

Digital Transformation and Collaborative Innovation in Public Health Services in Indonesia: A Qualitative

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ABSTRACT

Introduction: Digital transformation has emerged as a strategic approach to improve efficiency, accessibility, and data-driven decision-making in public health services. However, implementing digital health initiatives often faces institutional, governance, and coordination challenges. In addition, technological adoption alone may not guarantee sustainable improvements without collaborative innovation among stakeholders. This study aimed to explore how digital transformation and collaborative innovation interact in shaping public health service delivery.

Research Methodology: This study employed a qualitative research design using a multiple case study approach. Data were collected through in-depth interviews, focus group discussions, and document analysis involving 18 stakeholders, including policymakers, public health managers, healthcare professionals, information technology personnel, and community representatives. Participants were selected using purposive sampling based on their involvement in digital health initiatives. Data were analyzed using thematic analysis in NVivo, with triangulation to enhance the credibility of the findings.

Results: The study identified four major themes influencing digital transformation in public health services: digital infrastructure readiness, collaborative innovation among stakeholders, institutional and governance challenges, and perceived impacts on service delivery. Participants emphasized that integrated health information systems improved reporting efficiency and program monitoring. However, challenges related to system interoperability, regulatory fragmentation, and institutional coordination were reported as barriers to effective implementation.

Conclusion: Digital transformation in public health services is shaped by the interaction between technological infrastructure, collaborative innovation, and governance capacity. Strengthening digital health governance, promoting cross-sector collaboration, and improving institutional digital capacity are essential to ensure sustainable and effective digital health implementation.

Keywords: Collaborative Innovation; Digital Health; Health Governance; Public Health Services



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INTRODUCTION

Public health systems are increasingly challenged by complex health problems, rapid epidemiological transitions, and rising community expectations for accessible and efficient health services [1]. Traditional service delivery models often struggle to respond effectively to these dynamics due to fragmented information systems, limited coordination among institutions, and slow policy adaptation [2]. In many settings, these limitations hinder public health systems' ability to deliver timely, data-driven, and integrated services [3]. Consequently, the integration of digital technologies within public health governance has become a strategic priority for improving service quality, strengthening surveillance systems, and enhancing decision-making processes [4].

Digital transformation in the public health sector extends beyond the simple adoption of information technology. It represents a structural change in how health institutions collect, manage, analyze, and utilize health data to support service delivery and policy formulation [5]. Digital health platforms, electronic medical records, telehealth services, and integrated health information systems have demonstrated the potential to improve efficiency, transparency, and service accessibility [6]. Empirical studies have shown that digital health innovations can strengthen disease surveillance, support real-time monitoring of health indicators, and facilitate coordination across different levels of the health system. However, the effectiveness of digital transformation depends heavily on governance structures, institutional capacity, and stakeholder collaboration [7].

Recent literature emphasizes that technological solutions alone are insufficient to achieve sustainable improvements in public health systems. Collaborative innovation involving government agencies, healthcare providers, technology developers, and communities is increasingly recognized as a key mechanism for enabling successful digital transformation [8]. Studies highlight that cross-sector collaboration supports knowledge sharing, resource mobilization, and adaptive policy implementation [9]. Through collaborative governance models, digital innovations can be co-developed and tailored to local health system needs. Despite this growing recognition, the operationalization of collaborative innovation within digital public health initiatives remains uneven and insufficiently understood, particularly in decentralized health systems [10].

Existing research on digital health transformation tends to focus primarily on technological adoption, infrastructure readiness, or system performance indicators [11]. While these studies contribute valuable insights into the technical aspects of digitalization, they often overlook the institutional processes, stakeholder interactions, and governance dynamics that shape innovation outcomes [12]. Moreover, empirical evidence examining how collaborative innovation processes influence the implementation of digital transformation in public health services remains limited. This gap is particularly evident in developing contexts, where institutional capacity, policy coordination, and digital governance structures vary significantly across regions.

Addressing this gap is critical because digital transformation in public health does not occur in isolation; it is embedded within complex governance networks that involve multiple actors with diverse interests and capacities. Understanding how collaborative innovation emerges, evolves, and influences service delivery can provide deeper insights into the mechanisms that enable or constrain digital health initiatives. Without such understanding, digital transformation efforts risk becoming technology-driven projects that fail to produce sustainable improvements in public health outcomes.

This study offers a novel contribution by examining digital transformation in public health services through the lens of collaborative innovation and governance dynamics. Rather than focusing solely on technological adoption, this research investigates how interactions among institutional actors shape the development and implementation of digital health initiatives. By employing a qualitative research approach, the study seeks to capture the perspectives, experiences, and institutional practices that underpin collaborative digital innovation in public health systems.

The objective of this research is to explore how digital transformation and collaborative innovation interact in shaping public health service delivery. Specifically, the study aims to identify key actors involved in digital health initiatives, analyze collaborative processes that facilitate innovation, and examine the institutional challenges that influence the sustainability of digital transformation in public health services.

MATERIALS AND METHODS

Study Design

This study employed a qualitative research design, using a multiple-case study approach, to explore how digital transformation and collaborative innovation are implemented within public health service systems. A qualitative approach was selected because it enables an in-depth examination of institutional processes, stakeholder interactions, and governance dynamics that cannot be adequately captured through quantitative measurement. The case study strategy allows the investigation of real-world contexts where digital health initiatives are implemented and where collaboration among public health actors occurs.

Setting and Participants

The study was conducted in public health institutions, including local health offices and primary healthcare facilities that have implemented digital health initiatives. Data collection took place between January and June 2025. Participants consisted of stakeholders involved in digital public health programs, including policymakers, health service managers, healthcare professionals, information technology personnel, and community representatives. Participants were selected through purposive sampling to ensure informants had relevant knowledge and experience in digital transformation and collaborative governance in public health services. Inclusion criteria included individuals who were directly involved in digital health policy development, implementation, or management for at least one year. Individuals who were not directly engaged in digital health initiatives were excluded from the study.

Variables and Measurement

In qualitative research, the primary analytical constructs in this study included digital transformation processes, collaborative innovation mechanisms, governance structures, and institutional challenges in public health service delivery. These constructs were operationalized through thematic indicators derived from existing literature on digital health governance and collaborative public sector innovation.

Data sources consisted primarily of primary data obtained from in-depth interviews and focus group discussions. Secondary data were collected from policy documents, strategic plans, digital health program reports, and institutional regulations related to digital transformation in the health sector. Interview guides were developed based on theoretical constructs and were reviewed by experts in public health and health policy to ensure content validity. Reliability of findings was strengthened through triangulation of data sources and researcher reflexivity.

Data Collection

Data were collected using three main techniques: in-depth semi-structured interviews, focus group discussions (FGDs), and document analysis. Interviews were conducted with key stakeholders to explore their experiences and perspectives regarding digital transformation and collaborative innovation processes. Each interview lasted approximately 45–60 minutes and was audio-recorded with participant consent. Focus group discussions were conducted to facilitate collective reflection among stakeholders regarding collaborative practices and challenges in digital health implementation. In addition, relevant institutional documents and digital health policy reports were reviewed to complement interview data. Quality control procedures included standardizing the interview protocol, verifying audio recordings, conducting verbatim transcription, and member checking with selected participants to confirm the accuracy of the interpreted findings.

Data Analysis

Data analysis followed a thematic analysis framework. Interview and FGD transcripts were systematically coded to identify patterns related to digital innovation processes, collaboration mechanisms, governance arrangements, and implementation barriers. The analysis process included data familiarization, initial coding, theme development, theme refinement, and interpretation. To enhance analytical rigor, data triangulation was performed across interviews, FGD, and document sources. Coding procedures were conducted iteratively to ensure conceptual consistency across themes.

Ethical Approval

Ethical approval for this study was obtained from the Institutional Ethics Committee of the affiliated university before data collection. All participants received detailed information about the study objectives, procedures, confidentiality protections, and their rights to voluntary participation. Written informed consent was obtained from each participant before interviews or discussions were conducted. Participant identities were anonymized in transcripts and publications to ensure confidentiality.

RESULTS

Table. Participant Characteristics

Stakeholder Category	Number of Participants (n)	Description
Polymakers	4	Officials responsible for policy formulation and digital health governance
Public Health Service Managers	5	Managers of health programs and health service administration
Healthcare Professionals	4	Medical and public health practitioners involved in service delivery
Information Technology Personnel	3	Technical staff responsible for digital health systems and infrastructure
Community Representatives	2	Community stakeholders involved in public health initiatives
Total Participants	18	Participants from multiple stakeholder groups

Table 1. Themes and Subthemes of Digital Transformation and Collaborative Innovation in Public Health Services

Theme	Subtheme	Description
Digital Infrastructure for Public Health Transformation	Integrated health information systems	Implementation of electronic reporting systems and integrated health databases to support real-time monitoring and decision-making
	Interoperability challenges	Limited integration among multiple digital platforms used in public health services
	Digital capacity of institutions	Variation in technical skills and digital readiness among health institutions
Collaborative Innovation Among Stakeholders	Cross-sector partnerships	Collaboration between government agencies, universities, and technology developers in digital health initiatives
	Knowledge sharing mechanisms	Stakeholder forums, workshops, and collaborative platforms facilitate the exchange of expertise.
	Co-development of digital solutions	Joint design of digital tools aligned with public health service needs
Institutional and Governance Challenges	Regulatory fragmentation	Inconsistent policies and overlapping regulations affect digital health implementation.
	Institutional coordination	Limited coordination across administrative levels in the health system
	Leadership and strategic direction	Importance of leadership commitment in sustaining digital transformation
Impact on Public Health Service Delivery	Improved service accessibility	Digital platforms supporting wider access to public health services
	Faster surveillance and reporting	Real-time monitoring of health indicators and disease trends
	Program monitoring and evaluation	Digital data supporting evidence-based health program management

Theme 1: Digital Infrastructure as a Foundation for Public Health Transformation

Participants consistently emphasized that reliable digital infrastructure is a prerequisite for successful digital transformation in public health services. Health information systems, electronic medical records, and integrated reporting platforms were perceived as essential tools for improving data management and service efficiency.

One health service manager explained:

"Digital systems help us monitor health data more quickly. Previously, reporting from health centers could take weeks, but now information can be accessed in real time."

However, participants also reported challenges related to system interoperability and uneven digital capacity across institutions. An information technology officer noted:

"Many applications exist, but they are not always connected. Sometimes we must enter the same data into different systems."

Theme 2: Collaborative Innovation Among Stakeholders

Collaborative engagement among government agencies, healthcare providers, and technology partners emerged as a key driver of digital innovation. Participants described collaboration as essential for aligning technical solutions with public health needs and local service contexts. A policymaker stated:

"Digital transformation cannot be implemented by the health office alone. We need collaboration with technology developers, universities, and community organizations to design systems that are actually useful."

Focus group discussions further revealed that collaborative forums and cross-sector partnerships facilitated knowledge sharing and accelerated innovation in digital health programs.

Theme 3: Institutional and Governance Challenges

Despite the potential benefits of digital transformation, participants highlighted several governance barriers that hinder implementation. These included regulatory fragmentation, limited institutional capacity, and insufficient coordination between administrative levels of the health system. A public health professional commented:

"Sometimes policies supporting digital health exist at the national level, but implementation at the local level is still unclear. This creates uncertainty for program execution."

Participants also emphasized the need for stronger leadership and clearer governance frameworks to support sustainable digital innovation in public health services.

Theme 4: Perceived Impact on Public Health Service Delivery

Participants generally perceived that digital transformation contributed to improved service accessibility, faster reporting systems, and better monitoring of public health programs. Digital platforms were considered particularly useful for disease surveillance, health program management, and inter-institutional coordination. A healthcare worker stated:

"With digital reporting systems, we can quickly identify emerging health problems in the community and respond faster."

However, several participants stressed that technological improvements must be accompanied by capacity building and organizational change to achieve sustainable benefits. Overall, the findings indicate that digital transformation in public health services is shaped not only by technological infrastructure but also by collaborative innovation processes and stakeholder governance arrangements.



Figure 1. Conceptual Framework of Digital Transformation and Collaborative Innovation in Public Health Services

This conceptual framework illustrates how digital transformation and collaborative innovation interact to strengthen public health service delivery. Digital infrastructure, including integrated e-health systems, data integration, and technological accessibility, provides the operational foundation for digital health initiatives. Collaborative innovation among stakeholders, such as government agencies, healthcare providers, technology developers, and communities, facilitates the co-creation of solutions and knowledge exchange. However, institutional and governance challenges, including regulatory fragmentation, resource limitations, and leadership capacity, influence implementation processes. Through effective digital health governance, these components collectively contribute to improved public health outcomes, including enhanced service accessibility, system efficiency, and community health resilience.

DISCUSSION

This study explored how digital transformation and collaborative innovation interact in shaping public health service delivery. The findings indicate that digital infrastructure, collaborative stakeholder engagement, and governance capacity jointly determine the effectiveness of digital health initiatives. Participants consistently emphasized that integrated digital systems and reliable information infrastructure are fundamental for improving health service management, surveillance, and reporting processes. However, the results also show that technological availability alone is insufficient to ensure successful transformation. Instead, collaborative innovation among multiple actors, including policymakers, healthcare providers, information technology professionals, and community stakeholders, plays a critical role in aligning technological solutions with the operational needs of public health systems. In addition, institutional and governance challenges, particularly regulatory fragmentation and coordination gaps across administrative levels, significantly influence the sustainability and scalability of digital health initiatives [13].

The findings can be interpreted through the lens of collaborative governance and digital transformation theory in the public sector. Digital transformation in public health represents not merely the adoption of new technologies but a systemic change in organizational processes, institutional structures, and decision-making mechanisms [14]. According to digital governance frameworks, the effectiveness of digital transformation depends on integrating technological capacity, institutional readiness, and stakeholder collaboration. The results support the argument that digital transformation in complex public systems is fundamentally a socio-technical process [15]. Technological infrastructure provides the technical backbone for innovation, yet the actual impact of digital initiatives emerges through interactions among institutional actors [16]. Collaborative innovation mechanisms such as knowledge sharing, joint problem-solving, and co-development of digital tools enable health organizations to adapt technological solutions to specific service delivery contexts [17]. This finding aligns with collaborative governance theory, which suggests that multi-stakeholder engagement can enhance policy implementation by facilitating resource pooling, shared learning, and collective problem-solving [18].

Furthermore, the study highlights the role of governance capacity in shaping the trajectory of digital health transformation. Regulatory clarity, institutional coordination, and leadership commitment were repeatedly identified as enabling conditions for sustainable innovation [19]. In decentralized health systems, governance fragmentation can create inconsistencies between national digital health policies and local implementation practices [20]. Therefore, effective digital transformation requires governance mechanisms that align policy frameworks, institutional capacities, and technological development [21].

This study contributes conceptually by integrating perspectives on digital transformation and collaborative innovation within the context of public health service delivery. Previous research often focuses on technological readiness or system performance indicators [22]. In

contrast, the present study demonstrates that digital transformation should be understood as a multi-actor governance process embedded within institutional networks [23]. By highlighting the interactions among digital infrastructure, collaborative innovation processes, and governance structures, the study offers a more comprehensive understanding of how digital health initiatives evolve within complex public sector environments [24].

From a systemic perspective, the findings imply that public health digitalization strategies should prioritize institutional collaboration and governance integration rather than focusing exclusively on technological deployment [25]. Investments in digital infrastructure must be accompanied by mechanisms that foster cross-sector partnerships, inter-organizational learning, and participatory innovation processes [26]. Strengthening governance capacity, particularly in policy coordination, regulatory alignment, and leadership commitment, can enhance the sustainability of digital health initiatives and ensure that technological innovations translate into tangible improvements in public health outcomes [27]. In addition, the findings highlight the importance of building digital competencies among health professionals and institutional actors. Capacity-building initiatives, training programs, and digital literacy development are essential for enabling public health organizations to effectively utilize digital tools. Without adequate human resource capacity, digital systems risk underutilization or fragmentation across institutions [28].

Strengths and Limitations

This study has several strengths. First, the qualitative design enabled an in-depth exploration of institutional dynamics, stakeholder perspectives, and governance processes that shape digital transformation in public health services. By involving multiple stakeholder groups, the study captured diverse perspectives on digital innovation, which enhances the richness and credibility of the findings. Second, the use of multiple data sources, including interviews, focus group discussions, and document analysis, strengthened methodological rigor through data triangulation. However, several limitations should be acknowledged. The study was conducted across a limited number of institutional contexts, which may limit the transferability of its findings to other health systems with different governance structures or digital capacities.

Additionally, qualitative research relies on participants' experiences and perceptions, which may introduce interpretive bias. Although triangulation and member checking were applied to enhance trustworthiness, the findings should be interpreted as contextually grounded insights rather than universally generalizable conclusions. Future research could expand this line of inquiry by integrating mixed-method approaches that combine qualitative institutional analysis with quantitative evaluation of digital health outcomes. Comparative studies across different regions or health systems may also provide deeper insights into how governance structures influence the success of digital transformation in public health.

CONCLUSIONS

This study examined how digital transformation and collaborative innovation interact to shape public health service delivery. The findings demonstrate that the effectiveness of digital health initiatives depends not only on the availability of digital infrastructure but also on the strength of collaborative processes and the health system's governance capacity. Integrated health information systems enable faster reporting, improved data management, and more responsive health program monitoring. However, sustainable digital transformation requires coordinated collaboration among policymakers, healthcare providers, technology developers, and community stakeholders. Institutional challenges such as regulatory fragmentation, uneven digital capacity, and limited inter-organizational coordination remain key barriers to implementation. Overall, the study highlights that digital transformation in public health should be approached as a systemic governance process rather than a purely technological intervention. Strengthening digital health governance, promoting cross-sector collaboration, and investing in human resource capacity are essential to ensure that digital innovations

translate into improved public health services and outcomes.

Based on these findings, policymakers should prioritize integrated digital health strategies that support interoperability of health information systems, establish collaborative innovation platforms among stakeholders, and develop regulatory frameworks that facilitate coordinated digital health implementation. Such policy actions can enhance the sustainability and effectiveness of digital transformation in public health systems.

Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Committee of Politeknik Sandi Karsa before data collection. All participants received clear information about the study objectives, procedures, confidentiality, and voluntary participation. Written informed consent was obtained from each participant, and anonymity was ensured throughout data collection, analysis, and publication.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

Authors' Contributions

Suprpto contributed to the study conception and design, data collection, data analysis, interpretation of findings, and manuscript preparation. The author reviewed and approved the final version of the manuscript.

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