REVIEW

# Operational Efficiency in Teaching Hospitals:

## A Review of Evidence from Selected Countries

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**Keywords**: Teaching hospitals; Efficiency; Health system performance; Resource allocation; Hospital management.


# ABSTRACT

**Background:** Improving the efficiency of teaching hospitals is a growing concern in health systems worldwide. These institutions face unique challenges due to their dual role in delivering care and training professionals. This review synthesizes recent international evidence on strategies to improve teaching hospital efficiency.

**Methods:** A structured literature search was conducted in the PubMed, EMBASE, and Cochrane Library databases for English-language articles published between 2015 and 2024. Articles were selected based on predefined inclusion and exclusion criteria. Eligible studies were analysed and thematically synthesized.

**Results:** Five studies met the inclusion criteria. The most common analytical method was Data Envelopment Analysis (DEA) (n=3), with one study each using DEA combined with PROMETHEE, DEA with propensity score matching, and stochastic frontier analysis. Key efficiency drivers identified included fixed-price payment systems, hospital closures, centralized bed and waitlist management, outpatient service prioritization, and resource optimization. Teaching hospitals were generally found to be less efficient than non-teaching ones, largely due to greater operational complexity.

**Conclusion:** A variety of strategies and hybrid analytical methods are being used internationally to enhance efficiency in teaching hospitals. Structural reforms and operational innovations, particularly those related to centralized management and financial incentives, appear to be most effective. Partnerships between public and academic hospitals may improve efficiency through better resource sharing. However, findings are limited to a small number of countries. Further research is needed to assess the long-term impacts of these strategies across diverse healthcare contexts.


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**What do we already know about this topic?**
Previous research shows that hospital efficiency varies by ownership (public vs. private), payment models, and operational structures. Public and teaching hospitals often exhibit lower efficiency due to handling complex cases, teaching, and research. Methods like DEA, stochastic frontiers, and propensity matching are commonly used to assess efficiency. Studies highlight that fixed-price payment systems, resource optimization, and strategic hospital closures can improve efficiency, particularly in developing countries. However, most evidence focuses on single-country analyses, with limited comparisons across healthcare systems.

**What is the main contribution to Evidence-Based Practice from this article?**
This review consolidates evidence from five studies (2015–2023) on hospital efficiency, emphasizing methods (DEA, PROMETHEE, stochastic frontiers) and key drivers (payment systems, closures, centralized management). It confirms that fixed-price contracts boost efficiency, while teaching hospitals struggle due to unmeasured outputs (e.g., training). Unique insights include the role of crisis-driven reforms (e.g., Spain's bed management) and competitive effects from closures (Turkey). The synthesis provides actionable strategies for policymakers to enhance efficiency in diverse settings.

**What are this research's implications towards health policy?**
The article contributes to theory by expanding the strategy of improve the efficiency of teaching hospital. The implication for management work is that adopt fixed-price payment models to incentivize efficiency, optimize resource allocation, implement centralized management, consider strategic closures to improve regional efficiency and balance austerity and quality during crises.

Authors' Contributions Statement:
Na Chen and Kun Wang were responsible for the conception and design of the study. Na Chen worked on the article search and articles revision. Na Chen wrote the paper and Kun Wang reviewed it thoroughly.

## Introduction

Improving the efficiency of teaching hospitals is a pressing issue for healthcare systems worldwide. This concern affects patients, healthcare professionals, providers, financial stakeholders, and policymakers. A rapid literature review reveals increasing attention from researchers to the challenges of measuring and enhancing efficiency in teaching hospitals. This article aims to synthesize recent findings on strategies for improving efficiency in teaching hospitals and to assess the significance of the most recent contributions to the field.

This imperative aligns with the World Health Organization's renewed emphasis on reimagining hospital infrastructure to meet 21st-century healthcare demands. The recent Hospitals of the Future technical brief (WHO, 2023) outlines a transformative vision for healthcare facilities, emphasizing modular design flexibility, climate-resilient infrastructure, and workflows optimized through digital integration. While this guidance broadly targets hospital modernization across the WHO European Region, its principles—particularly the call for "resource-efficient spaces adaptable to evolving care models"—hold amplified relevance for teaching hospitals. These institutions face the dual challenge of maintaining operational efficiency while fulfilling their tripartite mission of clinical care, medical education, and research innovation. Our analysis extends this discourse by examining how efficiency strategies specifically address the unique architectural, financial, and pedagogical constraints inherent to academic medical centers.

## Methods

A structured search was conducted in the PubMed, EMBASE, and Cochrane databases for

English-language articles published between 2018 and 2023. Search terms included ('efficiency'[Title/Abstract]) AND ('university hospital'[All Fields]) AND ('hospital management'[All Fields]) AND ('efficiency improvement'[All Fields] OR 'hospital efficiency reforms'[All Fields]) , and either “efficiency improvement” or “hospital efficiency reforms” [full text]. Inclusion criteria were: (i) original research in English, (ii) full-text availability, (iii) studies conducted in university hospitals, and (iv) research describing activities to improve hospital performance. Although the focus was on original research, additional articles such as editorials and brief reports were considered if they provided relevant data on efficiency. Study selection followed PRISMA guidelines and was independently conducted by two reviewers, with a third consulted in case of disagreement.

## Results

The reviewed studies (n=5) employed diverse methodologies to assess technical efficiency in teaching hospitals, with three dominant approaches emerging:

### DEA and Hybrid Extensions

Nonparametric Data Envelopment Analysis (DEA) served as the primary tool in three studies, valued for its ability to evaluate multi-input/output systems without restrictive production function assumptions (Özgen Narcı et al., 2015; Firouzi Jahantigh & Ostovare, 2020; Cinaroglu, 2024). Two studies enhanced DEA’s limitations:Firouzi Jahantigh & Ostovare (2020) integrated DEA with PROMETHEE to prioritize 12 critical efficiency factors in Tehran’s teaching hospitals, emphasizing budget allocation optimization. Cinaroglu (2024) combined DEA with propensity score matching and difference-in-differences regression to isolate the causal impact of Türkiye’s 2011 hospital closures on neighboring facilities’ efficiency.

### Stochastic Production

FrontiersYildiz et al. (2018) applied transitive stochastic frontier analysis to 1,079 Turkish hospitals, revealing systematic inefficiencies in university hospitals due to unmeasured educational outputs—a methodological strength in capturing latent productivity determinants.

### Management Indicator Analysis

Fernández Castañer et al. (2018) retrospectively analyzed four categories of operational indicators (activity, quality, costs, satisfaction) in a Spanish tertiary hospital, linking austerity-driven bed reductions to efficiency gains through multivariate trend analysis.

### Cross-Cutting Efficiency Strategies

Financial Incentive Restructuring: Fixed-price payment systems (Özgen Narcı et al., 2015) reduced moral hazard in Türkiye’s public hospitals, with fully contracted facilities outperforming partial-contract peers by 18-22%. Crisis-driven budgetary discipline in Spain (Fernández Castañer et al., 2018) enabled reinvestment in outpatient care, offsetting initial activity declines through workflow optimization.

Structural Consolidation: Türkiye’s 2011 hospital closures improved regional efficiency by 14-19% through reduced service duplication (Cinaroglu, 2024), while centralized bed management (Fernández Castañer et al., 2018) and surgical waiting list coordination increased Spanish hospital productivity by 26% post-2012.

Resource Sharing Models: Cross-hospital collaborations yielded efficiency dividends:Public-university partnerships in Türkiye leveraged complementary strengths—MoH hospitals improved infrastructure utilization by 31%, while university facilities enhanced specialty care capacity (Yildiz et al., 2018).Low-complexity patient referrals in Spain

reduced tertiary hospital workloads by 19%, preserving capacity for high-acuity cases (Fernández Castañer et al., 2018).

Geographical and Methodological Limitations
Regional Concentration: 80% of studies (4/5) focus on Türkiye and Spain, limiting generalizability to other developing contexts with differing governance models (e.g., South Asian decentralized systems).
Output Measurement Gaps: DEA-based studies omit qualitative factors like staff motivation, while stochastic frontiers exclude teaching/research outputs (Yildiz et al., 2018).
Temporal Narrowness: All studies used cross-sectional or short-panel data (max 10 years), obscuring long-term strategy impacts.

| Authors + years | County | Tools | Improvement strategy |
|---|---|---|---|
| Ozgen-Narci 2015 | Turkey | DEA | Payment reforms |
| Farzad Firouzi 2020 | Tehran | DEA, PROMETHEE | Managers adopt the necessary planning |
| Songul Cinaroglu 2023 | Turkey | DEA, propensity score matching techniques | Structural reforms |
| Mustafa S. Yildiz 2018 | Turkey | stochastic production frontiers | Resource-sharing between public and university hospitals |
| Fernández Castañer M 2018 | Spain | DEA | Austerity-driven measures |

Table 1 Measuring Tools and Improvement strategy for Teaching Hospital Efficiency

| Methodology | Strategy Type | Key Efficiency Gain | Contextual Limitation |
|---|---|---|---|
| DEA + PROMETHEE | Budget prioritization | 12 critical factors | Tehran-specific indicators |
| DEA + PSM/DiD | Hospital closures | 14-19% regional gain | Türkiye's centralized system |
| Stochastic frontiers | Resource sharing | 31% utilization rise | Excludes education outputs |
| Indicator trend analysis | Crisis management | 26% productivity rise | Single-center Spanish data |

Table 2 Key Strategies to Improve Efficiency of Teaching Hospitals

Discussion
1. Methodological Insights: Hybrid Approaches for Complex Systems
The methodological diversity across studies—spanning nonparametric DEA (Firouzi Jahantigh & Ostovare, 2020; Özgen Narcı et al., 2015), stochastic frontiers (Yildiz et al., 2018), and DEA-propensity score matching hybrids (Cinaroglu, 2024)—reflects the necessity of tailored analytical frameworks for teaching hospitals' tripartite mission (care, education, research). While DEA's flexibility in handling multiple inputs/outputs remains valuable, its limitations in addressing unobserved heterogeneity (e.g., patient case-mix variations) highlight the critical need for

complementary methods. For instance, Cinaroglu's (2024) integration of propensity score matching with DEA demonstrates how quasi-experimental techniques can isolate policy impacts in observational data—a significant advancement over traditional cross-sectional efficiency analyses. This aligns with broader calls for methodological pluralism in health systems research, particularly when evaluating institutions balancing competing objectives. However, the absence of dynamic network DEA applications or machine learning approaches in these studies suggests untapped opportunities to model temporal efficiency trajectories and complex input-output relationships.

2. Efficiency Strategies: Balancing Financial and Operational Innovation

Payment reform: Fixed-price contracts (Özgen Narcı et al., 2015) address moral hazard risks in fee-for-service models, theoretically aligning with principal-agent frameworks.

Structural consolidation: Hospital closures (Cinaroglu, 2024) and centralized bed management (Fernández Castañer et al., 2018) reflect transaction cost economics principles by reducing redundancy.

Resource-sharing: Public-university hospital collaborations (Yildiz et al., 2018) operationalize resource dependency theory through strategic pooling of physical and human capital.

Notably, Fernández Castañer et al.'s (2018) Spanish case demonstrates how austerity measures can be counterbalanced by process innovations (e.g., outpatient expansion), providing empirical support for adaptive resilience theory in healthcare. However, the Turkish dominance in four of five studies raises questions about strategy transferability. For example, Türkiye's centralized Health Transformation Program creates distinct institutional conditions rarely replicated elsewhere, underscoring the need to contextualize findings within governance structures and financing regimes.

3. Contextual Constraints and Generalizability Limitations

Institutional path dependency: Strategies successful in Türkiye's state-driven system may falter in decentralized contexts (e.g., India's federalized healthcare).

Resource stratification: Proposed bed-sharing models presume baseline infrastructure availability—a problematic assumption in low-income settings.

Measurement bias: DEA-based studies predominantly use administrative data, potentially overlooking qualitative efficiency determinants like staff motivation.

The narrow geographical focus (three Türkiye studies, one Spain, one Iran) limits cross-regional validity, particularly regarding: Cultural factors in staff-resistance to mergers (absent in studies) ; Varying research/education funding models (e.g., contrasts between Türkiye's state-funded medical schools and U.S. models); Epidemiologic transitions (e.g., efficiency pressures from NCDs vs. infectious diseases).

Recommendations for practice in teaching hospital management

To operationalize the evidence-based strategies identified, teaching hospital administrators should prioritize three synergistic interventions:

Adopt value-aligned payment models: Transition from fee-for-service to fixed-price contracts (Özgen Narcı et al., 2015), particularly for routine procedures, to incentivize resource stewardship while maintaining safeguards for complex care reimbursement.

Implement phased structural reforms: Strategically consolidate underutilized facilities through data-driven closure protocols (Cinaroglu, 2024), coupled with parallel investments in regional referral networks to maintain access.
Accelerate operational digitalization: Establish centralized command centers for real-time bed management and surgical scheduling (Fernández Castañer et al., 2018), complemented by telehealth expansion to shift ⩾30% of low-complexity consultations to outpatient settings.

## Conclusion

This rapid literature review synthesizes evidence from five studies (2015–2023) to identify actionable strategies for improving operational efficiency in teaching hospitals, predominantly in developing countries. The findings underscore that hybrid methodologies—such as combining nonparametric DEA with PROMETHEE, propensity score matching, or stochastic frontier analysis—are critical for capturing the multifaceted challenges of teaching hospitals, which juggle clinical care, education, and resource constraints. These methodologies provide policymakers and hospital administrators with evidence-based frameworks to prioritize context-adaptive interventions, such as deploying DEA-propensity score matching hybrids to evaluate consolidation impacts or stochastic frontiers to monitor resource-sharing partnerships. Key strategies include adopting fixed-price payment systems to incentivize efficiency, structural reforms like hospital closures to eliminate redundancies, and operational innovations such as centralized bed management and outpatient care expansion to optimize workflows. Additionally, resource-sharing partnerships between public and university hospitals demonstrate the value of leveraging complementary strengths in infrastructure and expertise. While these insights are largely drawn from Turkey and Spain, they highlight the importance of context-specific adaptations and hybrid approaches to balance efficiency with equity and quality. Future research should prioritize longitudinal studies across diverse regions to evaluate the sustainability of these strategies and their impact on long-term healthcare outcomes.

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