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BEYOND INTEROPERABILITY STANDARDS: ADDRESSING FRAGMENTED DATA EXCHANGE IN U.S. HEALTHCARE THROUGH INTEGRATED GOVERNANCE-DRIVEN AND SCALABLE HEALTH INFORMATION EXCHANGE FRAMEWORKS

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ABSTRACT

Digitization of the United States healthcare system has increased the use of the electronic health records as well as improved the data systems, but smooth data exchange is still a challenge. Although the interoperability standards like Health Level Seven and Fast Healthcare Interoperability Resources have been adopted, healthcare data remain fragmented among institutions limiting care coordination and data-driven decision-making. This work provides an assessment of the shortcomings of the existing interoperability strategies and offers a method of health information exchange that is governance-based and scalable and incorporates technical, organizational and policy aspects. The review indicates that even though interoperability standards allow data exchange in a structured and application programming interface format, their success is limited to inconsistent implementation, poor enforcement, and limited practical integration. The institutional silos, inconsistencies in regulations, distrust, and misaligned incentives have continued to cause fragmentation. The review pinpoints the key missing factor in governance, which is roles of policy harmonization, frameworks of trust, and alignment of incentives. It also points out that new technologic systems like federated systems, cloud computing, artificial intelligence, and blockchain can improve scalability when they are backed up by robust governance systems.

Keywords: Health Information Exchange; Interoperability; Data Fragmentation; Data Governance; Digital Health Infrastructure

1 INTRODUCTION

The rapid digitalization of the United States healthcare system has completely changed the way clinical data is generated, stored, and used, making health information an essential strategic resource in the contemporary care delivery process. The growth of have electronic health records (EHRs), data-driven clinical decision systems, and artificial intelligence (AI)-based healthcare applications has resulted in the massive increase in the volume, speed, and complexity of healthcare data, thus driving the requirement of efficient and seamless healthcare data exchange among various health care parties (Matog, 2025; Wang *et al.*, 2025). Simultaneously, regulatory policies and compliance

standards like Health Insurance Portability and Accountability Act (HIPAA) and Health Information Technology for Economic and Clinical Health Act (HITECH) are influencing the way health data is accessed, shared, and protected and tend to add further complexity to the data exchange processes (Utomi *et al.*, 2024; Osifowokan *et al.*, 2025). The capacity to incorporate and transfer data across systems has become an essential part of health care systems as they strive to enhance their performance in terms of patient outcome optimization and operational efficiency (Ahmed *et al.*, 2025; Oware & Mensah, 2025).

To satisfy these requirements, standards of interoperability, including Health Level Seven International (HL7) and Fast Healthcare Interoperability Resources (FHIR) among others, have been developed as the basic instruments to facilitate the process of structured and standardized health data exchange (Osamika *et al.*, 2025). These norms offer the syntactic and semantic interoperability mechanisms and ensure the harmonization of heterogeneous data sources, as well as supporting real-time and Application Programming Interface (API)-based communication between health care systems (Saripalle *et al.*, 2019; Saini *et al.*, 2021; Osamika *et al.*, 2025). Further development of FHIR-based architectures and API-determined interoperability models has made the data exchange process more flexible and scalable, allowing it to integrate and work in a multi-institutional setting and contribute to the emergence of the digital health ecosystem (Chitta *et al.*, 2022; Hornback *et al.*, 2025). Nevertheless, the adoption of interoperability standards remains unequal, and we are still experiencing some problems with inconsistent adoption, coverage, and integration with legacy systems (Garza *et al.*, 2021; Hovenga & Grain, 2022). Thus, though interoperability standards have enhanced the technical ability of the data exchange, they have not addressed the barriers systemically that limit effective and meaningful health information exchange.

This disjointing has resulted in what may be termed as the paradox of fragmentation; a situation whereby the ongoing endeavors at standardization are accompanied by the existence of data silos, lack of cross-organizational data sharing and inefficiencies in health care provision. Empirically, it is pointed out that institutional resistance, lack of trust, regulatory inconsistencies, and poorly structured governance structures remain the prevalent barriers to the effective use of health information exchange systems (Esmaeilzadeh, 2022; Ambalavanan *et al.*, 2025; Chuma, 2025). These issues highlight the severe weakness of an exclusively technical concept of interoperability, in which the existence of standards does not always mean the existence of functional, scalable, and trusted data exchange ecosystems. The growing academic literature focuses more on the idea that governance (including policy alignment, data stewardship, consent management, and accountability) is the key to defeating the problem of fragmentation and facilitating sustainable interoperability (Holly *et al.*, 2023; Ghaffari Heshajin *et al.*, 2024; Huber, 2025). It is in this context that this study contends that in order to realize successful health information interchange in the United States, the current state of interoperability standards must be transcended in favor of a more governance-centric, integrated and scalable system. This study will expand current knowledge on the interoperability concept by synthesizing available evidence and introducing a multi-layered conceptual framework to forecast the comprehensive interoperability concept that incorporates both the technical, organizational, and policy aspects to ensure that data fragmentation in healthcare systems is resolved.

2 CONCEPTUALIZING INTEROPERABILITY AND DATA EXCHANGE

The concept of interoperability in healthcare has developed into a multidimensional phenomenon that goes beyond just the technical connection of systems and devices to include the meaning and coordinated action across systems and stakeholders with health data. Overall, interoperability means that heterogeneous health information systems can share, understand, and use data in a consistent applicable way, usually on the technical, syntactic, semantic, and organizational levels (Osamika *et al.*, 2025). Technical interoperability guarantees that the system can be connected, whereas syntactic and semantic interoperability mean that structured data are formatted and share a meaning in standards like HL7 and FHIR (Saripalle *et al.*, 2019; Saini *et al.*, 2021). Nevertheless, the new literature points to the fact that to determine real interoperability, it is necessary to go to organizational and contextual levels, where workflows, governance systems, and institutional fit can define whether the shared data can be used in practice (Hovenga & Grain, 2022; Hornback *et al.*, 2025).

Health Information Exchange (HIE) is the practical implementation of interoperability, turning the functions to the practical data sharing between health care organizations. Health Information Exchange platforms facilitate the flow of patient data between providers, payers, and other population health bodies to assist in care coordination, clinical decision-making, and population health (Esmaeilzadeh, 2022; Zuniga *et al.*, 2026). The performance of HIE systems is still dependent on variables that include the quality of data, accuracy of patient matching, and institutional involvement despite the existing interoperability standards (Ambalavanan *et al.*, 2025; Licciardello, 2025). Architectures based on APIs and the FHIR-based exchange models have enhanced the efficiency and scalability of HIE because they facilitate real-time access to data and provide integration of distributed systems (Chitta *et al.*, 2022; Adelusi *et al.*, 2025). However, sustained obstacles such as irregular use of standards and coordination among the stakeholders still constrain

the complete operationalization of HIE, which still solidifies the discrepancy between interoperability possibilities and actual data exchange results (Chuma, 2025; Matog, 2025).

Most importantly, data exchange in healthcare should be perceived as a social-technical system, in which technological systems interrelate with organizational processes, regulatory agencies, and human activities. This point of view emphasizes the difference between interoperability, usability and exchange: interoperability is the ability of the system, usability is the effectiveness of the data to be applied in clinical and operational situations, exchange is the process of data transfer and sharing among the entities (Wang *et al.*, 2025; Mishra *et al.*, 2026). The interactions are determined by governance mechanisms, trust frameworks and policy environments which determine whether interoperable systems result in meaningful and sustained data exchange (Winter & Davidson, 2019; Ghaffari Heshajin *et al.*, 2024; Huber, 2025). Also, new paradigms, including patient-centered data models and decentralized architectures, have the potential to emphasize the necessity of balancing technical interoperability with the control, privacy, and institutional responsibility of the user (Rai, 2025). As a result, to think about interoperability, one has to go beyond technical definitions and to a more comprehensive vision that would address the socio-technical, organizational and governance aspects of interoperability in the modern healthcare systems.

3 METHODOLOGY

The study used a narrative review method to critically assess the situation of fragmented data exchange in the U.S. healthcare system and the potential for governance-led scalable health information exchange. Major academic databases such as Google Scholar, Scopus, PubMed, ScienceDirect and IEEE Xplore were searched for a comprehensive literature review. Specific keywords that were used in combination with other terms in the search included health information exchange, interoperability, Health Level Seven, Fast Healthcare Interoperability Resources, data governance, healthcare data fragmentation, federated systems, blockchain in healthcare, and digital health infrastructure.

The keywords were combined as follows;

- Health information exchange AND interoperability AND Health Level Seven
- Fast Healthcare Interoperability Resources AND data governance AND healthcare data fragmentation
- Federated systems AND blockchain in healthcare AND digital health infrastructure

Health information exchange AND interoperability OR Fast Healthcare Interoperability Resources AND Health Level Seven AND data governance AND healthcare data fragmentation AND digital health infrastructure

The search was mainly conducted on peer-reviewed journal articles, conference papers, policy studies, and conceptual publications from 2018 to 2026, to ensure that it covered the most recent and foundational work on problems in healthcare interoperability.

Studies included in the inclusion criteria were those that dealt with interoperability standards, healthcare governance models, health information exchange models, data sharing issues, and scalable digital health architectures in the U.S. healthcare environment. Articles that were purely about non-interoperability, non-governance, and/or had weak conceptual or empirical contribution were removed. Sources were purposefully selected because of their relevance, concept and congruence with the study objective. The literature selected was then critically synthesized to uncover common themes regarding technical fragmentation, limitations of governance, interoperability problems, and rising scalable exchange models. The narrative review method allowed for technical, organizational, regulatory, and policy considerations to be incorporated into the creation of a governance-based approach for sustainable health information exchange.

4 THE FRAGMENTATION PROBLEM IN U.S. HEALTHCARE DATA EXCHANGE

4.1 Technical Fragmentation

One of the most obvious impediments of information exchange in the United States is the problem of technical fragmentation, which is mostly facilitated by the lack of legacy systems and proprietary infrastructures. Several healthcare institutions still use old electronic health records (EHR) systems that were never intended to be interoperable, which does not mean that the data is incompatible and constitutes a limited API functionality and poor data portability (Hovenga & Grain, 2022; Osamika *et al.*, 2025). Their implementation inconsistencies and partial adoption even with the advent of standards like HL7 FHIR frustrate their capacity to fill these technical gaps fully even when integrating with legacy architectures (Garza *et al.*, 2021; Saini *et al.*, 2021). Moreover, the vendor lock-in approaches, i.e., the EHR providers either limit the access to the data or make its integration expensive, persists in

maintaining the siloed data environment, compromising the possibility of the open and scalable interoperability (Saripalle *et al.*, 2019; Chuma, 2025).

Moreover, there are heterogeneities in data structures and absence of standardised semantics that lead to the fact that there is always incompatibility between systems even where technical connectivity is realised. Coding system differences or lack of standardization of terminologies and inconsistent implementations of the API usually lead to the production of technically shared but meaningless cross-platform data (Hornback *et al.*, 2025). These shortcomings underscore the fact that technical fragmentation is not entirely a characteristic of the lack of infrastructure but is also a wider problem of standard harmonization and integrations among the healthcare system landscape.

4.2 Organizational Fragmentation

In U.S. healthcare, organizational fragmentation can be attributed to the fact that the system is inherently decentralized, and providers, payers, and public health entities are mostly independent actors with little co-ordination. Instead of sharing the data between organisations, healthcare organizations tend to focus on the internal optimization, which results in the fragmented workflow and limited interoperability across the care environments (Esmaeilzadeh, 2022; Ambalavanan *et al.*, 2025). This misalignment is also more intensified by the difference in institutional policies, operation priorities and technological abilities, all of which hamper the creation of common data exchange practices (Matog, 2025).

In addition, the ineffective coordination processes in the healthcare networks lead to ineffective transfer of information, especially when changes of care, referring and managing population health take place. Lack of structured collaboration models and trust on the relationship between stakeholders stifles involvement in HIE projects, which strengthens institutional silos and minimizes the overall success of interoperability activities (Licciardello, 2025; Wang *et al.*, 2025). Consequently, the organizational fragmentation still hampers the practical application and scalability of technical solutions even in situations where they are present.

4.3 Regulatory Fragmentation

One of the most important barriers to effective health data exchange is regulatory fragmentation, which is caused by the presence of several federal and state-level policies of healthcare data. Although federal policies, including HIPAA and HITECH, provide minimum protection of privacy and security of data, state legislations usually add new or contradictory provisions to the scope of the existing policies, making it difficult to comply with and exchange information across borders (Winter & Davidson, 2019; Osifowokan *et al.*, 2025). Such overlapping regulatory landscape causes healthcare organizations to be uncertain about what is allowed and discouraged as data exchange practices, which in turn makes them risk-averse and less willing to use HIE systems (Holly *et al.*, 2023; Ghaffari Heshajin *et al.*, 2024).

Furthermore, the governance environment is complicated by the development of regulatory issues surrounding artificial intelligence, data protection, and digital health innovation. Organizations will have to find a way to operate between the compliance needs that overlap, and at the same time, ensure that the processes of data exchange are safe, ethical, and lawful, which frequently leads to the incompleteness of interoperability program implementations (Korang *et al.*, 2024; Utomi *et al.*, 2024). Such regulatory inconsistency eventually holds back the scalability of health information exchange through barriers that go beyond technical possibility.

4.4 Economic Fragmentation

Competitive incentives are the driving force of economic fragmentation in healthcare in the United States because they do not encourage sharing of data and instead, they support data silos. The view of data as a competitive edge is widespread in healthcare organizations, which results in the emergence of intentional data hoarding designed to preserve a competitive advantage, regulate patient flows, and defend the market position (Esmaeilzadeh, 2022; Huber, 2025). This is an economic rationality that is fundamentally incompatible with interoperability, which is collaborative, finding value in the common access to systemic patient data.

Besides, financial burdens on interoperability implementation and maintenance such as system upgrades, integration services and compliance investments also- are a big impediment to most organizations. Such expenses, along with the absence of clarity regarding a remuneration, and non-correlation between reimbursement models, diminish the incentives to participate in HIE initiatives (Ambalavanan *et al.*, 2025; Wang *et al.*, 2025). Therefore, economic fragmentation does not only discourage the implementation of interoperability technologies but systemic inequities in the access and exchange of data across healthcare ecosystem.

Table 1: Dimensions and Drivers of Healthcare Data Fragmentation

Fragmentation Type	Key Drivers	Impact on Health Information Exchange	Example	References
Technical	Legacy systems; proprietary electronic health record systems; inconsistent use of interoperability standards	Poor system compatibility; limited data sharing	Vendor-controlled electronic health record systems	Osamika et al. (2025); Saini <i>et al.</i> (2021); Hovenga & Grain (2022); Hornback <i>et al.</i> (2025)
Organizational	Decentralized providers; weak coordination across institutions	Limited collaboration; fragmented care processes	Isolated hospital networks	Esmailzadeh (2022); Ambalavanan <i>et al.</i> (2025); Matog (2025)
Regulatory	Differences between federal and state policies; complex compliance requirements	Restrictions on data sharing; uncertainty in implementation	Conflicts between national privacy laws and state regulations	Osifowokan <i>et al.</i> (2025); Utomi <i>et al.</i> (2024); Holly <i>et al.</i> (2023)
Economic	Competitive incentives; high implementation and integration costs	Data hoarding; low participation in data exchange initiatives	Proprietary control of patient data	Ambalavanan <i>et al.</i> (2025); Huber (2025); Wang <i>et al.</i> (2025)

5 INTEROPERABILITY STANDARDS: PROGRESS AND PERSISTENT GAPS

The development of interoperability standards in the healthcare sector can be said to be characterized by a gradual change in simple data exchange standards towards more loose and scalable architectures. Initial standards like Health Level Seven introduced fundamental messaging standards, which were improved by Fast Healthcare Interoperability Resources to facilitate application program interface-based real-time data transfer across systems (Saripalle *et al.*, 2019; Osamika *et al.*, 2025). These developments have made data sharing more structured and standardized, enhanced system connectivity and facilitated the emergent digital health ecosystems (Saini *et al.*, 2021; Chitta *et al.*, 2022). Emerging trends such as national-level exchange frameworks will expand interoperability past the institutional level and bring about coordinated strategies to the large-scale data exchange (Mishra *et al.*, 2026; Zuniga *et al.*, 2026). The combination of these standards has greatly enhanced the technical capability of interoperability through contributing to modular integration, enhanced harmonization of data and scalable exchange infrastructures.

But even with these success stories, there are still major gaps that exist that hinder the true effectiveness of interoperability standards in practice in healthcare environments. The variation in the implementation between different organizations leads to the inconsistent application of standards, which leads to incomplete or incompatible data exchange even between those systems that purport to be interoperable (Garza *et al.*, 2021; Hovenga & Grain, 2022). The ineffective enforcement mechanisms also enable practices that are not standardized, and there are still challenges of integrating with old systems that prevent its large-scale adoption (Chuma, 2025; Hornback *et al.*, 2025). More to the point, the fact that the technical standards do not correspond to governance structures, including data sharing, trust, and accountability policies, negatively affects the effective implementation of seamless health information exchange (Ghaffari Heshajin *et al.*, 2024; Huber, 2025). According to the empirical evidence, organizational resistance, the complexity of regulations, and the lack of incentives still hinder valuable data sharing despite the adoption of sophisticated standards (Esmailzadeh, 2022; Ambalavanan *et al.*, 2025; Osifowokan *et al.*, 2025). This highlights a very important point, which is that interoperability standards do not suffice, and unless there are strong governance frameworks, the technical solution will not be able to overcome fragmentation within healthcare data exchange systems.

6 GOVERNANCE AS THE MISSING LINK IN HEALTH INFORMATION EXCHANGE

In healthcare, data governance can be defined as the collection of policies, processes, standards, and accountability mechanisms used to govern the handling of health data access, sharing, protection, and use within the systems and stakeholders. Although interoperability standards have been mainly concerned with the provision of technical connectivity, governance frameworks define the level of entrusted, compliant, and operationally effective data exchange (Ghaffari Heshajin *et al.*, 2024; Huber, 2025). Lack of coherent and coordinated governance models within the United

States has led to a decentralized nature of data stewardship, as different organizations have differing policies on data ownership, access controls, as well as the extent of sharing their data (Winter & Davidson, 2019; Holly *et al.*, 2023). Such fragmentation is further aggravated by lack of accountability and oversight as the roles of data quality, security and its usage are sometimes ambiguous and not uniformly applied, which restricts the reliability and scalability of health information exchange systems.

Furthermore, the critical governance issues concerning trust, consent as well as identity management remain to be obstacles to effective exchange of data. Indeed, healthcare stakeholders are often reluctant to share data because of privacy, liability, and competitive disadvantage concerns that is linked to a general absence of institutional trust (Esmailzadeh, 2022; Kaplow *et al.*, 2024). Moreover, the discrepancies between consent management systems and patient identifiers provide obstacles to the correct and secure data transfer within the organizations (Licciardello, 2025; Rai, 2025). These problems indicate that interoperability is not merely a technical issue but a governance challenge that needs to be coordinated on policy, ethical alignment and stakeholder formed alliances. Even the best technical standards cannot bring any significant and scalable health information exchange without well-developed governance mechanisms to account for these socio-organizational factors (Osifowokan *et al.*, 2025). In this way, governance can be identified as the most crucial factor of interoperability success, which helps to close the divide between the technical ability and the actual data exchange.

Table 2: Comparison of Technical vs Governance Barriers in Health Information Exchange

Dimension	Technical Barriers	Governance Barriers	Relative Impact
Data Exchange	Format incompatibility; inconsistent standards implementation	Data-sharing reluctance; lack of trust among institutions	High (Governance > Technical)
Scalability	System limitations; legacy infrastructure constraints	Lack of coordination; absence of unified frameworks	High
Trust	Security vulnerabilities; system-level risks	Institutional distrust; unclear accountability and data ownership	Very High
Compliance	Integration challenges; technical complexity	Policy inconsistency; regulatory fragmentation and consent issues	Very High

7 EMERGING MODELS FOR SCALABLE AND INTEGRATED HEALTH INFORMATION EXCHANGE

The new paradigms of health information exchange are moving towards the more centralized architecture models into the federated and distributed models that effectively tackle the challenges of scalability, privacy, and data ownership. Effective because of the data aggregation, centralized systems may be disadvantaged in control and integration of data across different institutions, with the federated models permitting the data to stay in the source yet permitting secure and standard access across the networks (Adelusi *et al.*, 2025). This solution helps to increase the institutional freedom and corresponds to patient-centered data paradigms that prioritize data sovereignty and controlled sharing (Rai, 2025). Simultaneously, ecosystems that rely on application programming interface have improved real-time data exchange and system interoperability through scalable and modular integration across platforms, especially ones based on Fast Healthcare Interoperability Resources (Saini *et al.*, 2021; Chitta *et al.*, 2022). Such advancements are further enhanced by cloud computing and distributed infrastructures that ensure the flexibility and computing power needed to integrate large amounts of data and participate in unceasing data interactions (Mishra *et al.*, 2026).

Simultaneously, emerging technologies like artificial intelligence and blockchain are making a game changer in solving long-standing issues of interoperability in terms of trust, security, and the integration of data. Artificial intelligence facilitates automated synchronization of data and predictive analytics as well as intelligent decision-making across interconnected systems and increases the usability and value of exchanged data (Ramanathan *et al.*, 2024). In their turn, blockchain technologies propose decentralized and safe data-sharing systems that enhance the transparency, integrity, and trust among stakeholders in the multi-institutional settings (Zhang & Lin, 2018). Interoperability is being redefined by these innovations in combination with the transformation to platform-based healthcare ecosystems as an active and integrated ability integrated into digital health infrastructures. Together they reflect a change away to a page of technology to scalable, intelligent, and coordinated health information exchange systems.

8 A GOVERNANCE-DRIVEN AND SCALABLE HEALTH INFORMATION EXCHANGE FRAMEWORK

8.1 Framework Overview

The study, based on the shortcomings of the current interoperability strategies, establishes a governance-based and scalable health information exchange framework based on unifying the technical, organizational, and policy aspects of the model into a single entity. The conceptualization of interoperability as a coordinated stature overseen by regulations, motivations, and institutional harmony is conceptualized within the framework. It highlights the fact that successful data exchange is a result of the synergistic exchange between standardized technologies and strong governance frameworks that foster the aspects of trust, accountability, and compliance (Ghaffari Heshajin *et al.*, 2024; Huber, 2025). The model guarantees a more sustainable and scalable health information exchange in the healthcare system of the United States by putting governance at the heart of interoperability and allowing the United States of America to overcome the problem of endemic fragmentation.

8.2 Core Architectural Layers

The framework suggested is arranged in four layers, which are interdependent and are technical, data, governance, and ecosystem. The technical layer offers the underlying infrastructure of interoperability by reducing the standards to Fast healthcare interoperability resources and application programming interfaces that can facilitate inter-system exchange of data in real-time (Chitta *et al.*, 2022; Osamika *et al.*, 2025). The data layer is oriented on harmonization via standard formats, metadata matching, and federated repositories, such that any exchanged data is uniform, readable, and not only can be utilized in a variety of the healthcare environment but also is interpretable (Adelusi *et al.*, 2025; Hornback *et al.*, 2025).

Governance layer is the main coordination system, which outlines policies, roles, and accountability frameworks, which govern data access, sharing and use. Such a layer is a guarantee of the adherence to regulatory requirements, data stewardship, as well as the development of trust among interested parties (Winter & Davidson, 2019; Holly *et al.*, 2023). Lastly, the ecosystem layer will combine the stakeholders, such as healthcare providers, policymakers, technology vendors, and patients, and align incentives and collaboration across the healthcare value chain (Ambalavanan *et al.*, 2025; Wang *et al.*, 2025). Collectively, the layers make a unified architecture that mediates between technical interoperability and coordination, which are concerned with organizational and policy.

8.3 Governance Mechanisms

The main aspect of the suggested framework is the development of governance mechanisms that should eliminate the socio-organizational barriers restricting efficient health information exchange. Trust frameworks are essential to facilitate data sharing through the clear rules on a data access, security and accountability that minimize institutional reluctance and improve collaboration (Kaplou *et al.*, 2024; Huber, 2025). Targeting harmonization of policies is also critical because ensuring that both federal and state regulations are in line with each other reduces the uncertainty of compliance and allows maintaining similar data exchange practices within different jurisdiction (Holly *et al.*, 2023; Osifowokan *et al.*, 2025).

Moreover, incentive alignment mechanisms are required to eliminate economic barriers that put off data sharing. Healthcare organizations with links between data exchange involvement and value-based care models and performance outcomes are more likely to have collaborative data ecosystems (Esmailzadeh, 2022; Wang *et al.*, 2025). All of these mechanisms of governance are in place to make sure that interoperability efforts are not just technically viable, but operationally and institutionally feasible as well.

8.4 Scalability and Implementation Pathways

To attain national scale, this framework of governance needs to be incorporated into the current and future health information exchange systems. The framework can be implemented by providing a national level by integrating into interoperability efforts and incorporating principles of governance into large-scale networks of exchange (Mishra *et al.*, 2026; Zuniga *et al.*, 2026). This involves improving the coordination of the healthcare systems, harmonizing the implementation practices and encouraging the mass involvement of the stakeholders.

Moreover, interoperability solutions should be scaled by means of the public-private collaboration, which can be used to share resources, innovate and develop a coordinated policy across sectors. The implementation of interoperable systems may be even faster with collaborative work of government agencies, health entities, and technology organizations, which need to adhere to regulatory and ethical requirements (Korang *et al.*, 2024; Utomi *et al.*, 2024). The proposed framework integrates governance, technology, and stakeholder engagement, which would offer a viable way of attaining scalable and sustainable health information exchange in the United States.

Table 3: Proposed Governance-Driven Health Information Exchange Framework Components

Layer	Key Components	Function	Expected Outcome
Technical	Fast Healthcare Interoperability Resources application programming interfaces; interoperability gateways	Enable standardized and real-time data exchange	System compatibility and integration
Data	Federated repositories; metadata standards; data harmonization models	Ensure consistency and usability of data across systems	Data quality and consistency
Governance	Policies; trust frameworks; compliance structures	Regulate data access, sharing, and accountability	Trust, security, and regulatory compliance
Ecosystem	Stakeholders; incentive structures; collaboration platforms	Enable coordination and participation across healthcare actors	Scalable and sustainable health information exchange

9 POLICY AND STRATEGIC IMPLICATIONS

Enhancement of national health information exchange activities needs enhancement of governance enforcement in emergent interoperability frameworks, especially by more coordinated and more standard implementation strategies. Although large-scale exchange initiatives offer a platform on which countrywide knowledge sharing takes place, its success hinges on how governance principles, including accountability, compliance, and trust, are instituted and implemented in participating organizations (Ghaffari Heshajin *et al.*, 2024; Huber, 2025). Lack of consistency in the implementation of standards and policies remains a hindering factor to interoperability results, and more robust checking mechanisms and institutional obligations should be used as a solution (Holly *et al.*, 2023; Osifowokan *et al.*, 2025). Secondly, regulatory transparency in fields like data protection, artificial intelligence and digital health innovation is necessary to make sure that interoperability frameworks can run within a consistent and enforceable policy setting (Korang *et al.*, 2024; Utomi *et al.*, 2024). The reinforcement of governance at the national level is hence a crucial move towards having a trustworthy and scalable health information exchange.

The second key priority is the restructuring of economic incentives that would foster data sharing and collaboration of healthcare systems. The existing incentive programs tend to focus on competition and data control which makes organizations not fully engage in data exchange programs (Esmailzadeh, 2022; Huber, 2025). The shift to the value-based care model that rewards outcomes, coordination, and data-driven decision-making may motivate healthcare providers to become more active in the interoperability process (Ambalavanan *et al.*, 2025; Wang *et al.*, 2025). The introduction of financial incentives involving the sharing of data and interoperability performance can diminish the blocking of information and lead to a more collaborative healthcare ecosystem by the policymakers. In addition, the lack of digital infrastructure and interoperability capabilities can be addressed through investment to ensure that the smaller or resource-constrained organizations do not end up on the sidelines of national data exchange networks.

Lastly, successful and fair interoperability takes harmonization of national and state policies and increased focus on patient-centered data ownership models. The difficulty in cross-organizational data sharing due to fragmentation in regulatory frameworks across jurisdictions shows that congruent and consistent policy standards are required (Winter & Davidson, 2019; Holly *et al.*, 2023). Meanwhile, new technologies, focusing on letting patients own and control their health data, provide an opportunity to increase trust, transparency, and involvement in the process of sharing the data (Kaplou *et al.*, 2024; Rai, 2025). Interoperable technologies and governance frameworks can help patients to control their health data and enable them to securely and ethically transfer data between providers through patient-centered models. Patient-centric and policy harmonization are necessary elements in the creation of a resilient, inclusive, and sustainable health information exchange ecosystem.

10 DISCUSSION

This study has shown that the ongoing disjointing of healthcare data exchange in the United States is not only a technological constraint but essentially a socio-technical issue. Although interoperability standards have played a significant role in enhancing both the structural and technical capability of data exchange, they have failed to be translated into a seamless, scalable, and functioning health information exchange in reality. The analysis in the above sections brings out the idea that it is an interplay of technical, organizational, regulatory, and economic contexts that lead to fragmentation, and that all these issues are highly entrenched in the larger healthcare ecosystem. In this regard, the main understanding of the present study is quite straightforward: interoperability without any governance is

inadequate. Technical standards are not sufficient to address the problem of trust, coordination, policy inconsistency, and misaligned incentives that end up winning or losing the battles of sharing and using data.

The combination of these dimensions contributes to the development of a governance-based and replicable framework that redefines interoperability as a coordination system but not a technical operation. The theoretical contribution of the model proposed is that the field of health information exchange should be viewed as a socio-technical one, where the technology, governance, and institutional processes should be aligned to bring about significant results. This viewpoint will help fill the gaps in the current literature, as it will go beyond isolated descriptions of standards or technologies and highlight the role of governance systems to include trust systems, policy harmonization, and incentive alignment. Moreover, the conclusions indicate the criticality of policy intervention since the further lack of unified governance frameworks can lead to the further existence of disparities, inefficiencies, and unutilized opportunities in healthcare delivery that is based on data.

11 CONCLUSION

The study has reviewed the ongoing division of healthcare data exchange in the United States and has shown that to surpass this problem it is essential to develop a paradigm shift towards governance rather than a standards-based model. Even when interoperability standards like Health Level Seven, Fast Healthcare Interoperability Resources and so on have been developed to enhance the technical capability of exchanging structured data, they have not been effective without governance coordination mechanisms to guarantee trust and accountability and uniformity in implementation. The discussion shows that interoperability is a socio-technical issue with technical infrastructure to be coordinated with institutional practices, regulatory, and stakeholder incentives to create relevant and scaled health information exchange.

The suggested governance-oriented and scalable structure gives an opportunity to overcome these shortcomings as it incorporates the technical, data, governance, and ecosystem levels into a common model. To achieve the interoperability full potential in the future, more policy alignment, better coordination of activities among the healthcare stakeholders, and incentive systems that enhance sharing of data and collaboration will be necessary. With the ongoing transformation of the healthcare sector to be data-driven, patient-centered, and uphold governance as the primary foundation of interoperability initiatives will be key to providing efficient, secure, and equitable healthcare delivery in the United States.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of 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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