

Organizational and infrastructural modeling of telemedicine services in Ukraine

Serhii Riabkov

Kyiv University of Market Relations, Kyiv
<https://orcid.org/0009-0003-3146-7260>

Olena Borodina

Kyiv University of Market Relations, Kyiv
<https://orcid.org/0000-0002-9028-8268>

Abstract. *The article provides a substantiation of telemedicine as a strategic instrument for modernizing Ukraine's health care system under the conditions of war and post-war reconstruction. The study justifies the organizational and infrastructural modeling of three architectures for telemedicine service delivery—centralized, decentralized, and hybrid—and demonstrates the economic feasibility of the hybrid model as the optimal solution for enhancing macroeconomic efficiency, ensuring sustainable development of health service provision, and facilitating Ukraine's integration into the European digital ecosystem.*

Keywords: *telemedicine, economic efficiency, organizational and infrastructural modeling, digital health care, hybrid architecture, system resilience, eHealth, digital transformation.*

Modernization of the health care system through the implementation of telemedicine is presented as a strategic socio-economic instrument for Ukraine under the conditions of war and post-war reconstruction. It ensures improved accessibility of medical care, reduction of expenditures, and increased resilience of the health care network. Integration with the Unified Electronic Health Care System (eHealth) and alignment with EU data protection requirements establish the foundation for an interoperable digital ecosystem. In this context, telemedicine is considered not merely as a technology but as an organizational and economic model capable of influencing labor productivity, cost-efficiency, and macroeconomic indicators. The purpose of the study was to develop a comprehensive organizational and infrastructural approach to modeling the delivery of telemedicine services in Ukraine and to assess the economic feasibility of three architectures: centralized, decentralized, and hybrid. Additionally, the research aimed to measure the potential macroeconomic effect in the medium-term perspective. The research methodology combined: (1) comparative analysis of international practices [1, 2, 3, 4, 6, 7, 11]; (2) systemic modeling of data, service, and financial flows; and (3) economic evaluation using the discounted cash flow (DCF) method, with calculations of net present value (NPV), internal rate of return (IRR), and break-even point. The analysis horizon was set at 5 years, with varying discount rates of 5–15% and implementation levels covering 20%, 50%, and 80% of the population.

Sensitivity analysis was conducted with respect to tariffs (200–400 UAH per teleconsultation), discount rates, and penetration levels. The analysis of organizational models revealed the following: the centralized model assumes a national telemedicine hub with unified registries and security policies. It is highly manageable and scalable but requires substantial capital expenditures (CAPEX) and carries the risk of a single point of failure. The decentralized model is based on regional hubs, ensuring resilience and adaptability; however, it increases operational expenditures (OPEX) and complicates interoperability. The hybrid model combines a centralized core with regional hubs, balancing manageability and flexibility while reducing risks and maintaining deployment speed. A comparative review of international practices demonstrated the following: in the United States, Medicare and Medicaid have established sustainable financing mechanisms for telemedicine [2]; in the United Kingdom, large-scale deployment of remote consultations has been achieved [3]; the German approach secured reimbursement for digital applications [5]; the Ontario Telemedicine Network in Canada demonstrated the effectiveness of regional hubs [6]; and Estonia's system provides an exemplary model of interoperability [7]. This synthesis has been adopted as a recommended framework for localization in Ukraine. The conducted discounted cash flow (DCF) analysis indicates that the centralized architecture requires the highest initial investment (CAPEX) but later maintains moderate OPEX. The decentralized system demands constant operational expenditures and results in a lower internal rate of return (IRR). By contrast, the hybrid model achieves a positive net present value (NPV) by the fifth year at 50% population coverage, while its IRR exceeds 12% at a 10% discount rate. Generalized sensitivity profile parameters of the hybrid model's NPV are presented in Figure 1.

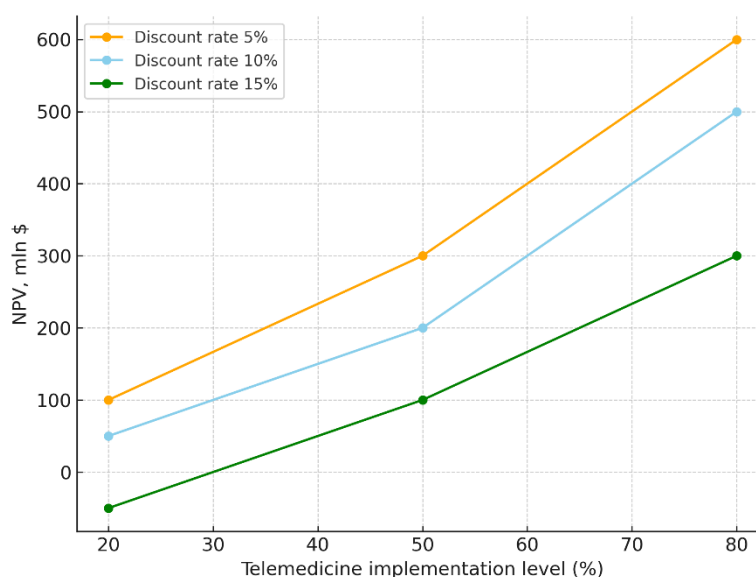


Fig. 1. NPV Sensitivity Matrix (discount rates 5/10/15% × coverage levels 20/50/80%)

Source: compiled by the author.

International data confirm a 10–25% reduction in expenditures for chronic patients and an approximately 20% decrease in hospitalizations due to remote patient monitoring (RPM) and teleconsultations. The combined savings in time and reduction of indirect costs generate an additional contribution to GDP (+0.3–0.5% annually) [8, 9]. For Ukraine, under the 50% implementation scenario, the integrated effect is estimated at 1–1.5% of GDP annually, as illustrated in Figure 2.

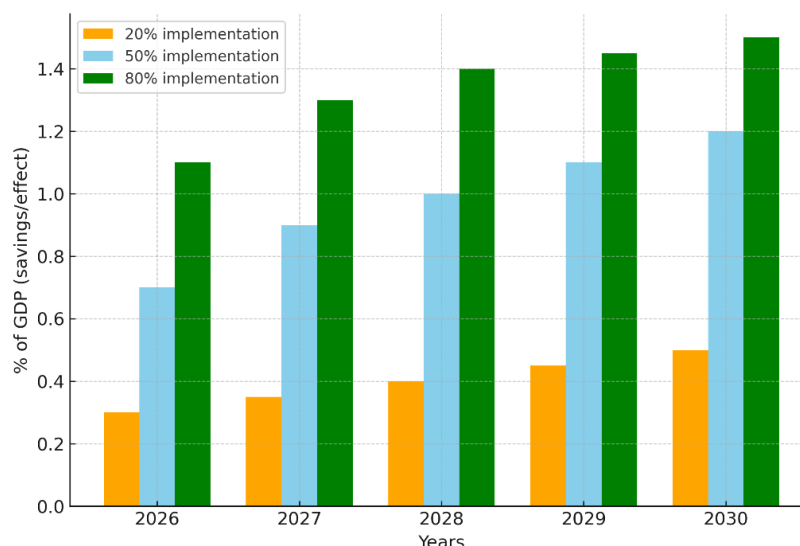


Fig. 2. Projected Integral Macroeconomic Effect of Telemedicine (2026–2030)

Source: compiled by the author.

The presented calculations are scenario-based and rely on scaling international data to the Ukrainian context. At the same time, certain limitations are inherent to wartime statistics; financial outcomes remain sensitive to tariff policies and reimbursement mechanisms; and sociocultural barriers (digital literacy, trust, and staff readiness) have not been fully quantified. Military-logistical risks and cybersecurity threats further add to the uncertainty. In this regard, the hybrid architecture emerges as the most appropriate option for Ukraine: it integrates centralized standards, data protection, and analytics with regional autonomy and resilience. The model demonstrates a positive NPV and an IRR exceeding 12% under the 50% coverage scenario, reduces single-point-of-failure risks, and facilitates integration into the European Health Data Space (EHDS).

Thus, telemedicine should be regarded as a key component of national health policy and sustainable economic development.

References

1. World Health Organization. (2023). Consolidated telemedicine implementation guide. Geneva: WHO. Available at: <https://www.who.int/publications/i/item/9789240059184> (accessed October 20, 2025).

2. U.S. Department of Health & Human Services. (2025, January 17). Medicare and Medicaid policies – Telehealth. Telehealth.HHS.gov. Available at: <https://telehealth.hhs.gov/providers/telehealth-policy/medicare-and-medicare-policies> (accessed October 20, 2025).
3. NHS England. (2025). Remote consulting. London: NHS. Available at: <https://www.england.nhs.uk/long-read/remote-consulting/> (accessed October 20, 2025).
4. Centers for Medicare & Medicaid Services. (2025). Telehealth & Remote Patient Monitoring (MLN901705). Baltimore, MD: CMS. Available at: <https://www.cms.gov/files/document/mln901705-telehealth-remote-patient-monitoring.pdf> (accessed October 20, 2025).
5. Federal Institute for Drugs and Medical Devices (BfArM). (2025). Digital Health Applications (DiGA). Bonn: BfArM. Available at: <https://gesund.bund.de/en/digital-health-applications-diga#further-information> (accessed October 20, 2025).
6. Ontario Telemedicine Network. (2019). EAPC evaluation report. Toronto: OTN. Available at: <https://otn.ca/wp-content/uploads/2019/08/eapc-evaluation-report.pdf> (accessed October 20, 2025).
7. e-Estonia. (2024). e-Health Record. Tallinn: e-Estonia. Available at: <https://e-estonia.com/solutions/e-health-2/e-health-records/> (accessed October 20, 2025).
8. Neves, A. L., Li, E., Gupta, R., Fontana, G., Darzi, A., & Mayer, E. (2022). Economic evaluation of digital health interventions: Systematic review. *Frontiers in Public Health*, 10, 787135. Available at: <https://doi.org/10.3389/fpubh.2022.787135> (accessed October 20, 2025).
9. Tomini, S.M., Massou, E., Crellin, N.E. et al. A Cost Evaluation of COVID-19 Remote Home Monitoring Services in England. *PharmacoEconomics Open* 8, 739–753 (2024). Available at: <https://doi.org/10.1007/s41669-024-00498-3> (accessed October 20, 2025).
10. European Commission. (2022). Impact assessment on the European Health Data Space (EHDS). Brussels: EC. Available at: https://health.ec.europa.eu/system/files/2022-05/ehealth_ehds_2022ia_1_en_0.pdf (accessed October 20, 2025).
11. OECD. (2023). Health at a glance 2023: Digital health. Paris: OECD. Available at: https://www.oecd.org/en/publications/2023/11/health-at-a-glance-2023_e04f8239/full-report/digital-health_d79d912b.html (accessed October 20, 2025).

