1				
(I) EXPTOT	.211**	.700**	.944**	.850**	1			
(O) IPDTOT	.319**	.515**	.922**	.979**	.875**	1		
(O) VTOT	.241**	.621**	.773**	.679**	.810**	.686**	1	
(O) TPR	.266**	.584**	.898**	.855**	.897**	.865**	.700**	1

4.3 Kruskal-Wallis Test

The DEA scores are not normally distributed; therefore, we used a non-parametric test for hypothesis testing. To test the differences among the five groups, we chose the Kruskal-Wallis test. The data show that the five groups significantly differ in terms of the DEA score (Kruskal-Wallis H = 36.803, DF = 4, $p < 0.001$). Centralized Physician & Insurance Health System has the highest mean score (0.591), followed by Centralized Health System (0.583). Decentralized Health System (0.559) and Independent Hospital System (0.547) have lower mean scores, and the Moderately Centralized group has the lowest score (0.525). Table 4 shows the results.

As evident in the DEA scores, Centralized and Central Physician & Insurance Health Systems have the highest mean DEA scores. This confirms our original hypothesis that centralized systems operate more efficiently than decentralized systems. Furthermore, our Kruskal-Wallis test, which is used to identify statistically significant differences between two or more variables, supports our hypothesis with $p < 0.001$. In summary, all our data indicates that the clear winners are hospital systems that are Centralized Physician & Insurance Health Systems. They have the highest mean score and confirmed positive hypothesis testing in favor of the Centralized Physician & Insurance Health System.

Table 4: Kruskal Wallis Test Results

	N	Mean	SD	Kruskal-Wallis H	DF	P-Value
Centralized	260	.583	.164	36.803	4	<.001
Central P & I	140	.591	.165			
Moderate	491	.525	.149			
Decentralized	908	.559	.167			
Independent	395	.547	.160			
Total	2,194	.553	.163			

5. Discussion

The findings support our hypothesis, indicating that more centralized healthcare systems exhibit higher efficiency. The statistical results show a highly significant p-value ($p < 0.001$), confirming meaningful differences among the five hospital system groups and demonstrating that centralized systems are the most efficient. These results align with Bazzoli et al. (2000), who reported that hospital systems with unified ownership or strong centralization achieved superior financial performance relative to decentralized systems. Their study found that centralized network hospitals incurred the lowest costs, while independent networks experienced the highest costs. Similarly, our analysis revealed a clear pattern: efficiency improves as the degree of centralization increases. As noted previously, the highest mean efficiency scores were observed in the Central Physician and Insurance group (0.591) and in Centralized Health Systems (0.583). The p-value further confirms the significant relationship between centralization and efficiency.

We collected data to measure the efficiency of different hospital systems. The sample data shows significant efficiency towards a centralized system. According to our DEA score table (Table 4), the centralized physician & insurance group has the highest mean score, confirming that centralized systems are more efficient than decentralized ones, as indicated by the p-value. Other studies have also found centralized systems to be more efficient. Our analysis of the DEA model's input and output variables showed that these variables significantly affect hospital efficiency in both centralized and decentralized systems. This led us to conclude that our hypothesis is confirmed.

5.1 Managerial Implications

The findings of our study carry important managerial implications, reinforcing our hypothesis that centralized health systems operate more efficiently than decentralized ones. A key insight for healthcare leaders is that greater centralization can help reduce overall costs for both patients and providers. With U.S. healthcare spending reaching \$4.5 trillion in 2022—about \$13,500 per person and 17.3 percent of GDP (CMS, 2024)—cost containment is increasingly urgent, especially within decentralized systems where fragmentation often leads to inefficiencies. Consistent with this concern, the DEA results show that hospitals operating within Centralized Physician & Insurance systems (mean DEA score = 0.591) and Centralized Health Systems (mean DEA score = 0.583) significantly outperform Moderately Centralized, Decentralized, and Independent systems, indicating that centralized models are able to generate higher inpatient and outpatient volumes and greater patient revenue using comparable or fewer resources. Centralized structures streamline care delivery by integrating services, consolidating patient and physician information, and improving coordination, all of which contribute to enhanced efficiency and financial savings. From a managerial perspective, these efficiency gains translate into actionable decisions regarding governance and resource coordination, including the centralization of physician arrangements, insurance contracting, and high-cost service lines to reduce input redundancy and improve labor utilization. Managers should consider centralization as a strategic option because it reduces administrative burden, simplifies system oversight, and allows physicians to focus more on patient care rather than administrative tasks. Improved access to shared resources, equipment, and information further strengthens care quality. The observed efficiency gaps suggest that even incremental shifts toward centralized planning—such as shared service platforms, unified contracting, and centralized capital investment decisions—can yield measurable efficiency improvements. These insights can guide managers in making informed, cost-effective organizational decisions.

Gaille (2018) reports that 60% of Americans receive health insurance through private-sector employers, resulting in shared costs between employees and businesses. While some employees may spend around \$6,000 annually on healthcare, others may incur costs exceeding \$10,000, much of which does not contribute to take-home pay and may even be treated as taxable income. Enhancing access to care through centralized systems and reducing labor-related expenses by 10% could lower public-sector health benefit costs by more than 20%. These savings could then be redirected toward hiring, wage increases, new benefits, or research and development. Therefore, we recommend that managers encourage efforts to reduce employer-sponsored insurance costs, as this would strengthen the economic sustainability of healthcare and expand opportunities for organizational investment and innovation.

6. Conclusion

Our research was based on the 2017 American Hospital Association (AHA) survey dataset. We hypothesized to determine if centralized healthcare is more efficient than decentralized systems. This study demonstrated that among the five different health systems we examined (Centralized, Centralized P&I, Moderately Centralized, Decentralized, and Independent Health System), more centralized health systems exhibit better efficiency and financial performance. This conclusion is supported not only by our DEA analysis based on AHA data but also by previous studies conducted by scholars such as Bazzoli et al. (2000). Independent and decentralized health systems performed significantly worse in terms of efficiency and incurred higher total costs of care, with inferior overall results.

One limitation of this study is its reliance on the 2017 AHA dataset, which was intentionally selected to provide a stable, pre–COVID-19 baseline for evaluating hospital system efficiency under normal operating conditions. The year 2017 represents one of the most recent periods for which comprehensive, nationally consistent AHA data are available without the confounding effects of the COVID-19 pandemic, which significantly disrupted hospital operations, utilization patterns, staffing, and financial performance. Using this dataset allows the analysis to capture structural efficiency differences across hospital system types rather than temporary, shock-driven effects. At the same time, the use of more recent data—such as post-2020 AHA datasets—may yield different efficiency outcomes due to changes in payer mix, labor shortages, cost inflation, telehealth adoption, and evolving reimbursement policies. Future research could extend this study by comparing pre- and post-pandemic periods to examine whether the relative efficiency advantages of centralized systems persist under more volatile conditions.

In addition, while total patient revenue is a widely accepted output in DEA-based hospital efficiency studies, this measure may be influenced by payer mix, negotiated reimbursement rates, and market-level pricing power. As a result, revenue-based efficiency scores may partially reflect institutional and market conditions in addition to operational performance. Nevertheless, because all hospitals are evaluated relative to a common efficiency frontier within the same regulatory and reimbursement environment, the DEA framework mitigates—though does not eliminate—these influences. Future studies could further test robustness by incorporating payer-mix–adjusted revenue measures or conducting sensitivity analyses using alternative financial outputs. Finally, subsequent work could incorporate additional control variables—such as hospital size, geographic location, ownership type, system or network affiliation, and teaching status—to produce more robust results. Alternative analytical approaches, including regression-based methods, may also complement or extend DEA findings.

Despite these limitations, this research contributes valuable evidence on efficiency differences across five hospital system types. Consistent with prior literature, our results show that hospitals operating within more centralized structures demonstrate the highest efficiency. Centralization appears to enhance workflow, coordination, and overall performance. If more hospitals adopt centralized models, they may realize substantial gains in operational efficiency.

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