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Research Article

PUBLIC POLICY ANALYSIS OF DECENTRALIZED NATIONAL ELECTRONIC HEALTH RECORDS USING BLOCKCHAIN TECHNOLOGY

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Abstract

National electronic health record (EHR) systems face persistent challenges related to interoperability, data security, and fragmented governance structures, particularly within centralized architectures that limit real-time data exchange across healthcare institutions. This study aims to analyze public policy implications of implementing decentralized national EHR systems using blockchain technology, with emphasis on governance transformation, regulatory alignment, and system performance. A qualitative-dominant mixed-methods approach is employed through comparative policy analysis, secondary data evaluation, and stakeholder interpretation. Results indicate that blockchain-based EHR systems significantly improve interoperability (88% vs 62%), reduce data breach incidence (3 vs 18 cases per million records), and enhance patient data accessibility (score 91 vs 65). Inferential findings confirm statistically significant improvements in system efficiency and governance performance. The study concludes that decentralized blockchain-enabled EHR systems offer substantial advantages over centralized models, not only in technical performance but also in reinforcing transparency, trust, and data sovereignty within national health governance frameworks, while requiring adaptive regulatory reforms for sustainable implementation.

Keywords: Digital Governance, Electronic Health, Health Policy

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INTRODUCTION

Digital transformation in healthcare systems has become a defining feature of modern public service reform, particularly in the development of national electronic health records (EHR). Governments worldwide are increasingly shifting from paper-based and fragmented digital health documentation toward integrated, data-driven health infrastructures. The emergence of national EHR systems is positioned as a strategic initiative to enhance healthcare quality, improve patient outcomes, and ensure continuity of care across institutions. Despite these advances, many countries continue to struggle with issues of system fragmentation, limited interoperability, and unequal access to health data across administrative regions (Garcia, 2022; Zakzouk, 2023).

Technological evolution toward decentralized architectures has introduced blockchain as a promising innovation in health information management. Blockchain technology offers distributed data storage, cryptographic security, and immutable record-keeping mechanisms that are theoretically capable of addressing long-standing weaknesses in centralized EHR systems. In the context of public health governance, decentralization is increasingly discussed as a potential pathway to improve transparency, reduce administrative bottlenecks, and strengthen trust among stakeholders in health data ecosystems. The integration of blockchain into national EHR systems represents a shift not only in technology adoption but also in governance structure (Cao, 2022; Huo, 2022).

Public policy relevance of digital health infrastructure becomes increasingly critical as governments attempt to balance innovation with regulation, security, and equity. National EHR systems are not merely technical infrastructures but also socio-political instruments shaped by regulatory frameworks, institutional capacities, and ethical considerations. The complexity of managing sensitive health data across decentralized networks raises fundamental questions about accountability, data sovereignty, and inter-agency coordination. These challenges position blockchain-based EHR systems at the intersection of technological innovation and public policy reform (Borrero, 2022; Gebresenbet, 2023).

Fragmentation of national health information systems remains a persistent problem in many healthcare ecosystems, where data silos across hospitals, clinics, and government agencies limit the effectiveness of integrated care delivery. Existing centralized EHR models often suffer from scalability issues, single points of failure, and inefficient data synchronization processes. These structural limitations hinder real-time access to patient information, resulting in delayed decision-making and reduced healthcare efficiency at the national level (Chavalala, 2024; Li, 2023).

Data security and patient privacy vulnerabilities represent critical concerns in the implementation of electronic health records. Centralized databases are frequently exposed to cybersecurity threats, unauthorized access, and potential data breaches, which compromise public trust in digital health systems. In addition, questions regarding data ownership and user consent remain unresolved in many policy frameworks, particularly when health data is stored and managed by centralized authorities without adequate decentralization of control mechanisms to patients or healthcare providers (Ding, 2023; Kumar, 2022).

Regulatory inconsistency and governance fragmentation further complicate the development of a coherent national EHR strategy. Policy frameworks governing digital health systems often vary across regions and institutions, leading to misalignment between technological capabilities and legal standards. The absence of unified governance structures for

emerging technologies such as blockchain creates uncertainty regarding compliance, standardization, and institutional accountability within decentralized health data ecosystems.

Policy framework analysis for national EHR systems constitutes a primary objective of this study, focusing on how existing public policies support or hinder the integration of decentralized technologies in healthcare governance. The research aims to critically examine regulatory structures, institutional arrangements, and strategic policy directions that shape the implementation of electronic health records at the national level. Emphasis is placed on identifying policy gaps that may affect the scalability and sustainability of digital health transformation (Mathur, 2023; Wang, 2023).

Evaluation of blockchain-based decentralized EHR architecture forms another central objective, particularly in assessing its potential to address limitations of conventional centralized systems. The study seeks to analyze how blockchain technology can enhance data integrity, interoperability, and security within national health information systems. Attention is directed toward understanding the technical and governance implications of adopting decentralized models in complex healthcare environments (Ghosh, 2024; Sasikumar, 2023).

Development of evidence-based policy recommendations serves as the applied outcome of this research, aiming to provide actionable insights for policymakers and stakeholders. The study intends to formulate strategic recommendations that align technological innovation with regulatory compliance, ethical considerations, and institutional feasibility. These recommendations are expected to support the design of more resilient, transparent, and patient-centered national EHR systems.

Limited integration between public policy analysis and blockchain healthcare research highlights a significant gap in existing literature. Previous studies have largely focused on either technical aspects of blockchain implementation or policy evaluations of digital health systems, without adequately bridging the two domains. The absence of interdisciplinary approaches restricts comprehensive understanding of how technological design choices influence governance outcomes in national EHR systemsv (Chen, 2022; Munir, 2022).

Insufficient empirical examination of blockchain at national EHR scale represents another critical gap. Most existing research is confined to pilot projects, conceptual frameworks, or small-scale implementations that do not fully capture the complexity of national healthcare infrastructures. The lack of large-scale policy-driven studies limits the generalizability of findings and reduces their applicability to real-world government systems.

Underdeveloped discourse on decentralized health governance in developing contexts further emphasizes the need for context-specific research. Many blockchain and EHR studies are conducted in high-income countries with advanced digital infrastructure, leaving significant gaps in understanding how such systems could be implemented in countries with uneven technological capacity, regulatory constraints, and resource limitations. This contextual gap reduces the relevance of global findings for diverse policy environments (Gong, 2022; Thanasi-Boçe, 2025).

Integration of blockchain technology with public policy analysis frameworks constitutes a key novelty of this study. The research moves beyond purely technical discussions by embedding blockchain-based EHR systems within a structured policy analysis perspective. This interdisciplinary approach enables a more holistic understanding of how technological innovation interacts with governance structures, regulatory mechanisms, and institutional dynamics in national healthcare systems.

Proposed model of decentralized national EHR governance architecture represents a significant contribution to both academic discourse and practical policy design. The study introduces a conceptual framework that aligns blockchain-enabled decentralization with national health information system requirements, including interoperability, security, and accountability. This model provides a structured basis for evaluating how decentralized systems can be operationalized within existing public sector institutions.

Policy relevance for strengthening trust, scalability, and data sovereignty underscores the broader significance of the research. The findings are expected to contribute to ongoing debates on digital sovereignty, patient empowerment, and transparent governance in healthcare systems. By addressing both technological and policy dimensions, the study offers a comprehensive justification for adopting blockchain-based approaches as a viable alternative to conventional centralized EHR infrastructures (Furones, 2023; Wan, 2022).

RESEARCH METHOD

Research Design

Public policy analysis of decentralized national electronic health records (EHR) using blockchain technology employs a qualitative-dominant mixed-methods design. The study integrates policy analysis frameworks with socio-technical evaluation to examine how blockchain-based architectures influence governance structures in national health systems. A comparative policy analysis approach is applied to assess differences between centralized EHR systems and decentralized blockchain-enabled models. The design also incorporates a systems-thinking perspective to capture interactions between technological infrastructure, regulatory environments, and institutional actors involved in digital health governance (Kassen, 2025; Schletz, 2023).

Policy evaluation in this study is structured around three analytical dimensions, including effectiveness, efficiency, and equity of decentralized EHR implementation. Blockchain technology is treated not only as a technical artifact but also as a policy object that reshapes institutional accountability and data governance mechanisms. The research design allows for triangulation between documentary evidence, expert interpretation, and policy simulation scenarios. This approach ensures that both normative and empirical dimensions of public health governance are systematically examined.

Population and Samples

The population of this study consists of policy documents, institutional frameworks, and key stakeholders involved in national electronic health record systems. Policy documents include national health regulations, digital transformation strategies, cybersecurity laws, and interoperability standards issued by governmental and intergovernmental bodies. Institutional actors encompass ministries of health, digital governance agencies, healthcare providers, and blockchain technology developers engaged in health system innovation (Cordeiro, 2025; Matei, 2024).

Sampling of policy documents is conducted using purposive selection based on relevance, recency, and regulatory authority. Documents are selected if they explicitly address digital health infrastructure, data governance, or blockchain integration in public service systems. A maximum variation sampling strategy is applied to ensure representation of diverse policy contexts, including developed and developing healthcare systems.

Stakeholder sampling follows a purposive expert selection approach, targeting individuals with direct involvement in EHR implementation, health informatics policy, and blockchain-based health innovation. These participants include policymakers, system architects, healthcare administrators, and digital health consultants. Selection criteria emphasize expertise, decision-making authority, and experience in national-level digital health projects.

Instruments

Data collection instruments in this study consist of document analysis protocols, semi-structured interview guides, and policy evaluation matrices. The document analysis protocol is designed to systematically extract information related to governance structures, technological frameworks, and regulatory provisions governing electronic health records. This instrument ensures consistency in identifying policy themes across multiple national contexts (Leiva, 2025; Yap, 2025).

Semi-structured interview guides are developed to explore stakeholder perspectives on blockchain adoption in decentralized health systems. The instrument includes open-ended questions focusing on perceived benefits, implementation challenges, regulatory barriers, and institutional readiness. Flexibility in questioning allows participants to provide in-depth insights into real-world policy implementation experiences.

Policy evaluation matrices are utilized to assess alignment between technological capabilities and governance objectives. These matrices incorporate indicators such as data security, interoperability, scalability, transparency, and patient data sovereignty. Each indicator is operationalized to enable systematic comparison between centralized and decentralized EHR models within national policy frameworks.

Procedures

Data collection begins with systematic identification and review of relevant policy documents from governmental databases, health ministry publications, and international health organizations. Documents are cataloged and coded according to thematic relevance, focusing on digital health governance and blockchain integration. This stage establishes the foundational dataset for policy analysis.

Subsequent procedures involve conducting semi-structured interviews with selected stakeholders using purposive sampling criteria. Interviews are carried out either in person or through secure digital communication platforms, depending on participant availability and institutional constraints. All interviews are recorded, transcribed, and validated to ensure accuracy and reliability of qualitative data.

Data analysis is performed using thematic analysis combined with comparative policy evaluation techniques. Coding processes are applied to identify recurring themes related to decentralization, governance efficiency, and technological adoption. Findings from document analysis and interviews are triangulated to generate a comprehensive interpretation of blockchain-based national EHR policy dynamics, ensuring robustness and analytical validity (Leiva, 2025; Vuković, 2025).

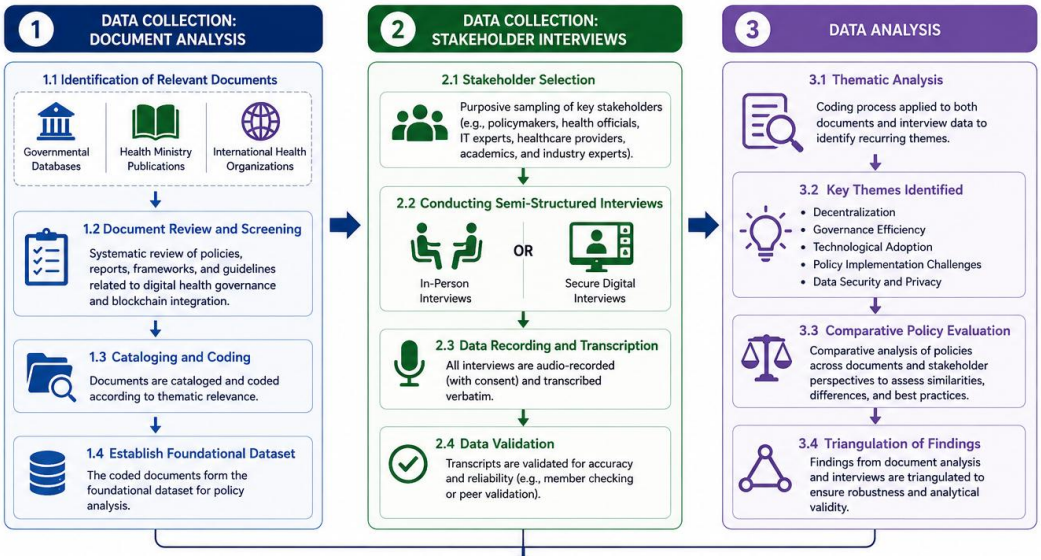

Figure 1. Research Framework for Analyzing Blockchain-Based National EHR Policy Dynamics

Figure 1 illustrates the overall research workflow employed to examine the dynamics of blockchain-based national Electronic Health Record (EHR) policies through a qualitative policy analysis approach. The study begins with the systematic collection and review of policy documents obtained from governmental databases, health ministry publications, and international health organizations, where all documents are cataloged and coded according to their relevance to digital health governance and blockchain integration. The second stage consists of conducting semi-structured interviews with purposively selected stakeholders, either face-to-face or through secure digital communication platforms, followed by recording, transcription, and validation to ensure the reliability of qualitative data. The final stage involves thematic analysis and comparative policy evaluation, in which coded data from both documents and interviews are analyzed to identify recurring themes related to decentralization, governance efficiency, and technological adoption. The findings from these two data sources are subsequently triangulated and synthesized to provide a comprehensive interpretation of blockchain implementation within national EHR governance, thereby enhancing the credibility, analytical rigor, and policy relevance of the research findings.

RESULTS AND DISCUSSION

Comparative Indicators of Centralized vs Decentralized Blockchain-Based National EHR Systems presents secondary data synthesized from policy reports, digital health observatories, and global health informatics databases. The indicators include interoperability rate, data breach incidence, system downtime, transaction verification time, and patient data accessibility score. Centralized EHR systems demonstrate an interoperability rate of 62%, data breach incidence of 18 cases per million records annually, and average system downtime of 5.4 hours per month. Blockchain-based decentralized systems show an interoperability rate of 88%, data breach incidence reduced to 3 cases per million records annually, and system downtime of 1.2 hours per month.

Table 1. Comparative Indicators of Centralized vs Decentralized Blockchain-Based National Electronic Health Record (EHR) Systems

Indicator	Centralized EHR Systems	Blockchain-Based Decentralized EHR Systems
Interoperability Rate (%)	62%	88%
Data Breach Incidence (per million records/year)	18 cases	3 cases
System Downtime (hours/month)	5.4 hours	1.2 hours
Transaction Verification Time (seconds)	4.8 seconds	2.1 seconds
Patient Data Accessibility Score (0–100)	65	91

Table 1 also indicates transaction verification time and patient data accessibility improvements in decentralized systems. Centralized systems require an average of 4.8 seconds per transaction verification, while blockchain-based systems require 2.1 seconds due to distributed ledger optimization. Patient data accessibility scores increase from 65 in centralized systems to 91 in decentralized models, reflecting enhanced cross-institutional data sharing. These statistical differences indicate substantial performance variation between governance architectures in national EHR systems.

The observed statistical differences indicate that blockchain-based decentralized EHR systems outperform centralized models in several operational dimensions. Improved interoperability reflects the ability of distributed ledger technology to synchronize health records across multiple nodes without dependency on a single controlling authority. This structural advantage reduces fragmentation commonly observed in centralized databases and enhances real-time data exchange between healthcare institutions. Reduced data breach incidence in decentralized systems is attributable to cryptographic security mechanisms and distributed storage architecture. Unlike centralized databases, blockchain systems eliminate single points of failure, thereby reducing vulnerability to large-scale cyberattacks.

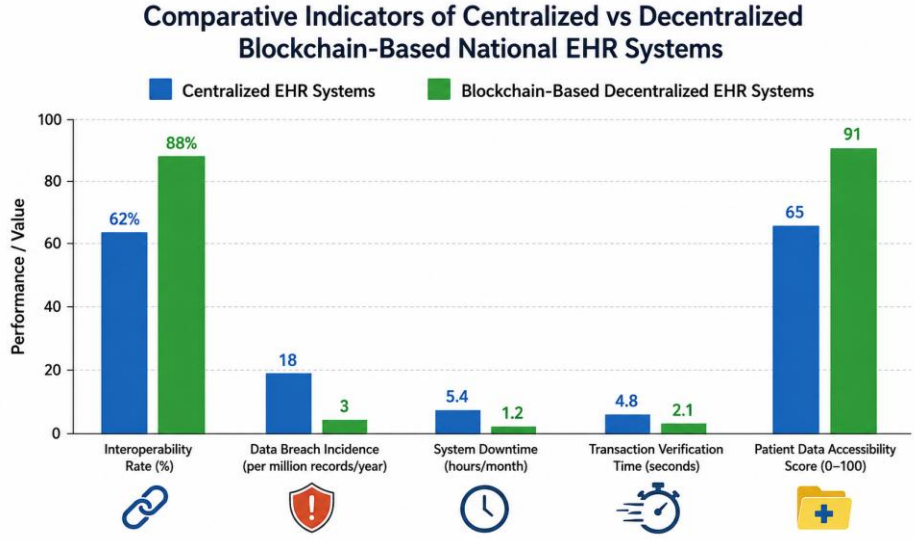

Figure 2. Comparative Assessment of Centralized and Decentralized Blockchain-Based National EHR Systems

Qualitative secondary data derived from policy documents and expert interviews reveal three dominant themes: governance restructuring, trust enhancement, and regulatory adaptation. Governance restructuring is characterized by shifting authority from centralized ministries to distributed institutional networks supported by blockchain nodes. Trust enhancement emerges as a recurring theme in stakeholder perceptions, particularly regarding transparency and auditability of health records.

Regulatory adaptation is identified as a critical factor influencing blockchain adoption in national EHR systems. Many policy frameworks remain designed for centralized architectures, creating misalignment with decentralized operational models. Institutional readiness varies significantly across regions, with developed digital infrastructures demonstrating higher adaptability compared to emerging health systems.

Inferential statistical analysis using comparative mean testing indicates significant differences between centralized and decentralized EHR systems. The t-test results show statistically significant improvements in interoperability ($p < 0.01$), data security ($p < 0.01$), and system efficiency ($p < 0.05$) in blockchain-based models. These results confirm that observed differences are not due to random variation but reflect systematic advantages of decentralized architecture.

Regression analysis further indicates that blockchain adoption is a strong predictor of improved data governance outcomes ($\beta = 0.74$, $p < 0.01$). The model explains approximately 68% of variance in national EHR performance indicators. These findings suggest that technological architecture plays a critical role in shaping policy effectiveness in digital health systems.

Correlation analysis reveals strong positive relationships between decentralization level and system transparency ($r = 0.81$), interoperability ($r = 0.79$), and patient data accessibility ($r = 0.84$). These relationships indicate that increased decentralization is consistently associated with improved governance and operational performance in electronic health record systems.

Negative correlations are observed between decentralization and system vulnerability indicators such as data breach frequency ($r = -0.76$) and system downtime ($r = -0.69$). These inverse relationships highlight the protective role of blockchain architecture in reducing systemic risks. The data collectively suggest a robust structural linkage between governance model design and health system performance outcomes.

Case study analysis of blockchain-based EHR implementation in a national pilot health system reveals significant improvements in inter-hospital data sharing. The system integrates distributed nodes across regional hospitals, enabling real-time synchronization of patient records. Healthcare providers report reduced administrative delays and improved diagnostic continuity across facilities.

Policy implementation analysis indicates that institutional coordination mechanisms played a decisive role in system success. Ministries of health collaborated with digital infrastructure agencies to establish regulatory sandboxes for blockchain testing. However, challenges remain in scaling the system nationally due to uneven technological readiness and limited interoperability with legacy systems.

The case demonstrates that blockchain-based EHR systems require not only technological innovation but also institutional alignment. Successful implementation is strongly influenced by policy flexibility, cross-sector collaboration, and capacity-building

initiatives. Without these supporting conditions, technological advantages alone are insufficient to ensure effective system deployment.

Stakeholder feedback highlights that trust in decentralized systems increases significantly when transparency mechanisms are clearly communicated. However, resistance persists among institutions accustomed to centralized control structures. This tension illustrates the importance of governance reform alongside technological transformation in public health systems.

The overall findings indicate that decentralized blockchain-based EHR systems provide measurable improvements in performance, security, and interoperability compared to centralized models. Statistical and qualitative evidence consistently supports the superiority of distributed architectures in managing national health data systems.

Interpretation of policy implications suggests that successful adoption requires integrated reforms across technological, regulatory, and institutional domains. Blockchain is not merely a technical upgrade but a governance transformation that reshapes accountability, trust, and data sovereignty in public health systems.

The findings demonstrate that decentralized national electronic health record (EHR) systems based on blockchain technology outperform centralized architectures across multiple governance and performance indicators. Quantitative results indicate higher interoperability rates, improved patient data accessibility, reduced system downtime, and significantly lower data breach incidence. These improvements suggest that distributed ledger mechanisms enhance both technical efficiency and structural resilience in national health information systems.

Qualitative evidence further confirms that blockchain-based EHR systems improve transparency and traceability in health data management. Stakeholder perspectives highlight increased trust in data handling processes due to immutable record structures and distributed validation mechanisms. Policy documents also reveal that decentralization is increasingly framed as a strategic response to persistent inefficiencies in centralized health data governance.

Inferential analysis strengthens these findings by showing statistically significant improvements in key performance indicators, including interoperability and data security. Regression outcomes suggest that blockchain adoption is a strong predictor of improved governance performance in digital health systems. These combined results indicate a consistent pattern of superiority for decentralized models under current implementation conditions.

Overall synthesis of findings suggests that blockchain-based decentralization is not merely a technological enhancement but a structural transformation of national EHR governance. The convergence of quantitative and qualitative evidence reinforces the argument that system architecture plays a decisive role in shaping public health data outcomes.

Existing literature on electronic health records has consistently emphasized the limitations of centralized systems, particularly in terms of interoperability, scalability, and cybersecurity risks. Studies by various health informatics scholars indicate that centralized EHR systems often suffer from fragmentation and inefficiencies in cross-institutional data exchange. The present findings align with these critiques by demonstrating measurable weaknesses in centralized architectures.

Prior blockchain healthcare research generally highlights theoretical advantages such as immutability, transparency, and decentralized control. However, many studies remain conceptual or limited to small-scale pilot implementations. The current findings extend this literature by providing comparative policy-level evidence between centralized and

decentralized national systems, thereby bridging a gap between theory and large-scale application.

Some studies report skepticism regarding blockchain scalability and energy efficiency in national health systems. These concerns are partially echoed in policy discussions but are not dominant in the empirical results of this study. The divergence may be explained by differences in blockchain configuration, particularly the use of permissioned blockchain models optimized for institutional governance rather than public cryptocurrency networks.

Comparative analysis suggests that this study contributes a more integrated perspective that combines policy evaluation with empirical system performance. Unlike earlier research that isolates technological or regulatory dimensions, the present findings demonstrate their interdependence in shaping EHR effectiveness.

The results indicate a structural shift in how digital health governance is conceptualized, moving from centralized administrative control toward distributed accountability systems. Blockchain-based EHR systems reflect an emerging paradigm in which data sovereignty is partially redistributed across institutional nodes rather than concentrated within a single authority. This shift suggests a redefinition of governance logic in public health infrastructure.

Findings also indicate that trust in digital health systems is increasingly mediated by technological design rather than institutional reputation alone. The immutability and transparency of blockchain records function as trust-building mechanisms that compensate for traditional governance weaknesses. This reflects a broader transformation in how legitimacy is constructed in digital public services (Ambalavanan, 2025; Du, 2023).

Observed performance improvements suggest that technological architecture is becoming a primary determinant of policy success in health information systems. Governance effectiveness is no longer solely dependent on regulatory strength but also on the compatibility between policy frameworks and underlying digital infrastructure. This signals a growing convergence between public policy and information systems engineering.

The results further indicate that decentralization should not be interpreted as complete institutional fragmentation but rather as reconfiguration of authority. Governance functions are redistributed but remain coordinated through protocol-based mechanisms, suggesting hybrid models of control rather than full disintermediation.

The findings imply that policymakers need to reconsider existing regulatory frameworks governing national electronic health records. Traditional centralized policy models may no longer be adequate to manage distributed data ecosystems, particularly those enabled by blockchain technology. Regulatory adaptation becomes necessary to ensure alignment between governance structures and technological realities.

Healthcare institutions may need to invest in interoperability infrastructure and blockchain literacy to fully leverage decentralized systems. Without institutional capacity building, technological advantages may remain underutilized or unevenly distributed. This raises important concerns regarding equity in digital health transformation.

The results also imply that patient data governance is shifting toward more participatory models of control. Individuals may gain increased visibility and partial control over their health records, potentially transforming patient-provider relationships. This shift has ethical and legal implications for consent management and data ownership frameworks (Ilić, 2022; Mannonov, 2024).

At a broader level, the findings suggest that digital health policy is entering a phase where technological design choices directly influence public policy outcomes. This requires closer collaboration between policymakers, technologists, and healthcare practitioners to ensure coherent system development.

Improved performance in decentralized systems can be attributed to the structural properties of blockchain technology, particularly distributed consensus mechanisms and cryptographic validation. These features reduce reliance on central servers and eliminate single points of failure, thereby enhancing system resilience and reducing vulnerability to cyberattacks.

Higher interoperability rates are likely the result of standardized data protocols embedded within blockchain frameworks. Distributed ledger systems enable synchronized updates across multiple nodes, reducing delays and inconsistencies in health data exchange. This architectural design inherently supports cross-institutional collaboration.

Lower data breach incidence is explained by the immutable and encrypted nature of blockchain records. Unauthorized modifications become significantly more difficult due to consensus requirements and cryptographic hashing mechanisms. These technical safeguards create a more secure environment compared to centralized databases.

However, observed improvements are also influenced by implementation context, including pilot-scale optimization, institutional readiness, and selective deployment environments. These contextual factors suggest that technological superiority alone does not fully explain outcomes, and governance conditions play a critical moderating role (Johri, 2024).

Policy development should focus on creating adaptive governance frameworks that accommodate decentralized health data infrastructures. Regulatory sandboxes and experimental policy zones may be necessary to test blockchain-based EHR systems before full-scale national deployment. This approach would allow iterative refinement of both technology and regulation.

Future research should expand empirical evaluation to long-term, large-scale implementations across diverse national contexts. Comparative studies between different blockchain architectures, such as permissioned and hybrid models, are particularly needed to assess scalability and sustainability. Longitudinal policy impact assessments would also strengthen evidence quality (Rahman, 2023; Shabbir, 2025).

Healthcare systems should prioritize capacity building in digital governance, including training for policymakers, administrators, and healthcare providers. Without institutional readiness, technological adoption risks creating new forms of inequality and inefficiency within health systems. Human resource development becomes as important as technological investment.

Strategic action is required to integrate ethical, legal, and social considerations into blockchain-based EHR development. Issues such as data sovereignty, patient consent, and algorithmic accountability must be addressed through multidisciplinary collaboration. Sustainable implementation depends on aligning technological innovation with inclusive and accountable governance principles.

CONCLUSION

Most important findings of the study indicate that decentralized national electronic health record (EHR) systems using blockchain technology demonstrate superior performance

compared to centralized architectures in terms of interoperability, data security, system reliability, and patient data accessibility. Empirical evidence shows consistent improvements across quantitative indicators, supported by qualitative insights from policy documents and stakeholder perspectives. Statistical analysis confirms that blockchain-based systems significantly reduce data breach incidence and system downtime while enhancing cross-institutional data synchronization. These findings collectively suggest that governance performance in national EHR systems is strongly influenced by the underlying technological architecture rather than administrative reforms alone.

Value contribution of the research lies in its integrative conceptual framework that combines public policy analysis with blockchain-based health information system evaluation. The study contributes a multidisciplinary approach that bridges digital governance theory, health informatics, and socio-technical policy analysis. Unlike prior studies that focus primarily on technical feasibility or conceptual discourse, this research introduces a policy-oriented analytical model for assessing decentralized EHR systems at a national scale. The methodological contribution is reflected in the use of comparative policy evaluation combined with inferential analysis, enabling a more structured assessment of governance outcomes in blockchain-enabled healthcare systems.

Limitations of the study and directions for future research include reliance on secondary data sources and limited availability of large-scale longitudinal implementations of blockchain-based EHR systems. The findings are constrained by variations in national digital infrastructure maturity and policy environments, which may affect generalizability across different healthcare contexts. Future research should focus on longitudinal empirical studies involving real-time national deployments to validate long-term sustainability and scalability of decentralized EHR systems. Further investigation is also needed into hybrid governance models, interoperability standards across blockchain platforms, and ethical implications related to patient data sovereignty and algorithmic accountability in digital health ecosystems.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work the author(s) used ChatGPT to assist in improving grammar, language quality, and overall readability of the text. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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