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Health Economic Evaluation in Healthcare Management : A Systematic Review of Cost-Effectiveness Studies in Hospital Operations

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Abstract. *Healthcare systems worldwide face increasing financial constraints while maintaining quality care standards. In this context, health economic evaluation has become a crucial tool for informing evidence-based resource allocation decisions within hospital operations. This systematic review aims to synthesize current evidence on cost-effectiveness studies in hospital operations and to identify the key factors that contribute to efficient healthcare management. A comprehensive search was conducted across PubMed, Scopus, and Web of Science databases for articles published between 2020 and 2024. The keywords applied included "cost-effectiveness," "health economic evaluation," "hospital operations," and "healthcare management." Studies were screened following PRISMA guidelines, and a total of twenty-five peer-reviewed articles met the inclusion criteria, representing diverse healthcare settings, interventions, and geographical contexts. The review identified several key themes, including the adoption of digital health interventions, the implementation of quality improvement collaboratives, and the integration of performance evaluation indicators in hospital management systems. Cost-effectiveness ratios varied significantly across interventions, with digital health solutions—such as telemedicine, electronic health records, and predictive analytics—showing particularly promising results in terms of both cost savings and patient outcomes. Overall, the findings confirm that health economic evaluation is essential for optimizing hospital operations. Future research should prioritize the standardization of evaluation methods, the inclusion of broader outcome measures, and the development of comprehensive frameworks that integrate both clinical and economic perspectives in healthcare management.*

Keywords*: Cost-Effectiveness; Health Economics; Healthcare Operations; Hospital Management; Systematic Review.*

1. INTRODUCTION

The global healthcare sector is experiencing increasing financial pressure due to rising operational costs and budget constraints. Hospitals, as the largest consumers of healthcare system budgets, require a systematic approach to economic evaluation to ensure optimal resource allocation (Smith et al., 2024).

Health economic evaluation has evolved into an important instrument in hospital management decision-making. Cost-effectiveness analysis (CEA), in particular, has become a key technique in assessing the efficiency of healthcare interventions and resource allocation decisions (Johnson & Williams, 2023). This analysis allows decision-makers to compare various interventions based on the ratio of costs to health outcomes achieved.

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Recent bibliometric research shows that publications on cost-effectiveness analysis in healthcare have grown significantly in the last decade, with 7,561 articles published between 2013 and 2023 (Chen et al., 2024). This reflects a growing awareness of the importance of economic evaluation in the context of healthcare.

The main challenges in hospital operations today include economic inflation, which reached 12.4% between 2021-2023, resulting in a significant increase in operating costs (American Hospital Association, 2024). More than half of hospitals experienced operating losses in 2022, highlighting the urgency of implementing effective cost management strategies.

Although the importance of health economic evaluation has been recognized, there are variations in the methodologies and definitions of perspectives used in previous studies (Thompson et al., 2024). This creates a need for a comprehensive review that can synthesize the latest evidence and identify best practices in hospital operational economic evaluation.

Therefore, this systematic review aims to analyze studies on cost effectiveness in hospital operations, identify key factors that contribute to efficiency, and provide recommendations for the implementation of optimal economic evaluation in healthcare management.

2. THEORETICAL STUDY

Health Economic Evaluation

Health economic evaluation is a comparative analysis of alternative actions in terms of costs (resource inputs) and consequences (outcomes) (Culyer, 2024). In the context of hospital management, this evaluation is a strategic tool for optimizing the allocation of limited resources while maintaining or improving the quality of health services.

Drummond et al. (2015) define health economic evaluation as a systematic analysis that compares the costs and benefits of two or more health interventions. This definition emphasizes the importance of relative comparisons and the use of systematic methods in assessing economic efficiency.

Economic Evaluation Methodology

The production function of a hospital can be modeled as the transformation of inputs (labor, capital, technology, and materials) into outputs (health services, patient outcomes) (Morrison & Kumar, 2024). This theory provides a conceptual basis for understanding the relationship between resources used and results achieved.

The Cobb-Douglas production model has been adapted to the hospital context:

$$\mathbf{Q = A \times L^{\alpha} \times K^{\beta} \times T^{\gamma}}$$

where:

Q = healthcare service output

A = technology efficiency

L = labor input

K = capital input

T = medical technology

α, β, γ = production elasticity

Types of Economic Analysis

CEA compares relative costs and outcomes in natural units (such as life years gained, cases prevented) (Neumann et al., 2023). This method produces an incremental cost-effectiveness ratio (ICER) calculated as: a) ICER = $(C_1 - C_0) / (E_1 - E_0)$: Where C_1 and C_0 are the costs of intervention and control, while E_1 and E_0 are their respective effectiveness. b) Cost-Utility Analysis (CUA) : CUA uses utility-based measures such as Quality-Adjusted Life Years (QALYs) to measure outcomes (Briggs & Gray, 2024). This approach allows for comparisons across different health conditions by integrating quality and quantity of life. c) Cost-Benefit Analysis (CBA) : CBA measures all costs and benefits in monetary units, enabling the calculation of net present value and benefit-cost ratio (Phelps & Madhavan, 2023). This method provides comprehensive results but poses challenges in monetizing health outcomes.

Lean Management Theory

Lean management in hospitals focuses on eliminating waste and increasing value-added activities (James & Womack, 2023). The seven types of waste identified in the hospital context include: a) Overproduction: Unnecessary excessive services, b) Waiting: Patient and staff waiting times, c) Transportation: Inefficient movement, d) Over-processing: Excessive processes, e) Inventory: Excessive supplies, f) Motion: Unnecessary movement, g) Defects: Errors and rework

3. RESEARCH METHOD

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency and research methodology quality. A comprehensive literature search was conducted in three major databases: PubMed/Medline, Scopus, and Web of Science. The keywords used included combinations of: “cost-effectiveness,” “health economic evaluation,” “hospital operations,”

"healthcare management," "hospital efficiency," "resource allocation," and "quality improvement." Inclusion criteria: Studies published in English or Indonesian, publication period 2020-2024, studies discussing economic evaluation in hospital operations, empirical studies with quantitative data, studies available in full-text.

Exclusion criteria: editorials, letters to the editor, or opinion pieces, studies without clear economic data, studies not specific to the hospital setting, duplicate publications. Two independent reviewers screened titles and abstracts, followed by a full-text review of articles that met the criteria. Discrepancies were resolved through discussion and consensus with a third reviewer. Data extracted included: Study characteristics (author, year, country), economic evaluation methodology, study setting and population, interventions evaluated, outcome measures, cost-effectiveness results. Study quality was assessed using the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) checklist to ensure adequate reporting standards.

4. RESULTS

Study Characteristics

From the initial search that yielded 1,247 articles, 25 studies met the inclusion criteria after a rigorous screening process. These studies came from various countries, with the majority from the United States (32%), followed by European countries (28%), and Asia Pacific (24%).

Types of Interventions Evaluated

The interventions evaluated in the selected studies can be categorized into five main groups:

1) Digital Health Interventions (36%)
    a) Electronic health information systems
    b) Telemedicine and telehealth
    c) Mobile health (mHealth) applications
2) Quality Improvement Collaboratives (28%)
    a) Service quality improvement programs
    b) Clinical pathway optimization
    c) Patient safety initiatives
3) Resource Management (20%)
    a) Staffing optimization
    b) Supply chain management
    c) Energy efficiency programs

4) Clinical Decision Support Systems (12%)
    a) Evidence-based clinical guidelines
    b) Decision support tools
    c) Predictive analytics
5) Infrastructure and Technology (4%)
    a) Medical equipment upgrades
    b) Facility improvements

Economic Evaluation Methodology

Most studies (72%) used cost-effectiveness analysis as the primary methodology, followed by cost-utility analysis (16%) and cost-benefit analysis (12%). The most commonly used perspective was the hospital perspective (48%), followed by the payer perspective (32%) and the societal perspective (20%).

Cost-Effectiveness Findings

Digital Health Interventions : Studies show that the implementation of digital health systems is generally cost-effective with favorable incremental cost-effectiveness ratios (ICERs). Martinez et al. (2023) reported that the implementation of electronic health records resulted in cost savings of $2.4 million per year with significant improvements in service quality.

Quality Improvement Collaboratives : Analysis shows variability in the cost-effectiveness of quality improvement programs. A study by Anderson & Brown (2024) found that quality improvement collaboratives produced an ICER of $15,000 per quality-adjusted life year (QALY), which is within the acceptable cost-effectiveness threshold.

Resource Management : Staffing optimization interventions show consistent results in operational cost savings. Lee et al. (2023) reported an 18% reduction in cost per patient day without compromising service quality.

Factors Affecting Cost Effectiveness

The analysis identified several key factors affecting the cost effectiveness of interventions: 1) Hospital Size: Hospitals with more than 400 beds tend to have better economies of scale. 2) Technology Level: Implementation of advanced technology requires a large initial investment but provides a positive long-term ROI. 3) Staff Engagement: The level of staff engagement in the implementation of interventions is positively correlated with cost effectiveness. 4) Leadership Support: Senior management support is a strong predictor of implementation success. implementasi

Challenges in Implementation

Studies identify several key challenges: a) Resistance to change (68% of studies), b) Limited financial resources (56% of studies), c) Complexity of system integration (44% of studies), d) Lack of expertise in economic evaluation (36% of studies)

5. DISCUSSION

Implications of Findings for Clinical Practice

The results of this systematic review show that health economic evaluation has become an integral component of hospital management decision-making. Consistent findings regarding the cost-effectiveness of digital health interventions are in line with the global trend of healthcare digitization, which has been accelerated by the COVID-19 pandemic (Roberts et al., 2024).

The success of quality improvement collaboratives in producing cost-effective outcomes underscores the importance of a systematic approach to improving service quality. This is consistent with the literature showing that investing in service quality can generate long-term savings through reduced readmission rates and medical errors (Davis & Wilson, 2023).

Methodological Variability

Despite consensus on the importance of economic evaluation, this study identified significant variability in the methodologies used. Differences in analytical perspectives, time horizons, and discount rates can affect the comparability of results across studies (Taylor et al., 2024). This emphasizes the need for standardized methodology guidelines in the context of hospital economic evaluation.

Stakeholder Perspectives

Analysis shows that the choice of economic evaluation perspective greatly influences results and policy recommendations. The hospital perspective tends to focus on direct costs and immediate outcomes, while the societal perspective provides a more comprehensive but more complex picture in its implementation (Kumar & Singh, 2023).

Sustainability and Scalability

Findings indicate that the sustainability of interventions is a major concern in long-term economic evaluations. Studies emphasize the importance of considering ongoing costs and maintenance requirements in the analysis (Thompson & Garcia, 2024). Scalability challenges are particularly evident in the implementation of advanced technologies in hospitals with resource constraints.

Indonesian Context

In the context of the Indonesian health system, these findings are particularly relevant

given the implementation of the JKN program and efforts to improve hospital efficiency. Adapting economic evaluation methodologies needs to consider the unique characteristics of the national health system, including case mix, payment systems, and the regulatory environment (Sari & Budiman, 2023).

Research Limitations

Several limitations should be acknowledged in this review: 1) Heterogeneity in study methodologies limits the possibility of meta-analysis, 2) Publication bias toward studies with positive results, 3) Limited representation of developing countries, 4) Variability in the quality assessment tools used, 5) Recommendations for Future Research

Recommendations for Future Research

Based on the findings, several priority areas for future research include: 1) Development of a standardized framework for hospital economic evaluation, 2) Long-term sustainability studies, 3) Comparative effectiveness research across different healthcare systems, 4) Integration of patient-reported outcomes dalam economic evaluation

6. CONCLUSION

This systematic review provides comprehensive evidence on the importance of health economic evaluation in optimizing hospital operations. Key findings indicate that:Intervention Diversity,Digital health interventions, quality improvement collaboratives, and resource management optimization demonstrate significant cost-effectiveness potential in hospital settings.Evaluation Methodology,Cost-effectiveness analysis remains the gold standard in hospital economic evaluation, despite variability in implementation and perspectives used.Determinant Factors,Hospital size, technology level, staff engagement, and leadership support are key factors that influence the successful implementation and cost-effectiveness of interventions.Sustainability Challenges,The sustainability and scalability of interventions are major concerns that need to be addressed in the planning and implementation of improvement programs.Standardization Needs,There is an urgent need for standardization of economic evaluation methodologies to improve the comparability and reliability of research results.

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