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Cost-Effectiveness Analysis of Telemedicine Implementation in the Management of Non-Communicable Diseases in Hospitals

Ahmad Farid Rivai[1], *Agus* Khurniawan[1] and *Firda* Mokodongan[1]

[1]Department of Public Health, Faculty of Health Sciences, Muhammadiyah Ahmad Dahlan University, Cirebon, West Java, Indonesia

Abstract. Non-communicable diseases (NCDs) remain the leading cause of morbidity and mortality, necessitating continuous and efficient care delivery. Telemedicine has emerged as an innovative approach to enhance healthcare accessibility, efficiency, and patient adherence. This study analyzes the cost-effectiveness of telemedicine implementation in managing chronic diseases within hospital settings using a mixed-method design with a sequential explanatory approach. Quantitative data were obtained through Cost-Effectiveness Analysis (CEA) of inpatient records for NCD patients over one semester, while qualitative insights were derived from in-depth interviews with hospital managers, Hospital Management Information System (HMIS) teams, and Electronic Medical Record (EMR) administrators. Findings indicate that telemedicine could potentially reduce 19 hospitalizations, with an incremental cost of IDR 134.1 million and an average Incremental Cost-Effectiveness Ratio (ICER) of IDR 7.1 million per avoided admission. The highest cost-effectiveness was observed in ischemic heart disease cases (ICER IDR 6.8 million), offering additional benefits such as time efficiency, shorter queues, and lower transportation costs. Nonetheless, barriers were identified in financing policies, human resource preparedness, and network infrastructure. In conclusion, telemedicine demonstrates relative cost-effectiveness in NCD management, particularly for ischemic heart disease and type 2 diabetes mellitus, highlighting the need for strengthened policies, infrastructure, and workforce capacity to support sustainable implementation.
Keywords: telemedicine, cost-effectiveness analysis, non-communicable diseases, incremental cost-effectiveness ratio, ischemic heart disease, type 2 diabetes mellitus, healthcare accessibility

1 Introduction

Non-communicable diseases (NCDs) such as diabetes, hypertension, ischaemic heart disease, and chronic kidney disease are the leading causes of morbidity and mortality in Indonesia. According to the Global Burden of Disease, NCDs account for more than 73% of global deaths and require continuous services with long-term management [1,2]. Significant challenges arise due to limited access to services, the burden of transportation costs, and long waiting times for patients at healthcare facilities [3,4]. This situation highlights the need for service innovations that can improve efficiency without compromising service quality.

Telemedicine is a strategic innovation in digital health services that enables remote interaction between patients and healthcare professionals through information technology [5]. Studies show that telemedicine effectively improves patient compliance with therapy, speeds up diagnosis, and reduces hospitalisation rates [6,7]. In hospital management, telemedicine serves as a medical communication tool and an efficiency strategy through the integration of Hospital Management Information Systems (HMIS) and Electronic Medical Records (EMR) [8,9].

However, the implementation of telemedicine in Indonesia still faces a number of obstacles. In terms of infrastructure, the uneven distribution of internet networks and limited digital devices are major obstacles in non-urban areas [10,11]. In terms of regulation, unclear financing policies and insurance claim mechanisms remain barriers to the integration of telemedicine services into the

national financing system [12-14]. The readiness of human resources and the low digital literacy of health workers also influence the success of programme implementation [15,16].
From a health economics perspective, telemedicine offers potential cost efficiencies through reduced frequency of hospital visits and prevention of complications due to delayed treatment[17-19]. Cost-Effectiveness Analysis (CEA) is a relevant approach to assess the ratio between the additional costs of implementing telemedicine and the resulting health benefits [20,21]. International studies report that telemedicine can reduce the cost burden of hospitalisation by 20–30% through a decrease in rehospitalisation rates [22-24]. However, similar empirical evidence in Indonesia is still very limited, especially in regional hospitals that face resource and financing regulation constraints [25,26].

From a hospital administration perspective, cost-effectiveness analysis of telemedicine is important for assessing the efficiency of technology investments in terms of human resources, medical equipment, and service time [27,28]. Several studies in developed countries show that telemedicine produces a lower incremental cost-effectiveness ratio (ICER) than conventional services, particularly for heart disease and diabetes [29,30]. However, in the Indonesian context, similar studies have not been widely conducted, even though the results have the potential to form the basis for the formulation of digital health financing policies in hospitals [31,32].

Based on these gaps, this study aims to analyse the cost-effectiveness of implementing telemedicine in the management of chronic diseases in hospitals. The CEA approach is combined with qualitative methods to understand the perceptions of hospital managers, HMIS teams, and EMR managers regarding implementation readiness. The results of this study are expected to provide a scientific basis for policymakers in developing efficient, sustainable telemedicine that is appropriate to the context of healthcare services in Indonesia.

2 Methods

This research method uses a mixed-methods design with a sequential explanatory approach, beginning with quantitative analysis and continuing with qualitative analysis. In the quantitative stage, a simulation-based cost-effectiveness analysis (CEA) was conducted, comparing the costs of conventional services with the estimated costs of implementing telemedicine using secondary data from the medical records of NCDs patients and standard rates based on the relevant Minister of Health Regulation (Permenkes) on INA-CBGs. This approach was used because telemedicine has not yet resumed operations after the COVID-19 pandemic, so empirical data on actual costs is not yet available. The simulation model allows researchers to estimate the potential cost efficiency that can be achieved if telemedicine services are reimplemented in hospitals.

The analysis was conducted by calculating the ICER using Microsoft Excel software in accordance with health economic analysis guidelines. Quantitative indicators included the number of NCDs patient admissions, inpatient costs based on INA-CBG, telemedicine programme investment and operational costs, and estimated savings from avoided inpatient costs. The qualitative stage was conducted through in-depth interviews with three hospital managers, the HMIS team, and EMR administrators to explore perceptions, barriers, and readiness for the implementation of telemedicine in the future. Qualitative analysis was conducted using a thematic approach following procedures to strengthen the interpretation of quantitative results and provide a relevant policy context for the development of telemedicine in hospitals..

3 Results And Discussion

3.1 Quantitative Data: Cost-Effectiveness Analysis

This study analyzed the cost-effectiveness of telemedicine implementation in chronic disease management using a Cost-Effectiveness Analysis (CEA) and qualitative exploration of stakeholder perceptions. A total of 1,682 outpatient visits for chronic diseases were recorded during the study

period, representing 561 unique patients and 183 hospitalizations. The quantitative results are presented in Table 1, showing the estimated impact of telemedicine implementation on hospitalization rates, costs, and efficiency for various non-communicable diseases (NCDs).

Table 1. Impact of Telemedicine on Hospitalization Rates, Costs, and Efficiency

Diagnosis	Baseline Admissions	After Telemedicine	Admissions Avoided	Program Cost (IDR)	Incremental Cost (IDR)	ICER (IDR/admission avoided)
Kidney Failure	9	8	1	71,900,000	+62,900,000	62,900,000
Type 2 Diabetes	8	7	1	34,400,000	+29,000,000	29,000,000
Ischemic Heart	6	5	2	27,200,000	+13,600,000	6,800,000
Hypertension	4	4	≈0.4	16,800,000	+15,200,000	~37,000,000
Ischemic Stroke	5	5	0.5	19,400,000	+13,400,000	~26,800,000
Total/Average	183 → ~164		19	169,700,000	+134,100,000	7,100,000

The results show an average ICER of IDR 7.1 million per admission avoided, indicating that telemedicine is cost-effective compared to conventional inpatient care, which costs around IDR 8–12 million per admission. The most cost-effective outcome was found in ischemic heart disease (ICER IDR 6.8 million), followed by type 2 diabetes mellitus (ICER IDR 29 million). Although the program increased expenditure by IDR 134.1 million, this was offset by avoided hospitalizations and improved service efficiency, suggesting long-term cost savings.

3.2 Qualitative Data: Stakeholder Perceptions

Qualitative findings support these quantitative results. The thematic analysis (Figure 1) shows the relationship between data sources (hospital managers, HMIS team, and EMR administrators) and the main themes. Hospital managers were most associated with codes related to strategy, benefits, readiness, and obstacles, underscoring the importance of managerial leadership in telemedicine implementation. The HMIS and EMR teams were more related to technical aspects such as data recording, integration, security, and network stability.

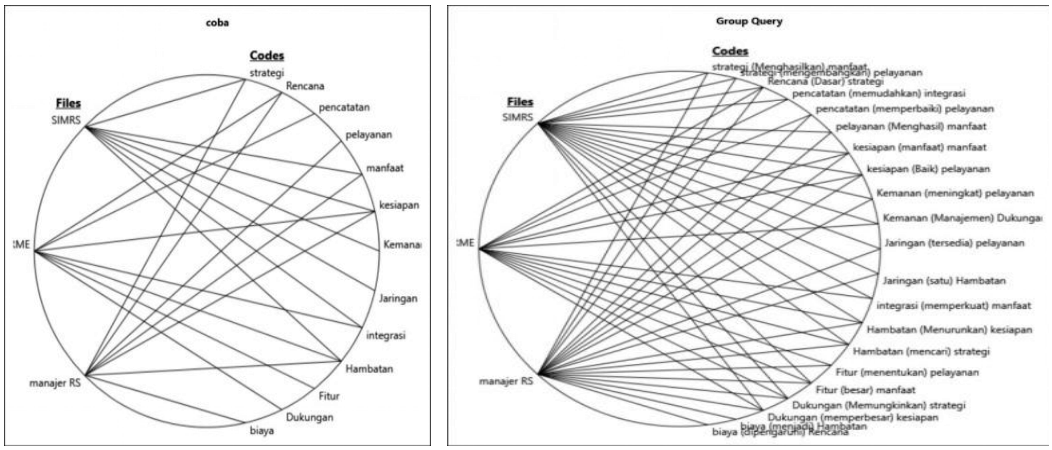

Fig. 1. Chart of Data Source-Main Theme Relationships

Interview results identified five key themes:

a. Benefits: faster services, reduced queues, lower transmission risks, and cost/time savings.
b. Readiness: trained human resources and EMR-HMIS integration since 2021, though infrastructure remains limited.
c. Barriers: financing regulation gaps, poor network capacity, limited servers, and adaptation challenges.
d. Solutions: improved network quality, HR training, third-party partnerships, and service socialization.
e. Future plans: Ciremai Hospital aims to develop an integrated telemedicine application aligned with health digitalization trends.

Integrating both quantitative and qualitative findings, the CEA demonstrates that telemedicine is economically advantageous, particularly in ischemic heart disease, with a cost per avoided admission lower than conventional inpatient costs. The qualitative insights reveal that sustainability requires regulatory clarity, funding support, and improved infrastructure. These findings are consistent with global evidence that telemedicine reduces costs and enhances access but depends on managerial leadership and technological readiness.

In summary, telemedicine is relatively cost-effective and beneficial in managing non-communicable diseases, especially ischemic heart disease and type 2 diabetes mellitus. However, its long-term success requires robust financing policies, adequate digital infrastructure, and ongoing capacity-building for healthcare personnel. Although the study is limited to one hospital and one semester, the evidence provides a valuable foundation for policy development and multicenter research to strengthen telemedicine's role in Indonesia's digital health transformation.

4 Conclusion

This study shows that simulating the implementation of telemedicine in chronic disease management has the potential to be cost-effective, as indicated by a lower ICER value compared to conventional hospitalisation costs, as well as its contribution to reducing the need for hospitalisation. In addition to direct cost efficiency, telemedicine also provides significant benefits in improving access to services, speeding up clinical processes, and reducing the logistical burden on patients. The success of implementation is highly dependent on synergy between hospital management, human resource readiness, and adequate technological infrastructure support. These findings provide scientific justification that telemedicine can be an effective strategy in the transformation of hospital health services in the digital era, as well as a basis for developing more sustainable service financing and governance models. This research opens up opportunities for the wider and multicentre application of telemedicine to generate more comprehensive evidence and strengthen its contribution to the efficiency of the national healthcare system.

Hospitals need to establish telemedicine as a chronic disease management strategy, supported by clear financing regulations, adequate digital infrastructure, and human resource training. Managerial leadership must encourage cross-unit coordination, while the government and financing parties are involved in joint funding. Multicentre research is recommended to evaluate the impact of telemedicine on cost efficiency and service quality.

References

1. World Health Organization. Noncommunicable diseases country profiles 2023. WHO Press (2023).
2. Institute for Health Metrics and Evaluation. Global burden of disease study 2024 results. University of Washington (2024).
3. Riyanto A. Faktor-faktor yang mempengaruhi pelaksanaan telemedicine (systematic review). J Manaj Inf Kesehat Indones 9, 174–183 (2021).

4. Syamsuddin S. Implementasi telemedicine dan implikasinya terhadap akses serta kualitas pelayanan kesehatan di komunitas pedesaan: Mini review. J Ilm Kesehatan Digital 1, 117–123 (2024).
5. Anawade PA, Sharma D, Gahane S. A comprehensive review on exploring the impact of telemedicine on healthcare accessibility. Cureus 16, e55996 (2024).
6. Muzzamil M, Saeed T, Khalid R. Patient perspectives and utilization of telemedicine for chronic conditions in Pakistan: Barriers and facilitators. Discover Public Health 3, 55–66 (2025).
7. Tolu-Akinnawo O, Ezekwueme F, Awoyemi T. Telemedicine in cardiology: Enhancing access to care and improving patient outcomes. Cureus 16, e62852 (2024).
8. Paramarta V, Dewi S, Sari N. Analisis biaya investasi sistem informasi manajemen rumah sakit (SIMRS). Comserva 3, 4135–4144 (2024).
9. Rimbun LR, Marisi ELD, Hidayati T. Tantangan keamanan data dalam telemedicine: Implikasi terhadap privasi dan kepercayaan pasien dalam layanan kesehatan digital. Mahesa 4, 1–23 (2024).
10. Lance A, Gillespie CM. E-Health and telemedicine in otolaryngology: Risks and rewards. J Otolaryngol Pract 18, 201–210 (2021).
11. Sitanggang AS, Wibowo DS, Hutagalung R. Telemedicine: Revolusi akses dan efisiensi pelayanan kesehatan di era digital. Nusantara J Multidiscip Sci 2, 12–18 (2024).
12. Lee NT, Karsten J, Roberts J. Removing regulatory barriers to telehealth before and after COVID-19. Brookings Institution Report (2020).
13. Garber K, Amon S, Patel A, McConnell J. Telehealth policy and the advanced practice nurse. J Nurse Pract 19, 104655 (2023).
14. Heriani I, Adlina NA. Aspek hukum telemedicine di Indonesia: Tantangan dan peluang dalam era digital. Indones J Islamic Jurisprud Econ Legal Theory 2, 1398–1405 (2024).
15. Arora S, Sharma M, Taneja P, Dutta S. Challenges, barriers, and facilitators in telemedicine implementation in India: A scoping review. Cureus 16, e67388 (2024).
16. Candra M, Paramarta V, Putra D. Pengembangan sistem telemedicine: Upaya mewujudkan kesejahteraan masyarakat di era society 5.0. J Kesehatan Digital 8, 294–303 (2024).
17. Henderson C et al. Cost effectiveness of telehealth for patients with long-term conditions: A cluster randomized controlled trial. BMJ 346, f1035 (2013).
18. Snoswell CL, Taylor ML, Caffery LJ. Determining if telehealth can reduce health system costs: A scoping review. J Med Internet Res 22, e17298 (2020).
19. Almalki ZS, Alobaylan MM, Alswat KA, Alsubaie SA, Alghamdi SA. The influence of telemedicine in primary healthcare on diabetes mellitus control and treatment adherence in Riyadh region. Saudi Pharm J 32, 101920 (2024).
20. de Jong MJ, van Tilburg SB, Hillegers MH. Cost-effectiveness of telemedicine-directed specialized vs standard care for patients with inflammatory bowel diseases in a randomized trial. Clin Gastroenterol Hepatol 18, 1744–1752 (2020).
21. Maida E, Sessa F, Calabrò RS. Cost-analysis of telemedicine interventions compared with traditional care in the management of chronic neurological diseases: A systematic review. Telemed e-Health 30, 404–414 (2023).
22. Le Goff-Pronost M, Boucherie Q, Blanchon T. Real-world clinical evaluation and costs of telemedicine for chronic wound management. Int J Technol Assess Health Care 34, 567–575 (2018).
23. Jiménez-Marrero S, Llopis J, García-González G. Impact of telemedicine on clinical outcomes and healthcare costs of patients with chronic heart failure. J Telemed Telecare 26, 64–72 (2020).
24. Oksman E, Linna M, Lammintakanen J. Cost-effectiveness analysis for a tele-based health coaching program for chronic disease in primary care. BMC Health Serv Res 17, 138 (2017).

25. Azhar Jaya. Pengembangan telemedicine guna mendukung pelayanan kesehatan masyarakat. Lembaga Ketahanan Nasional Republik Indonesia (2023).
26. Ferdian FR, Paramartha V, Sanggabuana U. Analisis cost-benefit pelayanan telemedicine untuk penanganan penyakit kronis. J Adm Kesehatan 7, 17–23 (2024).
27. Bertoncello C, Colucci M, Baldovin T, Buja A, Baldo V. How does it work? Factors involved in telemedicine home-interventions effectiveness: A review of reviews. PLoS ONE 13, e0207332 (2018).
28. Williams OE, Armoogum J, Morris J. The use of telemedicine to enhance secondary care: Some lessons from the front line. Future Healthc J 4, 109–123 (2017).
29. Wootton R. Twenty years of telemedicine in chronic disease management: An evidence synthesis. J Telemed Telecare 18, 211–220 (2012).
30. Haleem A, Javaid M, Singh RP, Suman R. Telemedicine for healthcare: Capability, feature, barrier, and applications. J Ind Integr Manag 5, 1–22 (2020).
31. Ezeamii VC, Uchenna I, Nwachukwu E. Revolutionizing healthcare: How telemedicine is improving patient outcomes and expanding access to care. Cureus 16, e63881 (2024).
32. Anasulfalah H, Wibowo JT, Wardani R, Widiyanto A, Atmojo JT. Peran telemedicine dalam peningkatan kepuasan pasien: Tinjauan literatur. J Language Health 3, 71–78 (2022).