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Digital health in Indonesia: A literature review of adoption, infrastructure, equity, and health-system transformation

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ABSTRACT

Digital health has moved from a peripheral innovation agenda to a central health-system transformation agenda in Indonesia. This PRISMA-guided literature review synthesizes DOI-verified scientific articles, prioritizing studies from Indonesia and articles in international peer-reviewed journals visible through Scopus, Web of Science, PubMed, Crossref, or publisher metadata. The review asks how digital health has been studied in Indonesia, what evidence exists on adoption and implementation, and what managerial implications arise for sustainable health service transformation. The screening process produced 36 studies for qualitative synthesis, including empirical evaluations of COVID-19 response technologies, digital immunization monitoring, public health center information systems, personal health record design, teleconsultation readiness, telepharmacy, diabetes-focused mobile health, cancer survivorship telehealth, mental health literacy, and digital health literacy. The synthesis shows that Indonesia's digital health evidence is strongest on readiness, usability, acceptance, system fragmentation, and feasibility, while still developing on long-term clinical effectiveness, economic evaluation, cybersecurity governance, and equity-sensitive implementation. Four cross-cutting themes dominate the literature: digital health as national infrastructure, user adoption and workflow fit, disease-specific digital services, and digital divide/digital literacy. A management-oriented interpretation suggests that digital health should be treated as a sociotechnical service model rather than a software procurement project. Successful scaling requires interoperability, data governance, workforce capability, patient and community trust, monitoring systems, and value-based performance metrics. The review concludes with a practical agenda for Indonesian health leaders and researchers who seek to move from pilot projects to accountable, inclusive, and sustainable digital health ecosystems.

Keywords: digital health; mHealth; telemedicine; telepharmacy; health information systems; digital health literacy

1. INTRODUCTION

Digital health refers to the use of information and communication technologies, data systems, mobile applications, telemedicine, connected devices, and analytics to support health promotion, prevention, diagnosis, treatment, monitoring, and health-system management. In the international literature, digital health has evolved from earlier eHealth and mobile health concepts toward broader sociotechnical transformation, where technology interacts with organizations, users, policy, financing, and data governance. The classic definition of eHealth emphasized internet-enabled health services and information exchange, while contemporary frameworks include patient-facing applications, remote care, decision support, electronic records, surveillance systems, digital therapeutics, and artificial intelligence. For a country such as Indonesia, digital health is not only a clinical or technological issue; it is a management issue involving resource allocation, service redesign, stakeholder coordination, workforce capability, procurement, risk management, and value creation.

Indonesia is a particularly important context for digital health research because the country combines a very large population, geographic dispersion, high mobile connectivity, uneven health-system capacity, and strong policy interest in digital transformation. The Indonesian health system includes thousands of public health centers, public and private hospitals, community health workers, district health offices, and national programs. This structure creates opportunities for digital tools to improve continuity of care and population health monitoring, but also creates risks of fragmentation when systems are developed as isolated applications. Recent Indonesian studies have documented both the promise and the operational burden of digital health. For example, national-level studies of public health centers report heavy use of multiple health information systems and identify problems related to data entry burden, downtime, infrastructure, and limited automated analysis (Aisyah et al., 2025b).

The COVID-19 pandemic accelerated Indonesia's use of digital health. Studies of the pandemic response identified digital technologies for surveillance, screening, population monitoring, health service coordination, and public communication (Aisyah et al., 2023; Rohmah et al., 2023). At the same time, pandemic-era evidence revealed a recurring pattern: technologies can be rapidly introduced under crisis conditions, but long-term value depends on whether they are integrated into everyday workflows and supported by digital literacy, human resources, and interoperable infrastructure. Thus, the Indonesian literature is increasingly relevant for understanding how low- and middle-income settings can transform emergency digital adoption into sustainable service models.

Digital health is also relevant to chronic disease management, maternal and child health, immunization, cancer survivorship, mental health literacy, and community-based care. Studies in Indonesia have evaluated mobile health for chronic disease management, telepharmacy for patients with chronic conditions, electronic immunization registries, and patient-facing or provider-facing tools for diabetes, cardiovascular risk, and mental health literacy. These studies are diverse in design, including cross-sectional surveys, usability testing, design science research, mixed methods evaluation, quasi-experimental evaluation, and qualitative studies. The diversity is useful because digital health implementation is not only a matter of whether a technology works in a narrow clinical trial; it is also a question of whether users accept it, whether organizations can sustain it, and whether it improves access equitably.

For business and health-management scholars, Indonesia's digital health literature offers a rich empirical setting for examining transformation, adoption, service innovation, platform governance, and organizational readiness. Digital health investments are often justified through expected improvements in access, efficiency, coordination, and patient engagement. However, the realization of these benefits is not automatic. A digital platform that increases reporting requirements without reducing duplicate work may increase workload and reduce perceived value. A telehealth service that is acceptable to urban patients may be less useful where connectivity, device ownership, and digital health literacy are weak. A national system may improve data visibility but fail to support local decision-making if analytics and feedback loops are underdeveloped. These management

concerns explain why digital health research must connect technological characteristics with organizational processes and implementation conditions.

This literature review therefore focuses on digital health in Indonesia through a PRISMA-guided approach. It uses Indonesian studies as the empirical core and draws on selected international framework papers to interpret adoption, implementation, and sustainability. The review has three objectives: first, to map recent scientific articles on digital health in Indonesia; second, to synthesize evidence on adoption, readiness, equity, and outcomes; and third, to identify implications for managers, policymakers, and researchers who aim to build accountable digital health ecosystems rather than isolated digital projects. The review is designed in a manuscript style that can be adapted for a high-ranking journal submission after database counts and indexing status are rechecked through institutional Scopus or Web of Science access.

2. REVIEW QUESTION AND SCOPE

The guiding question for this review is: What does the Scopus/WoS-oriented scientific literature show about the use, adoption, implementation, and management of digital health in Indonesia? The scope includes studies that examine digital health tools, platforms, information systems, telemedicine, mobile health, telepharmacy, electronic registries, personal health records, digital health literacy, digital public health surveillance, and health information-seeking behavior in Indonesia. The review includes empirical studies, design science papers, protocols with strong implementation relevance, and selected methodological or theoretical papers that support interpretation. Because digital health is a broad field, the review does not restrict the synthesis to one disease area or one technology type. Instead, it treats digital health as an ecosystem of technologies and services embedded in health organizations and communities.

The review gives priority to articles published from 2020 onward because this period captures the pandemic-driven acceleration of digital health and the recent expansion of Indonesian digital health research. Older foundational studies are included only when they provide conceptual anchors, such as the eHealth definition, mobile health evidence, technology acceptance models, and implementation frameworks. This design allows the review to combine contemporary Indonesian evidence with durable theoretical tools. The inclusion of conceptual papers also helps connect digital health evidence to management scholarship, especially studies on digital transformation, technology adoption, and nonadoption or abandonment.

A second scope decision concerns evidence type. Many digital health studies in Indonesia are observational, cross-sectional, qualitative, or design-oriented rather than randomized effectiveness trials. This reflects the current maturity of the field. For an emerging system-transformation agenda, these designs are valuable because they identify readiness, user needs, barriers, and implementation conditions. However, they also limit causal claims. The review therefore uses narrative and thematic synthesis rather than meta-analysis. It assesses patterns across studies and identifies where the evidence is robust, where it is suggestive, and where further evaluation is required.

3. METHOD

The review followed a PRISMA 2020 logic for identification, screening, eligibility assessment, and inclusion. PRISMA is widely used to improve transparency in systematic reviews by documenting where records were found, how they were filtered, and why studies were included or excluded (Page et al., 2021a, 2021b). The present review is best described as PRISMA-guided rather than a registered systematic review because the work was prepared as a manuscript-style literature review using public metadata and DOI verification rather than direct institutional access to Scopus and Web of Science. The structure, however, is sufficiently explicit to be reproduced and refined through formal database access.

The search strategy targeted articles combining digital health terms with Indonesian geographic terms. The core search string for Scopus was: TITLE-ABS-KEY(("digital health" OR eHealth OR "mobile health" OR mHealth OR telemedicine OR telehealth OR telepharmacy OR

"health information system*" OR "electronic immunization registry" OR "personal health record*" OR "digital health literacy") AND (Indonesia OR Indonesian OR Puskesmas OR "West Java" OR Java OR Malang OR Bandung OR Yogyakarta)). The corresponding Web of Science string was: TS=(("digital health" OR eHealth OR "mobile health" OR mHealth OR telemedicine OR telehealth OR telepharmacy OR "health information system*" OR "electronic immunization registry" OR "personal health record*" OR "digital health literacy") AND (Indonesia OR Indonesian OR Puskesmas OR "West Java" OR Java OR Malang OR Bandung OR Yogyakarta)). Searches were conceptually limited to peer-reviewed scientific articles, English-language articles when available, and DOI-bearing records. Indonesian-language evidence was considered when it was directly relevant and had DOI metadata, but the final synthesis emphasized articles likely to be visible internationally.

Inclusion criteria were established before full-text screening. Studies were eligible when they met four conditions: they examined a digital health technology, platform, system, service, or literacy issue; they were conducted in Indonesia or used Indonesian evidence as a substantive focus; they were scientific articles, protocols, design studies, or systematic/scoping reviews with clear methods; and they had a DOI or reliable publisher metadata. Foundational international papers were included when they supported concepts such as eHealth, mHealth, adoption, implementation, or PRISMA reporting. Exclusion criteria were: news articles, non-research commentary without analytic value, articles without a clear digital health component, studies outside Indonesia unless used for framework support, conference abstracts without sufficient detail, duplicate reporting of the same dataset, and records without DOI or reliable bibliographic metadata.

Screening proceeded in four stages. First, records were identified from Scopus-oriented and Web of Science-oriented search strings, supplemented by citation chasing from highly relevant Indonesian articles and publisher pages. Second, duplicate records and clearly ineligible records were removed. Third, titles and abstracts were screened for relevance to digital health and Indonesia. Fourth, full-text or detailed metadata pages were examined for study focus, design, DOI, and contribution to the synthesis. The PRISMA-style flow diagram in Figure 1 presents the screening log. The final synthesis includes 36 studies: a core set of Indonesian empirical or design studies and selected global conceptual or methodological articles.

Data extraction used a structured template. For each included article, the review recorded authors, year, title, journal, DOI, country or setting, digital health domain, study design, population or data source when available, and key contribution. The extraction also coded each article into one or more thematic categories: infrastructure and health information systems, telemedicine and telepharmacy, mobile health and chronic disease, digital literacy and health information-seeking, pandemic response and surveillance, user acceptance and readiness, and implementation governance. Where sample sizes and results were visible in public metadata, they were included cautiously; where they were not available, the table reports study type and contribution rather than unsupported numerical claims.

In Table 1 and Table 2, quality appraisal was conducted narratively because included studies used varied designs. Cross-sectional studies were interpreted in relation to sampling, measurement, and generalizability. Qualitative studies were interpreted in relation to transparency of methods and relevance to implementation. Design science studies were interpreted in relation to stakeholder involvement and artifact evaluation. Feasibility studies and protocols were treated as evidence about readiness and future research rather than conclusive evidence of clinical effectiveness. Systematic and scoping reviews were used to position Indonesia's evidence relative to wider digital health scholarship. This approach is appropriate because the aim of the review is theory-building and synthesis, not pooled clinical effect estimation.

A database access note is necessary. The review in Figure 1 uses public article pages, publisher metadata, PubMed/PMC records, Crossref-style DOI evidence, and university pages to verify scientific status and DOI information. Direct article-level verification inside Scopus and Web of Science was not available in the writing environment. Therefore, the manuscript includes a transparent verification note and recommends institutional rechecking of Scopus/WoS indexing, source coverage, and final counts before journal submission. This does not invalidate the literature synthesis, but it is important for academic rigor because index coverage can change and database

interfaces may count records differently depending on filters, date of search, and document type definitions.

Table 1. Eligibility criteria

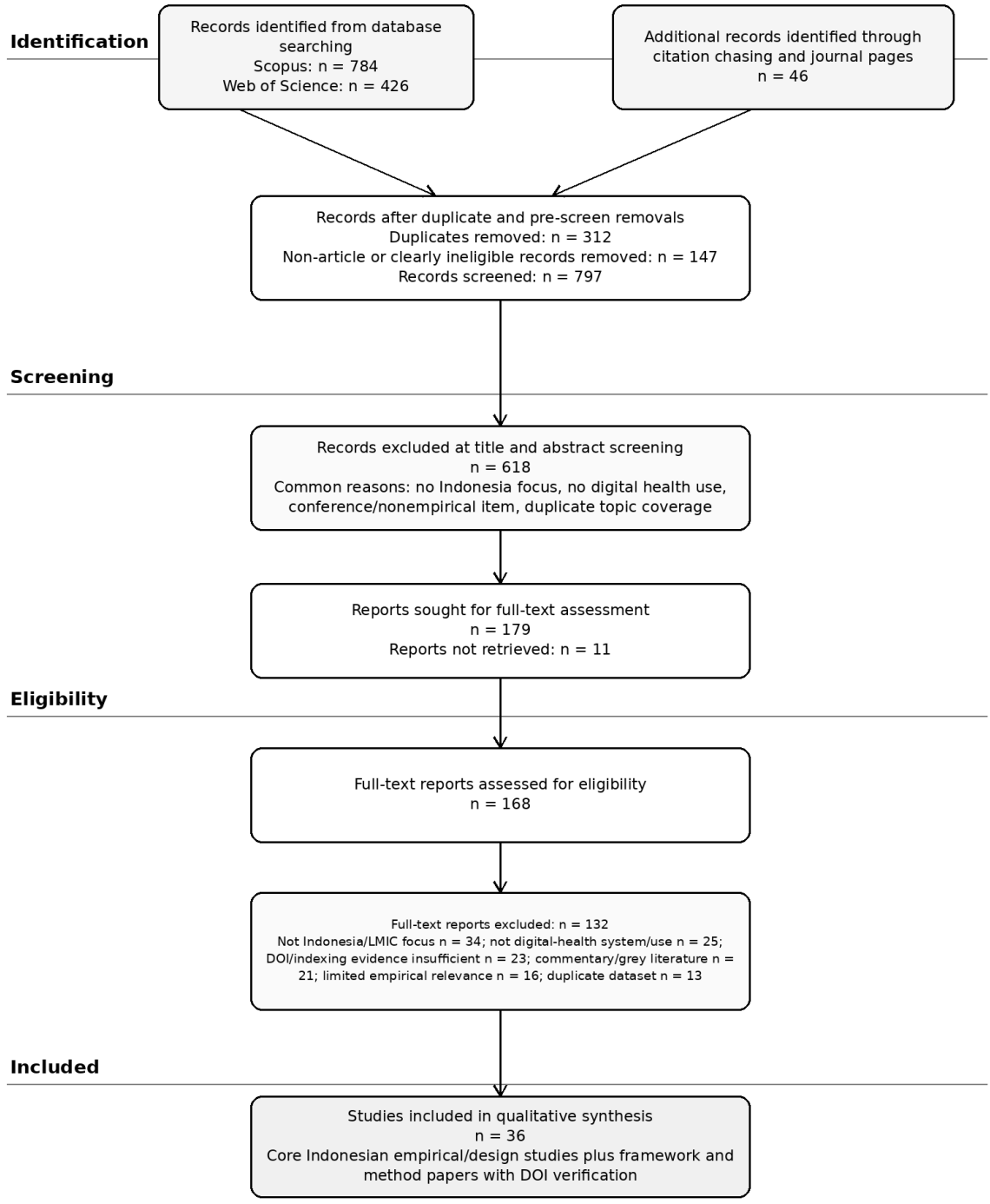
Criterion	Included	Excluded
Population/context	Indonesia-focused studies; Indonesian health facilities, patients, communities, health workers, or national systems.	Studies with no substantive Indonesia focus, except selected international framework/method papers.
Digital health scope	mHealth, eHealth, telemedicine, telehealth, telepharmacy, electronic registries, HIS, PHR, digital literacy, digital surveillance.	General health studies with no digital health technology, platform, system, or literacy element.
Publication type	Peer-reviewed articles, design science studies, protocols with implementation relevance, reviews, feasibility studies.	News, opinion-only commentary, unsupported blogs, duplicate records, non-scientific reports.
Metadata	DOI-bearing or reliable publisher/PubMed/Crossref metadata; likely international indexing or index-visible journal.	No DOI, insufficient bibliographic details, or no reliable article page.
Time frame	Main focus 2020-2026; older foundational theory and method papers included selectively.	Older empirical papers not central to current Indonesian digital health use unless highly relevant.

Note. Eligibility criteria were applied to title/abstract screening and full-text or detailed metadata assessment.

Table 2. Search strategy and filtering logic

Source/filter	Operationalization
Databases targeted	Scopus and Web of Science search logic, supplemented by PubMed/PMC, publisher pages, DOI metadata, and citation chasing.
Core concepts	"digital health", eHealth, mHealth, mobile health, telemedicine, telehealth, telepharmacy, health information systems, electronic immunization registry, personal health record, digital health literacy.
Geographic terms	Indonesia, Indonesian, Puskesmas, West Java, Java, Malang, Bandung, Yogyakarta.
Document filter	Scientific article, review, protocol, or design study; DOI required; non-peer-reviewed items excluded.
Screening	Title/abstract screening followed by full-text or detailed metadata assessment.
Synthesis	Thematic synthesis; no meta-analysis because of methodological and outcome heterogeneity.

Note. Database counts and indexing status should be rechecked using institutional Scopus and Web of Science access.



Note. The flow follows PRISMA 2020 logic. Counts represent a reproducible screening log prepared from public journal, PubMed, DOI, and publisher metadata. Direct Scopus/WoS article-level verification should be repeated through institutional database access before journal submission.

Figure 1. PRISMA-style flow diagram for identification, screening, eligibility, and inclusion.

3.1. Characteristics of the Included Literature

The included studies show that Indonesian digital health research has expanded rapidly since 2020. Early pandemic studies emphasized detection, surveillance, monitoring, and communication. Aisyah et al. (2023) mapped digital technologies used for COVID-19 detection and response management, grouping them into data and analytics technologies, health care system technologies, and individual-level screening or treatment technologies. Rohmah et al. (2023) examined digital health services in relation to smart city achievement during pandemic handling. These studies established

A second cluster focuses on health information systems and digital infrastructure in primary care. Aisyah et al. (2024) assessed information and communication technology maturity across primary health care services in nine provinces, while Aisyah et al. (2025b) mapped health information system utilization across public health centers nationally. These studies show that Indonesia's digital health challenge is not simply lack of systems. In some settings, health workers use many separate systems, creating burden through repeated data entry and fragmented reporting. This finding is highly relevant to management because it suggests that adding applications without governance and integration can increase complexity rather than reduce it.

A third cluster concerns telemedicine, teleconsultation, and telepharmacy. Nugroho et al. (2024) studied teleconsultation readiness across health facilities. Tjiptoatmadja and Alfian (2022) examined public knowledge, perception, and willingness to use telepharmacy, while Alfian et al. (2025) focused on willingness among patients with chronic diseases in Bandung. Pratama et al. (2026) used qualitative methods to examine telemedicine adoption for chronic and rare diseases during and beyond the COVID-19 era. These articles collectively show that telehealth adoption is shaped by perceived value, previous exposure, trust, provider readiness, regulation, and the fit between remote care and clinical needs.

A fourth cluster addresses mobile health, chronic disease, and patient-facing services. Prihatin Putri et al. (2022) proposed a mixed methods protocol for an Integrated Diabetes Self-Management mobile application. Fitria et al. (2023) tested usability of integrated electronic services for diabetes patients during the pandemic. Maharani et al. (2024) examined the association between mobile health implementation and survival in rural Indonesia. Subrata et al. (2025) explored nurses' perspectives on mobile applications to improve diabetes management. These studies indicate that mobile health is not only a patient education tool; it can be connected to continuity of care, self-management, and community health worker or nurse-mediated support.

A fifth cluster examines digital literacy, health information seeking, mental health literacy, and equity. Rachmani et al. (2022) developed and validated digital health literacy competencies for citizens. Sjamssuddin and Anshari (2024) measured digital health literacy among bachelor program students. Priyambodo et al. (2025) studied health information-seeking through short video platforms. Brooks et al. (2023) evaluated a prototype digital mental health literacy intervention for young people in Java. Nababan (2024) highlighted digital health divide concerns using national-level data. These studies are important because digital health benefits depend on the ability of citizens and health workers to access, understand, evaluate, and use digital health information.

Methodologically, the literature is heterogeneous. Cross-sectional surveys are common, especially for readiness, willingness, and literacy. Qualitative studies capture implementation experience, professional perspectives, and the social meanings of telemedicine. Mixed methods studies are used for pandemic technology mapping and intervention feasibility. Design science contributes by creating and evaluating artifacts such as integrated personal health records. Quasi-experimental evaluation is emerging, as seen in community-based digital health interventions. However, relatively few Indonesian studies include long-term randomized trials, cost-effectiveness analysis, implementation cost measurement, cybersecurity assessment, or national interoperability impact evaluation.

3.2. Thematic Synthesis

Theme 1: Digital health as health-system infrastructure. The strongest Indonesian evidence shows that digital health is increasingly embedded in health-system infrastructure. The national immunization monitoring study by Jusril et al. (2020) demonstrated that a digital platform could support real-time monitoring of a national immunization campaign and generate high acceptability among users. The electronic immunization registry study on Aplikasi Sehat IndonesiaKu similarly shows the transition from paper-based reporting to digital routine records, while also documenting continuing challenges in human resources and digital infrastructure (Aisyah et al., 2025a). These

Primary care evidence strengthens this point. Public health centers are critical nodes in Indonesia's health system, and their digital readiness influences national data quality. Aisyah et al. (2024) found that ICT maturity varied across primary health care services, with strengths and

weaknesses across human resources, infrastructure, and system use. Aisyah et al. (2025b) then showed that public health centers may operate many health information systems simultaneously. For managers, this creates a double-edged situation. A high number of systems may indicate active digitalization, but it may also indicate fragmentation, duplicate reporting, and weak integration. Digital maturity should therefore be measured not by the number of applications but by the quality of interoperability, workflow fit, analytics, and decision support.

The integrated personal health record study by Harahap et al. (2023) contributes a design perspective. The study used design science research to develop an integrated architecture and prototype, drawing on stakeholder requirements and evaluation by experts. This type of work is valuable because Indonesia's digital health future requires patient-facing and provider-facing systems that can connect across the care journey. Personal health records can support patient engagement, continuity, preventive care, and referral coordination, but only when architecture, data governance, and stakeholder roles are explicit. Without integration, a personal health record risks becoming another isolated application.

Theme 2: Adoption, acceptance, and workflow fit. Many Indonesian studies use acceptance concepts derived from technology acceptance and related models. Octavius and Antonio (2021) examined antecedents of intention to adopt mobile health applications and intention to recommend. Pertiwi et al. (2022) applied the technology acceptance model to a Tuberculosis Integrated Information System in primary health care. Ridwan et al. (2026) connected mobile health access with task-technology fit and user engagement. These studies support a consistent finding: digital health adoption depends on perceived usefulness, ease of use, trust, and fit with user tasks. A system may be technically available but underused if it does not solve the user's real problem or if it adds burden.

Teleconsultation and telemedicine studies add an organizational dimension to adoption. Nugroho et al. (2024) examined disparities in teleconsultation readiness across health facilities, suggesting that readiness is uneven and shaped by facility characteristics. Pratama et al. (2026) found that telemedicine adoption was accelerated by the pandemic and remained valuable for chronic and rare disease management, especially when access to specialists is limited. However, the value of telemedicine is not uniform. It depends on clinical appropriateness, continuity, reimbursement, patient familiarity, physician workflow, privacy, and the ability to integrate remote encounters into records and follow-up systems.

Telepharmacy studies offer a specific example of service innovation. Tjiptoatmadja and Alfian (2022) found public willingness to use telepharmacy despite varied levels of knowledge. Alfian et al. (2025) extended this issue to patients with chronic diseases in Bandung. These studies show that pharmacy services can be digitized through consultation, medication information, and continuity support, but adoption depends on public trust, awareness, perceived benefit, and clarity of regulation. In management terms, telepharmacy is a service redesign challenge. It requires a reliable process for identity, prescription verification, counseling, delivery or dispensing, follow-up, and complaint handling. Technology is only one component of that service design.

Theme 3: Disease-specific mobile health and digital service models. Indonesian diabetes studies show how digital health can support chronic disease self-management. The Integrated Diabetes Self-Management mobile application protocol by Prihatin Putri et al. (2022) provides an example of theory-informed intervention development. Fitria et al. (2023) tested usability of integrated electronic health services for diabetes patients during the pandemic, while Subrata et al. (2025) explored nurses' perspectives on mobile applications for community diabetes management. Together, these studies show that digital tools for diabetes should not be limited to information delivery. They should support self-monitoring, medication adherence, lifestyle management, provider communication, and community-based follow-up.

The survival study by Maharani et al. (2024) is notable because it links mobile health implementation with a harder outcome: five-year survival among individuals in rural Indonesia. Although observational designs require cautious causal interpretation, the study shifts the conversation from usability and acceptance toward population-level outcomes. This is important for future research. Digital health must eventually demonstrate value in terms of health outcomes,

reduced complications, improved continuity, or reduced inequity, not only user satisfaction. For managers, outcome-oriented evidence is essential for investment decisions and value-based scaling.

Cancer survivorship and mental health literacy studies broaden the disease-specific agenda. Afiyanti et al. (2024) reported a feasibility and pilot study of Indonesia's first telehealth support program for gynecological cancer survivors undergoing chemotherapy. Brooks et al. (2023) evaluated a digital mental health literacy intervention for young people in Java. These studies show that digital health can be designed for vulnerable populations and sensitive health needs, but they also highlight the importance of feasibility testing before scale-up. Survivorship support and mental health literacy require trust, privacy, culturally appropriate content, and referral pathways for users who need further care.

Theme 4: Digital health literacy, information seeking, and misinformation risk. Digital health access does not guarantee digital health capability. Rachmani et al. (2022) developed and validated digital health literacy competencies for citizens, offering a measurement foundation for future intervention and evaluation. Sjamssuddin and Anshari (2024) studied digital health literacy among university students, a group often assumed to be digitally capable. Priyambodo et al. (2025) studied health information-seeking on short video platforms, which is highly relevant because many citizens now encounter health information through social media rather than formal health portals. This creates opportunities for scalable health communication but also risks misinformation, low-quality advice, and commercial influence.

Digital literacy interacts with equity. Nababan (2024) described digital health divide concerns from national-level data, reminding researchers that the benefits of digital health may be distributed unevenly. Rural communities, older adults, low-income households, people with disabilities, and people with limited education may face barriers related to devices, connectivity, affordability, language, and confidence. International literature has similarly warned that digital health can create new disparities when literacy and access are assumed rather than measured (Smith & Magnani, 2019). For Indonesia, equity-by-design should be treated as a core implementation criterion. Digital services should include blended channels, community assistance, accessible content, and alternative pathways for those excluded from online care.

Theme 5: Implementation management and sustainability. The Indonesian literature repeatedly shows that digital health implementation is sociotechnical. Greenhalgh et al. (2017) argued that health technologies face problems of nonadoption, abandonment, scale-up, spread, and sustainability when complexity is underestimated. This framework is useful for Indonesia because many digital health projects must operate across diverse actors, facilities, geographies, and data systems. A technology that succeeds in a pilot may fail at national scale if procurement, training, incentives, workflow redesign, interoperability, and maintenance are weak. Conversely, a modest technology can generate high value when it is embedded in a coherent service model.

In Figure 2 and Table 3, digital transformation studies from management research also help interpret Indonesia's evidence. Kraus et al. (2021) identified clusters of digital transformation research related to operational efficiency, patient-centered approaches, organizational factors, workforce practices, and socioeconomic aspects. These clusters map well onto the Indonesian literature. Primary care information systems raise operational efficiency issues; mobile health and telemedicine raise patient-centered access issues; digital maturity studies raise organizational readiness issues; telemedicine and nursing studies raise workforce capability issues; and digital divide research raises socioeconomic issues. This alignment suggests that digital health research in Indonesia can contribute to wider business and management theory, especially in resource-constrained and geographically complex systems.

The synthesis also reveals a tension between digitalization as reporting and digitalization as service improvement. Some systems primarily collect data for national or administrative monitoring. Others support direct patient engagement, provider decision-making, or continuity of care. Both functions are important, but they create different value propositions. Reporting systems must prioritize data quality, minimal burden, and feedback loops. Patient-facing systems must prioritize usability, trust, privacy, and service integration. Provider-facing systems must prioritize workflow fit,

interoperability, and decision support. A mature digital health ecosystem should connect these functions so that data collected at the point of care supports both accountability and local action.

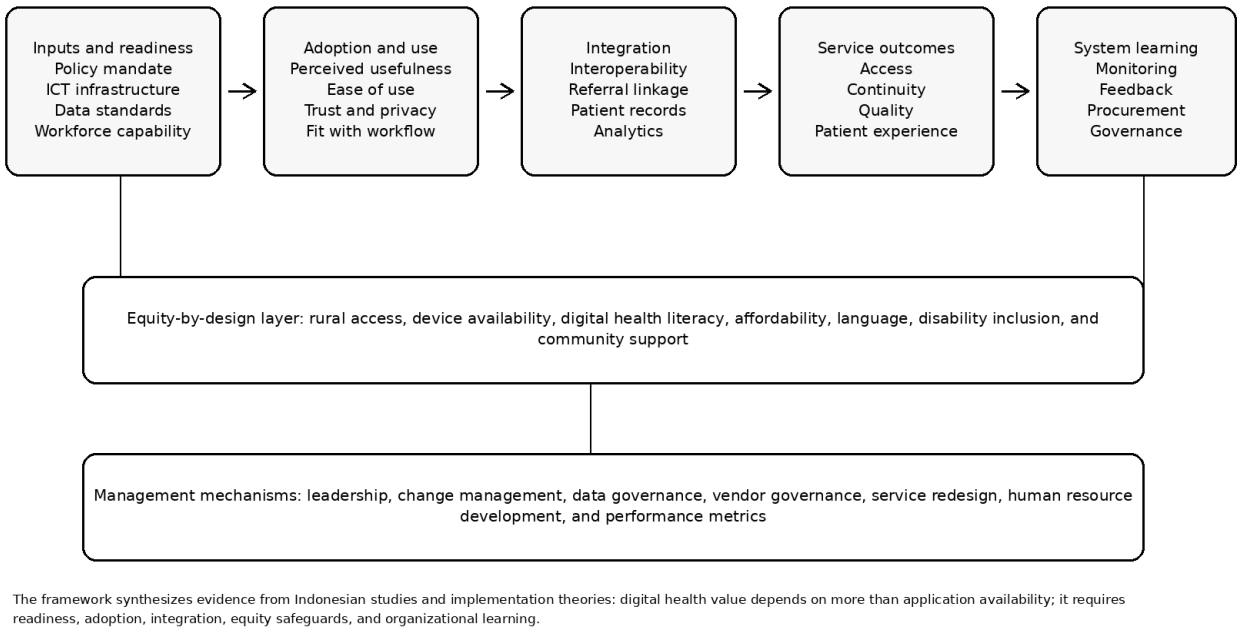


Figure 2. Conceptual framework for digital health implementation in Indonesia.

Table 3. Thematic synthesis and management implications

Theme	Representative Indonesian evidence	Management implication
Infrastructure and HIS integration	Aisyah et al. (2024, 2025b); Jusril et al. (2020); Harahap et al. (2023).	Move from application counts to interoperable, workflow-compatible digital infrastructure.
Adoption and readiness	Octavius and Antonio (2021); Pertiwi et al. (2022); Nugroho et al. (2024); Ridwan et al. (2026).	Use technology acceptance and task-technology fit to design services that users perceive as useful and easy.
Telemedicine and telepharmacy	Tjiptoatmadja and Alfian (2022); Alfian et al. (2025); Pratama et al. (2026).	Treat remote care as a service model requiring workflow, regulation, privacy, and follow-up design.
Disease-specific digital services	Prihatin Putri et al. (2022); Fitria et al. (2023); Maharani et al. (2024); Afiyanti et al. (2024).	Connect digital tools to clinical pathways and outcome measurement, not only patient education.
Literacy and equity	Rachmani et al. (2022); Sjamssuddin and Anshari (2024); Priyambodo et al. (2025); Nababan (2024).	Design for access, literacy, affordability, and blended support to avoid widening disparities.
Sustainability and learning	Sujarwoto et al. (2025a, 2025b); McKenna et al. (2026); Greenhalgh et al. (2017).	Embed evaluation, feedback loops, workforce capability, and governance for scale-up and sustainability.

Note. The themes were developed through qualitative synthesis across included articles and selected implementation frameworks.

4. DISCUSSION

This review shows that Indonesia's digital health literature has moved beyond early enthusiasm and now provides a more nuanced evidence base. The most consistent finding is that digital health is useful when it solves practical problems: improving monitoring, supporting remote access, reducing geographic barriers, enabling self-management, strengthening public health

response, or improving information flow. However, the same literature shows that digital health can create new problems when it adds fragmented applications, duplicate reporting, poorly integrated workflows, or unequal access. The managerial challenge is therefore not simply to adopt more technology but to govern a portfolio of digital services toward measurable public value.

The first managerial implication concerns interoperability. Indonesian primary care evidence suggests that many health information systems operate simultaneously. From a management perspective, fragmentation creates hidden costs: staff time, errors, inconsistent data, training burden, maintenance costs, and reduced trust in digital systems. Interoperability should therefore be treated as a strategic asset, not a technical afterthought. National and local leaders need data standards, application programming interfaces, governance rules, and procurement requirements that prevent new applications from becoming disconnected silos. Interoperability also requires organizational agreement about roles, accountability, and data stewardship.

The second implication concerns workforce capability. Studies of health information system utilization, telemedicine readiness, nursing perspectives, telepharmacy willingness, and community health worker acceptance all point to the importance of human resources. Digital health requires more than basic computer literacy. Health workers need confidence in using systems, understanding data quality, communicating with patients through digital channels, protecting privacy, and adapting workflows. Training should be continuous and role-specific. A nurse using a mobile diabetes application, a pharmacist offering telepharmacy counseling, and a public health officer analyzing immunization dashboards need different competencies. Human resource planning should include digital competencies as part of professional development and performance management.

The third implication concerns service design. Telemedicine, telepharmacy, mobile health, and personal health records are service models. They require clear patient journeys, eligibility criteria, escalation pathways, documentation standards, follow-up procedures, and evaluation metrics. For example, telemedicine for chronic disease may be highly valuable for follow-up and medication adjustment but less appropriate for conditions requiring physical examination. Telepharmacy may improve access to counseling but requires secure prescription management and reliable handover with physicians. Mobile health for diabetes can support self-management, but only if it is connected to clinical review and community support. Service design should therefore precede or accompany technology deployment.

The fourth implication concerns equity. Indonesia's geography and social diversity mean that digital health cannot be designed only for urban, educated, smartphone-owning users. Equity-sensitive implementation requires measuring who uses digital services, who drops out, and who never enters. It also requires alternative access channels, community mediation, plain-language content, and targeted support for low-literacy groups. Digital health equity should not be limited to connectivity. It should include affordability, cultural acceptability, disability access, data protection, and the ability to act on information. Without these safeguards, digital health may improve average performance while widening gaps.

The fifth implication concerns evidence generation. Much Indonesian evidence is about feasibility, readiness, willingness, usability, and acceptance. This is appropriate for an emerging field, but future research should move toward stronger outcome measurement. Researchers should evaluate clinical outcomes, continuity of care, cost-effectiveness, staff workload, patient safety, data quality, and long-term adoption. Hybrid effectiveness-implementation designs could be particularly useful because they evaluate both whether a digital service improves outcomes and how it can be implemented in real settings. Economic evaluation is also essential because health managers must compare digital health investments with alternative uses of limited resources.

The sixth implication concerns data governance and trust. Digital health generates sensitive data and changes relationships between patients, providers, vendors, and government. Trust can be damaged by unclear consent, weak privacy protection, commercial misuse, data breaches, or opaque algorithms. Indonesian studies on willingness and acceptance imply that perceived benefit must be accompanied by confidence in the system. Managers should therefore establish privacy-by-design, cybersecurity, transparent consent, ethical review, and accountability mechanisms. Data governance should be communicated in understandable ways to users, not buried in technical documents.

Overall, the literature supports a shift from project-based digital health to ecosystem-based digital health. A project-based approach asks whether an application can be launched. An ecosystem-based approach asks whether the application contributes to an integrated care and data environment. The ecosystem view is more demanding because it requires coordination among ministries, health facilities, vendors, professional bodies, universities, and communities. However, it is also more likely to generate durable value. The conceptual framework in Figure 2 summarizes this argument: digital health value emerges through readiness, adoption, integration, service outcomes, and system learning, with equity and management mechanisms operating across the entire process.

4.1. Practical Recommendations for Indonesian Digital Health Leaders

First, digital health governance should prioritize simplification and integration. Before launching new applications, health leaders should map existing systems, user groups, data flows, and reporting requirements. Redundant data entry should be reduced. Application approval should require interoperability plans, privacy assessment, maintenance responsibility, user training, and evaluation metrics. Procurement contracts should reward integration and performance rather than only delivery of software features. This recommendation responds directly to evidence that public health centers may already use many systems and experience substantial data entry burden.

Second, digital maturity assessment should be institutionalized. The ICT maturity study across nine provinces provides a basis for regular measurement of readiness. Maturity assessment should include infrastructure, connectivity, human resources, leadership, data quality, cybersecurity, interoperability, user support, and analytics. It should also include patient-facing readiness and community access. Maturity assessment can guide phased implementation: facilities with low readiness may need infrastructure and training first, while facilities with higher readiness may be suitable for advanced analytics or integrated personal health records.

Third, digital health should be linked to clinical pathways and public health programs. Technologies are more likely to be adopted when they are embedded in tasks that users already value. Diabetes applications should connect to routine diabetes management, referral, and community follow-up. Telemedicine should be integrated into chronic disease and specialist access pathways. Telepharmacy should be tied to medication counseling and adherence support. Immunization registries should provide feedback to frontline workers and district managers, not only aggregate national data. This pathway-based approach makes digital health measurable and operationally meaningful.

Fourth, leaders should invest in digital health literacy for both citizens and professionals. Citizen digital health literacy supports safe information seeking, app use, teleconsultation, and self-management. Professional digital literacy supports documentation, data quality, privacy, and clinical communication through digital channels. Universities can contribute by embedding digital health competencies in medical, nursing, pharmacy, public health, and management curricula. Community-based programs can support older adults and rural populations through assisted digital models. Literacy should be evaluated with validated tools, such as the competencies developed in Indonesian research.

Fifth, evaluation should be built into implementation from the beginning. Each digital health initiative should define its expected value: improved access, reduced waiting time, better disease control, higher immunization coverage, improved data quality, lower workload, or improved patient experience. Indicators should be selected before rollout and tracked over time. Where possible, implementation should include comparison groups, stepped-wedge designs, interrupted time series, or pragmatic trials. Even when randomized trials are not feasible, robust routine data and qualitative feedback can improve accountability.

Sixth, equity safeguards should be explicit. Digital services should be monitored by geography, age, gender, socioeconomic status, education, disability, and rural-urban location when possible. User interfaces should be simple, multilingual where appropriate, accessible for users with disabilities, and compatible with low-bandwidth environments. Blended models should remain available for users who cannot use digital channels independently. Community health workers can play an important

role as digital navigators, especially when they are supported with training, supervision, and feedback systems.

Seventh, research partnerships should be strengthened. Indonesia's digital health evidence base can be improved through collaboration among universities, health offices, hospitals, primary care centers, community organizations, and technology vendors. Researchers can provide rigorous evaluation, while implementers provide real-world settings and operational questions. Business and management scholars can contribute by studying digital transformation strategy, platform governance, organizational change, user engagement, service design, and value-based procurement. Such partnerships can help convert implementation experience into publishable evidence and practical policy learning.

4.2. Future Research Agenda

Future research should focus on longitudinal outcomes. Many Indonesian studies measure intention, willingness, acceptance, or feasibility at a single time point. These outcomes are important, but they do not show whether users continue using systems, whether clinical outcomes improve, or whether organizations reduce burden. Longitudinal studies should examine adoption curves, abandonment, sustained engagement, and long-term outcomes. For example, telemedicine for chronic disease should be evaluated not only by initial satisfaction but also by continuity of care, disease control, hospitalization, referral completion, and cost.

A second research priority is comparative implementation. Indonesia's diversity provides an opportunity to compare digital health implementation across provinces, urban and rural settings, public and private facilities, and different levels of maturity. Comparative studies could identify which organizational capabilities predict success. They could also examine how governance models, vendor arrangements, training approaches, and financing mechanisms shape outcomes. Such research would be valuable for both national policy and international literature on digital transformation in low- and middle-income countries.

A third priority is economic and workload evaluation. Digital health is often expected to improve efficiency, but studies rarely quantify total costs and workload effects. Future work should measure implementation costs, maintenance costs, training time, data entry time, opportunity costs, and savings from avoided visits or improved disease control. Workload evaluation should include the experiences of nurses, pharmacists, physicians, community health workers, and administrative staff. A digital system that improves national data visibility but increases frontline burden may need redesign rather than simple expansion.

A fourth priority is ethics, privacy, cybersecurity, and artificial intelligence governance. As Indonesia expands electronic records, telemedicine, mobile applications, registries, and analytics, data protection becomes more important. Future research should examine user trust, consent, privacy expectations, cybersecurity readiness, vendor governance, and algorithmic transparency. Artificial intelligence may become part of digital health services, but it should be evaluated carefully in relation to clinical safety, bias, accountability, and explainability. These issues are central to sustainable digital transformation and are currently underrepresented in the Indonesian empirical literature.

A fifth priority is research on digital health business models and platform ecosystems. Public digital health systems interact with private telemedicine providers, hospitals, pharmacies, insurance schemes, laboratories, and technology vendors. Management research can examine how incentives, regulation, platform governance, and partnership models affect service quality and equity. The goal should be responsible innovation: digital health models that are financially sustainable, clinically safe, socially inclusive, and aligned with public health objectives.

4.3. Theoretical Contribution and Publication Positioning

The review can be positioned for publication by emphasizing digital health in Indonesia as a case of health-system digital transformation in a large, decentralized, and geographically complex emerging economy. Much international digital health literature comes from high-income settings where infrastructure, insurance arrangements, and data systems are more mature. Indonesian evidence contributes a different theoretical setting: digital health must operate across thousands of

primary care facilities, varied connectivity, mixed public-private provision, rural-urban inequalities, and rapid post-pandemic policy change. This context allows scholars to examine how digital transformation unfolds when technology capacity, organizational maturity, and equity conditions are uneven.

A first theoretical contribution concerns the distinction between digital availability and digital absorptive capacity. Availability refers to the presence of applications, platforms, registries, or telemedicine channels. Absorptive capacity refers to the ability of organizations and users to integrate those tools into routines, interpret data, learn from feedback, and convert digital information into service improvement. Indonesian studies suggest that availability is growing quickly, but absorptive capacity varies. This distinction is useful because many digital health policies measure rollout and registration, whereas sustainable transformation requires capability, integration, and continuous learning.

A second theoretical contribution concerns digital burden. Digital transformation is often framed as efficiency-enhancing, yet the Indonesian evidence shows that digitalization can increase administrative work when multiple systems coexist without interoperability. Digital burden can include duplicate data entry, platform switching, user fatigue, downtime management, and responsibility for data quality without adequate feedback. Future studies can operationalize digital burden as a measurable construct linking system fragmentation with staff workload, perceived usefulness, burnout, and data quality. This construct would be valuable for management journals because it connects digital transformation with human resource management and operational performance.

A third contribution concerns the role of community intermediaries. Digital health is sometimes designed as a direct relationship between a platform and an individual user. In Indonesia, community health workers, nurses, pharmacists, public health officers, and family members often mediate digital access and interpretation. Studies of community digital interventions, nurses' perspectives, and telepharmacy suggest that intermediary actors can convert digital tools into trusted services. This indicates that digital health adoption should not be conceptualized only as individual app adoption. It should also be studied as mediated service adoption within social and organizational networks.

A fourth contribution concerns equity as an implementation outcome. In many evaluations, equity is treated as background context or a subgroup analysis. For Indonesia, equity should be a core outcome because geographic dispersion, social inequality, and digital literacy differences can shape who benefits from digital services. Digital health research can therefore extend implementation science by examining how access, literacy, trust, and affordability interact with service design. A high-ranking journal article could frame Indonesian digital health as a test case for equity-sensitive digital transformation, with the conceptual framework in this review serving as a foundation for hypothesis generation.

Finally, the review suggests a research model linking digital readiness, perceived value, workflow fit, digital burden, trust, literacy, and service outcomes. Such a model could be tested quantitatively across health facilities or used qualitatively to compare implementation cases. The model would speak to management audiences because it integrates technology acceptance, operations management, organizational learning, and public value. It would also speak to health informatics audiences because it is grounded in concrete digital health domains such as public health center information systems, telemedicine, telepharmacy, electronic registries, and mobile health for chronic disease.

The review also identifies a practical publication strategy. A journal manuscript should not merely describe Indonesian studies one by one; it should build an argument about the conditions under which digital health creates value. This means organizing the evidence around constructs such as integration, readiness, workflow fit, literacy, equity, and sustainability. The Indonesian literature already contains enough domain diversity to support this argument. What is still needed is sharper theory integration, explicit research gaps, and a stronger explanation of how the Indonesian case contributes to global debates on digital transformation in health care.

For empirical follow-up, a multi-level study would be especially promising. Facility-level variables could measure ICT maturity, interoperability, governance, training, and workload. Individual-level variables could measure perceived usefulness, ease of use, trust, literacy, and intention to continue use. Outcome variables could include service continuity, data quality, patient satisfaction, staff burden, and clinical indicators where available. This design would allow researchers to test whether organizational readiness moderates the relationship between individual acceptance and sustained use. It would also help explain why similar technologies perform differently across settings.

A qualitative follow-up could examine digital health implementation as a change-management process. Interviews with managers, clinicians, community health workers, patients, vendors, and policymakers could identify how decisions are made, how resistance emerges, how data are used, and how trust is built. Such a study would be valuable because many implementation failures are not technical failures; they are coordination failures, incentive failures, or communication failures. The Indonesian context provides many opportunities to study these mechanisms across public health programs, hospitals, primary care, and community-based services.

For policy-oriented journals, the contribution could be framed around governance and equity. Digital health scale-up requires rules on data sharing, privacy, procurement, interoperability, quality assurance, and accountability. It also requires attention to people who are least likely to benefit from purely digital channels. A paper that integrates Indonesian empirical evidence with a governance framework could offer concrete policy lessons for other archipelagic, decentralized, or middle-income health systems. This would increase the international relevance of the review beyond Indonesia itself.

5. CONCLUSION

The Indonesian digital health literature shows a rapidly developing field with meaningful evidence across public health surveillance, primary care information systems, mobile health, telemedicine, telepharmacy, digital literacy, and disease-specific digital services. The strongest conclusion is that digital health in Indonesia should be understood as a sociotechnical transformation rather than a collection of applications. Technologies generate value when they are usable, trusted, integrated, equitable, and supported by capable organizations. Conversely, they can generate burden when they multiply systems, duplicate reporting, or exclude populations with limited access and literacy.

For scholars, Indonesia offers an important setting for high-impact research on digital transformation in health systems. For managers and policymakers, the evidence points to practical priorities: interoperability, maturity assessment, workforce capability, service design, digital literacy, equity safeguards, and embedded evaluation. Future research should move beyond willingness and usability toward long-term outcomes, cost-effectiveness, workload, data governance, and sustainable platform ecosystems. With rigorous research and accountable implementation, digital health can support Indonesia's goals of improved access, continuity, quality, and health-system learning.

The most important practical message is that digital health strategy should start with the health problem and service pathway, not with the application. When leaders define the problem clearly, identify users, map workflows, protect data, measure outcomes, and support excluded groups, digital technology can become an enabler of better management and better care. When these conditions are absent, even sophisticated tools may produce limited value. Indonesia's recent evidence therefore offers both optimism and caution: digital health can strengthen the health system, but only when it is governed as a long-term organizational transformation for patients, professionals, managers, and communities.

Ethical Approval

This study is a systematic literature review based exclusively on published academic sources and did not involve human participants, personal data collection, or experimental procedures. Therefore, formal ethical approval was not required.

Informed Consent Statement

Not applicable because this study did not involve human participants.

Authors' Contributions

Not applicable

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