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Artificial Intelligence in Healthcare in Indonesia: Are We Ready to Race for Golden Indonesia 2045?

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Abstract
Indonesia stands at a decisive moment in implementing artificial intelligence (AI) to advance its healthcare system toward the Golden Indonesia 2045 vision. Despite promising clinical results, substantial gaps in infrastructure, regulation, and workforce capacity persist. This analytical review evaluates the current implementation of AI in Indonesian healthcare, identifies key barriers, and proposes strategic recommendations to achieve equitable and responsible AI integration aligned with national development goals. A narrative synthesis was conducted using targeted literature from PubMed, Google Scholar, Garuda, and SINTA (2020–2025), supplemented by national policy documents, SATUSEHAT governance reports, and Delphi consensus studies. Forty-two sources addressing clinical applications, regulatory frameworks, infrastructure, workforce readiness, and equity were thematically analyzed. Comparative benchmarking included regional maturity catalogues and international standards (EU AI Act, Singapore, Australia). AI demonstrates strong efficacy in diagnostics (e.g., 89.3% accuracy in diabetic retinopathy screening), telemedicine, and chronic disease management. However, Indonesia's AI healthcare maturity score (52/100) lags behind Singapore (92) and Malaysia (78), constrained by fragmented regulation, rural digital divides, limited workforce AI literacy (≈58.7% lacking competence), and governance gaps in transparency and explainability. Coordinated policy reform, infrastructure investment, workforce training, and equity-focused implementation are essential to prevent technological dependency and fulfill AI's potential for achieving universal health coverage by 2045.

Keywords: Artificial Intelligence (AI); Indonesian Healthcare System; Healthcare Infrastructure.

INTRODUCTION

Indonesia is facing a critical juncture in implementing artificial intelligence (AI) to transform its healthcare system. While significant progress has been made in demonstrating the efficacy of AI to improve diagnostic accuracy (87.5%), healthcare efficiency (82.3%), and the quality of clinical decision-making (85.2%), substantial barriers remain in terms of infrastructure, regulatory frameworks, and human resource capacity (Ahmadi & Wening, 2025). This analytical review aims to assess the current state of AI implementation in Indonesian healthcare, identify critical challenges hindering progress, and propose evidence-based strategies aligned with the Golden Indonesia Vision 2045. The analysis reveals that Indonesia, despite achieving a health AI maturity index of 52 out of 100, still lags significantly behind regional peers such as Singapore (92) and Malaysia (78) (Mulijono, 2025). The path forward for the nation requires coordinated action across infrastructure, policy, and human resource development to ensure that AI-driven healthcare transformation delivers equitable benefits to all Indonesians.

Indonesian healthcare institutions have initiated AI applications across multiple clinical domains with accountable and promising results. Recent systematic reviews note that AI applications in diagnostic imaging, telemedicine services, and chronic disease management indicate particularly strong evidence emerging from specialized centers (Ahmadi & Wening, 2025). A comprehensive analysis of AI-based telemedicine systems for chronic disease

management suggests significant improvements in the treatment index, with medication compliance scores increasing from an average of 6.8 to 8.9 ($p < 0.001$) following a three-month intervention period (Sari, 2025). Features such as medication reminders, self-monitoring interfaces, and interactive chatbots have proven effective in supporting patient participation, positioning these systems as "digital companions" for disease management (Sari, 2025).

In the case of Indonesia's unique geographical context, several innovative AI applications have been implemented. For diabetic retinopathy screening—a leading preventable cause of blindness—deep learning models achieved 89.3% accuracy (95% CI: 86.7–92.1%) with 91.7% sensitivity for detecting referable disease in Southeast Asian populations, demonstrating both clinical efficacy and stakeholder acceptance (87.5% patient trust, 90.0% physician interest) (Deivita et al., 2025). Similarly, AI-based applications for cervical cancer screening in resource-limited settings have achieved sensitivity of 80% and specificity of 96.4%, with an area under the ROC curve of 0.85 (95% CI: 0.66–1.0), comparable to experienced oncologists (Harsono et al., 2022). These applications address critical public health priorities in a context where specialist availability is severely constrained (Mangoma & Sulistiadi, 2024).

The implementation of the SATUSEHAT national integrated health service platform represents a foundational step toward a unified digital health infrastructure (Puspitasari & T, 2025). This ecosystem has become central to governance frameworks for responsible AI adoption in Indonesian healthcare, with 24 measurable governance indicators achieving expert consensus through Delphi processes (Puspitasari & T, 2025). High-priority indicators include clinical safety metrics (e.g., AUROC thresholds), data privacy compliance documentation, system integration standards (SATUSEHAT compatibility), and cybersecurity readiness assessments (incident response protocols) (Puspitasari & T, 2025).

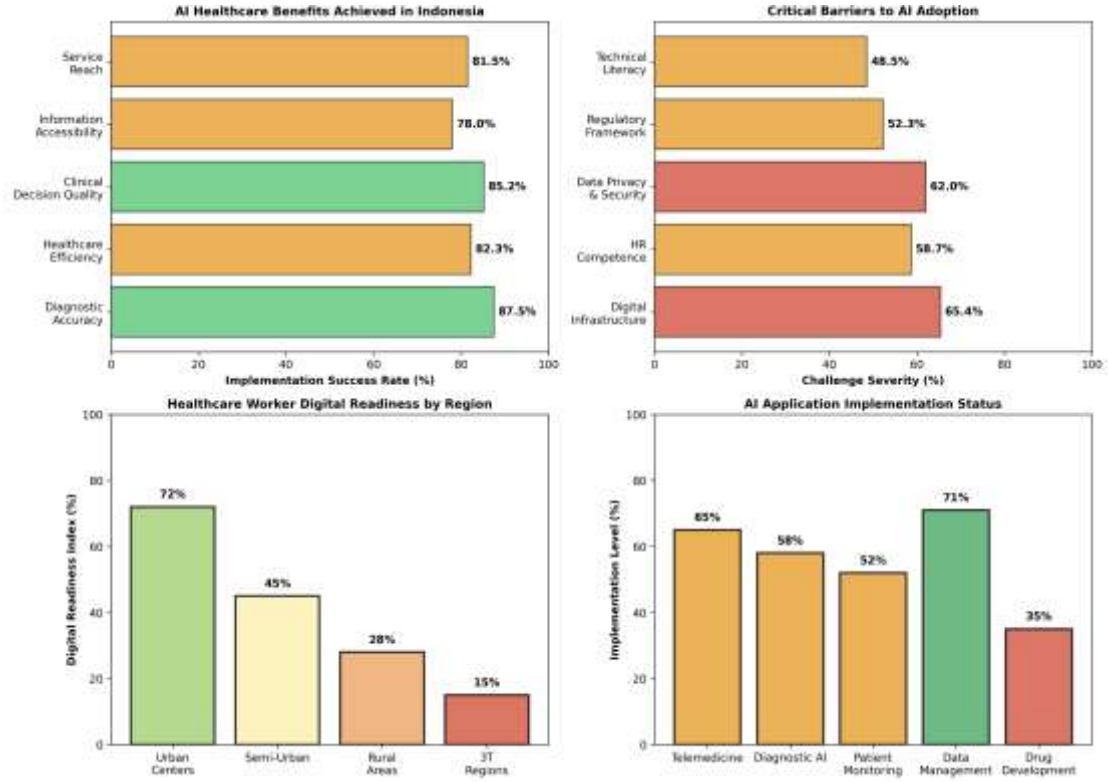

Figure. 1 Overview on the Indonesian Healthcare

However, the integration of AI with the SATUSEHAT program and other national platforms remains incomplete. Transparency-related indicators, such as training data

summaries and model cards, failed to reach consensus among experts, highlighting institutional gaps in AI explainability and the emerging state of governance capacity (Puspitasari & T, 2025). This gap between technical capability and governance complexity represents a critical bottleneck for scaling AI implementation across Indonesia's heterogeneous healthcare system (Wasir et al., 2025).

Indonesia's regulation of AI in healthcare remains fragmented and inadequate. While Law No. 17 of 2023 on Health and Government Regulation (PP) No. 28 of 2024 provide general authority for health technology adoption, neither legislation contains specific provisions addressing AI-related challenges (Islami et al., 2025). A normative legal analysis reveals that current regulations fail to address fundamental issues, including liability for AI errors, algorithm transparency, and real-time data handling protocols (Sebastian, 2024).

The Personal Data Protection Law (UU PDP) enacted in 2022 represents Indonesia's primary framework for data privacy governance, yet implementation challenges persist, particularly in healthcare contexts where data sensitivity is heightened (Zahra, 2025). Key legal gaps include: (1) the absence of clear accountability frameworks distinguishing responsibilities among AI system developers, healthcare institutions, and medical professionals; (2) limited guidance on informed consent procedures when AI systems support diagnosis or treatment decisions; (3) inadequate provisions addressing algorithmic bias and fairness in clinical decision-making; and (4) the lack of standards for algorithm auditing and validation prior to clinical implementation (Budiyanti et al., 2025).

The purpose of this study is to analyze the current state and maturity level of artificial intelligence (AI) implementation in Indonesia's health system; identify key challenges and barriers—including regulatory aspects, infrastructure, human resource readiness, and the digital divide—that hinder the widespread and equitable integration of AI; and formulate strategic recommendations that are evidence-based and aligned with the Golden Indonesia 2045 vision, in order to accelerate the adoption of responsible, sustainable, and equitable AI in transforming the national health system.

METHOD

This review utilized a narrative synthesis approach. Literature was identified through systematic searches of PubMed, Google Scholar, Garuda, and SINTA databases (January 2020–December 2025) using the keywords: "artificial intelligence," "healthcare," "Indonesia," "SATUSEHAT," "telemedicine," "digital health," and related terms. The inclusion criteria focused on peer-reviewed articles, conference proceedings, and grey literature directly addressing AI in Indonesian healthcare contexts. National regulations (Law No. 17/2023 on Health, PP No. 28/2024, Personal Data Protection Law 2022), SATUSEHAT platform documents, and Delphi-based governance consensus studies were incorporated. A total of 68 records were screened, and 42 were selected for full review based on relevance and recency. Data were thematically organized into clinical effectiveness, regulatory status, infrastructure, human resources, equity, and strategic alignment with RPJPN 2025–2045. International and regional comparisons informed the critical analysis and development of recommendations.

RESULTS AND DISCUSSION

International Benchmarking and Comparative Analysis

International comparison reveals that Indonesia lags significantly behind advanced regulatory frameworks established by the European Union, Singapore, and Australia (Sebastian, 2024). The EU's AI Act, while not healthcare-specific, provides comprehensive risk-based governance mechanisms, including transparency requirements, human oversight provisions, and algorithmic audit trails. Singapore's regulatory approach emphasizes adaptive governance with clear distinctions between clinical and support roles for AI, while Australia maintains mandatory regulatory approval processes before clinical implementation (Sebastian, 2024).

The absence of a specific legal framework addressing AI in healthcare has created a regulatory void that introduces uncertainty for healthcare providers, technology developers, and patients (Pratami & Dzulfiqar, 2024). Current law treats AI as a "tool" without independent legal status, implying that licensed medical professionals bear full responsibility for decisions supported by AI systems—a framework that may inadequately address shared accountability and complex causality in AI-related adverse events (Pratami & Dzulfiqar, 2024). This legal uncertainty serves as a significant deterrent to innovation while simultaneously failing to protect patients from algorithmic harms (Hartawati et al., 2025).

Expert Consensus on Regulatory Priorities

A rigorous Delphi-based expert consensus process involving 30 interdisciplinary experts identified agreement on 24 governance indicators but highlighted several non-consensus areas requiring immediate policy attention (Puspitasari & T, 2025). The failure to achieve consensus on transparency indicators (e.g., training data summaries, model cards) reflects institutional limitations and the lack of established best practices for AI explainability in Indonesian healthcare settings (Puspitasari & T, 2025). This suggests that regulatory development must be paired with targeted capacity-building initiatives to enable healthcare institutions to implement and sustain transparent AI systems.

Infrastructure, Capacity, and Implementation Barriers

Indonesia's healthcare system exhibits profound geographic disparities in digital readiness that directly limit the potential for AI implementation. Current assessments indicate internet connectivity coverage of 82% in urban areas but only 35% in rural regions (Mangoma & Sulistiadi, 2024). This disparity extends to essential infrastructure, including medical equipment availability (urban 78% vs. rural 28%), data management systems (urban 75% vs. rural 22%), and waste management capacity (urban 65% vs. rural 18%). These infrastructure gaps—compounded by inconsistent power supply reliability and limited technical support capacity—create fundamentally different implementation contexts across Indonesia's archipelago (Mangoma & Sulistiadi, 2024).

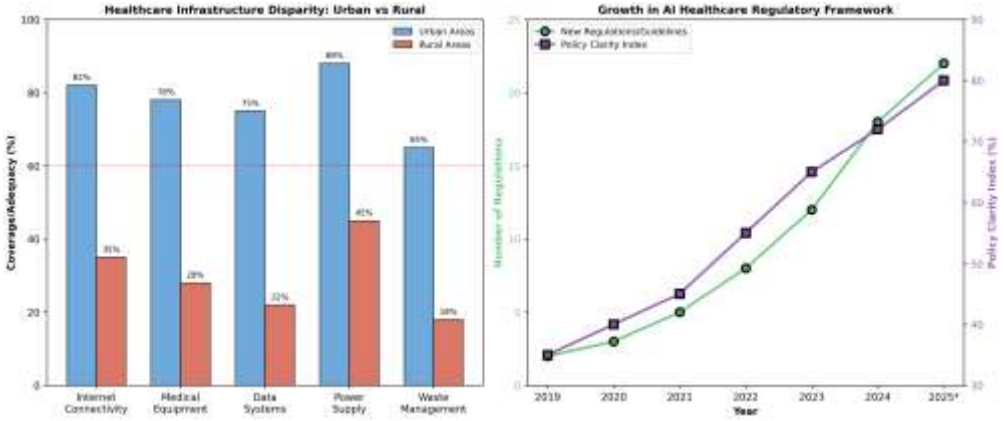

Fig. 2 Healthcare Infrastructure Readiness in Indonesia; disparity in infrastructure between urban and rural area, growth in regulation involving AI from 2019 and 2025.

The geographic disparity in digital infrastructure is not merely a technical challenge but a manifestation of deeper structural inequities. In Indonesia's 3T regions (Terdepan, Tertinggal, Terpencil; frontier, underdeveloped, and remote areas), only 15% of healthcare workers demonstrate digital readiness for AI-supported clinical work, compared to 72% in major urban centers (Wasir et al., 2025). These disparities raise critical questions about health equity: will AI-driven healthcare transformation exacerbate existing inequities by concentrating advanced technologies in urban centers, or can implementation strategies be designed to extend benefits equitably? (Mangoma & Sulistiadi, 2024).

Furthermore, inadequate competence among healthcare human resources represents a critical implementation barrier documented across multiple studies (Ahmadi & Wening, 2025). Approximately 58.7% of healthcare workers lack sufficient competence in AI system operation, interpretation, and troubleshooting (Ahmadi & Wening, 2025). Digital literacy assessments reveal that while 82.5% of Indonesian healthcare workers possess basic computer competency, fewer than 50% demonstrate proficiency in interpreting AI outputs or understanding algorithmic limitations (Ahmed et al., 2025).

The challenge extends beyond technical skills to include conceptual understanding of AI capabilities and limitations. Healthcare workers often harbor unrealistic expectations regarding AI accuracy, viewing AI outputs as infallible despite evidence of algorithmic bias and failure modes (Intani & Annisa, 2024). Training programs must therefore address not only technical operation but also the critical evaluation of AI recommendations, awareness of uncertainty quantification, and recognition of contexts in which AI reliability is inadequate for clinical decision-making (Ahmadi & Wening, 2025).

Despite the evidence of AI's benefits, considerable resistance persists among medical professionals and healthcare organizations. This resistance stems from multiple sources: legitimate concerns about professional autonomy, fear of job displacement, skepticism regarding algorithmic reliability, and uncertainty over liability for AI-related errors (Mulijono, 2025). A critical analysis of Indonesia's healthcare AI adoption barriers notes that "fierce resistance from entrenched interest groups" remains a significant impediment alongside infrastructural gaps and outdated medical training paradigms (Mulijono, 2025).

Effective change management strategies remain underdeveloped in most Indonesian healthcare institutions. Successful implementation requires not only technical upskilling but

also engagement strategies that address professional concerns, build trust in AI systems through transparent validation, and establish clear frameworks for AI-supported (rather than AI-autonomous) clinical decision-making (Sanantagraha et al., 2025). The relative lack of published implementation science research focused on Indonesian healthcare contexts highlights a key gap that must be addressed through pragmatic implementation research.

Clinical Applications and Effectiveness Evidence

AI-driven diagnostic systems have demonstrated substantial clinical utility in Indonesian healthcare contexts. Mobile health applications for cervical cancer screening using visual inspection of acetic acid (VIA) achieved high performance metrics (sensitivity 80%, specificity 96.4%, accuracy 93.8%), directly addressing a critical screening gap in resource-limited regions where trained colposcopists are unavailable (Harsono et al., 2022). Such applications exemplify how AI can extend specialist capabilities to peripheral healthcare facilities, supporting the decentralization of advanced diagnostic services (Setyoningsih et al., 2025). In pediatric dentistry, AI-powered applications for early childhood caries (ECC) detection demonstrated 90–97% accuracy with high usability scores (78.4 on the System Usability Scale), enabling parental involvement in home-based oral health monitoring and reducing clinical burdens (Hutami et al., 2025). These applications directly address Indonesia's high prevalence of preventable childhood diseases, with potential for community-based implementation (Maruf et al., 2024).

The effectiveness of such applications in developing-country contexts validates the hypothesis that AI can be adapted and deployed successfully in resource-constrained settings when designed with local context awareness (Maruf et al., 2024). Additionally, AI-based patient monitoring systems for chronic disease management have shown effectiveness in improving treatment adherence. A multicenter study in three Indonesian regions (Jakarta, Yogyakarta, East Sumba) documented that AI-supported telemedicine systems for chronic disease management produced significant increases in medication adherence (mean adherence scores increased from 6.8 to 8.9, $p < 0.001$), with sustained improvements over three-month follow-up periods (Sari, 2025). Qualitative findings revealed that patients valued the accessibility and non-stigmatizing nature of digital health support, particularly for mental health and chronic disease management (Dewi et al., 2025).

Virtual assistant systems such as VANESA (Virtual Assistant Nutritional Care Centre for Education and Consultation) demonstrate innovation in addressing healthcare resource constraints through scalable digital solutions. Designed for diabetes mellitus management in resource-limited settings, VANESA integrates rule-based and AI-based chatbot functionalities with telehealth consultation, facilitating dietary guidance and lifestyle modification support (Nuraini et al., 2025). Early implementation results suggest that such systems can extend specialized nutrition services to populations lacking access to dedicated nutritionists (Nuraini et al., 2025).

Furthermore, AI chatbots for mental health screening and support represent an important frontier, given the substantial mental health treatment gap in Indonesia. A scoping review identified seven studies demonstrating that chatbot-based mental health interventions reduced depression and anxiety symptoms while providing stigma-free access to preliminary screening and psychoeducation (Dewi et al., 2025). However, critical limitations were

identified: chatbots lack the capacity for deep clinical assessment, demonstrate limited ability to respond to dynamic clinical presentations, and carry significant risks of misdiagnosis in complex cases (Dewi et al., 2025). These limitations suggest that chatbots are optimally positioned as screening and triage tools rather than as primary treatment modalities.

Critical Analysis: Assessment of Current Progress Against Strategic Goals

An assertive but substantive analysis frames Indonesia's AI healthcare development within a strategic context of competitive disadvantage relative to China and other regional powers (Mulijono, 2025). While Western healthcare systems struggle with bureaucratic rigidity, China has launched a coordinated, government-backed strategy accelerating AI deployment across radiology, surgery, and diagnostics, positioning itself as the emerging global center of medical technology innovation (Mulijono, 2025). Indonesia, by contrast, faces infrastructural fragmentation, divergent incentives across public and private sectors, and insufficient coordination of research and implementation efforts (Mulijono, 2025).

This competitive analysis highlights an urgent need: without accelerated action, Indonesia risks technological dependency on more advanced nations, replicating healthcare systems designed for different epidemiological and socioeconomic contexts rather than developing indigenous AI solutions that address Indonesian health priorities (Mulijono, 2025). The analysis of Bethsaida Hospital's AI-driven cardiovascular care innovation (achieving restenosis rates below 2% through integrated DCB therapy and plant-based dietary interventions) demonstrates that isolated institutional excellence does not translate into system-wide transformation without policy support and resource allocation (Mulijono, 2025).

Moreover, a critical observation across multiple studies reveals an asymmetry between the technical capability to deploy AI systems and the institutional capacity to govern them responsibly. Indonesia has developed functional AI applications across multiple healthcare domains—telemedicine systems, diagnostic algorithms, and patient monitoring platforms—yet governance frameworks remain nascent (Puspitasari & T, 2025). This creates a scenario in which healthcare institutions may deploy AI systems without adequate ethical review, patient consent procedures, or fallback mechanisms when AI recommendations prove unreliable (Budiyanti et al., 2025).

The gap between governance and technical maturity has implications for public trust. Evidence indicates that patient and provider trust in AI healthcare systems depends critically on transparency and explicability—precisely the dimensions where consensus governance indicators failed to achieve expert agreement (Puspitasari & T, 2025). Without established practices for algorithm documentation, validation reporting, and explainability, public confidence in AI-driven healthcare may erode, particularly if high-profile failures occur (Intani & Annisa, 2024).

While AI offers theoretical potential to extend specialist capabilities to underserved regions, implementation patterns risk reinforcing health inequities. Data from digital health implementation studies in rural Indonesia indicate that telemedicine and AI systems are most successfully adopted by urban-based private facilities and well-resourced government hospitals (Sumarsono et al., 2022). Rural puskesmas and 3T region facilities face compounding barriers: limited broadband connectivity, insufficient power infrastructure, inadequate technical support capacity, and a workforce with limited digital skills (Mangoma & Sulistiadi, 2024).

The risk is evident in the digital divide literature: first-order digital divide (differential access to technology), second-order digital divide (differential capacity to use technology effectively), and tertiary digital divide (differential outcomes and benefits from technology use) all operate in Indonesian healthcare (Western et al., 2025). Without deliberate policy interventions and resource allocation, AI-driven healthcare transformation may be experienced

primarily by urban, affluent populations, while peripheral and rural populations are left further behind (Mangoma & Sulistiadi, 2024).

Finally, Indonesia has documented the effectiveness of multiple AI applications in controlled research settings, yet system-wide implementation remains limited. This evidence–implementation gap arises from multiple factors: inadequate financing mechanisms, fragmented responsibilities across national and local government levels, insufficient policy coherence, and limited organizational capacity for change management (Wasir et al., 2025). The gap between demonstrated efficacy (in clinical trials and pilot projects) and real-world effectiveness (in routine healthcare delivery) represents a critical challenge that implementation science research must address (Nurfadhila et al., 2026).

Strategic Recommendations: Pathways Toward Golden Indonesia 2045

As a recommendation, several actions are proposed as follows.

1. **Policy and Regulatory Development**

   Indonesia must act decisively to close the current regulatory vacuum surrounding artificial intelligence in healthcare. The immediate priority is the enactment of a comprehensive AI in Healthcare Bill that directly addresses the most pressing legal gaps. This legislation should introduce a risk-based governance framework capable of clearly distinguishing between AI systems that merely support clinical decisions and those capable of delivering autonomous recommendations. It must also establish explicit liability rules that fairly allocate responsibility among AI developers, healthcare institutions, and licensed medical professionals. Mandatory requirements for rigorous algorithm validation, independent testing, and comprehensive documentation prior to any clinical use are essential, as are clear national standards governing informed consent procedures whenever AI systems influence diagnostic or therapeutic decisions (Islami et al., 2025).

   Over the medium term (2025–2030), Indonesia should establish a National AI Healthcare Governance Authority with multidisciplinary representation—including clinicians, informaticists, ethicists, patient advocates, legal experts, and technologists—responsible for algorithm review, ongoing safety monitoring, and adaptive regulatory updates as technology and evidence evolve (Puspitasari & T, 2025). This authority should develop technical standards aligned with international best practices (EU AI Act; WHO Global Strategy on Digital Health 2020–2025) while maintaining flexibility for the Indonesian context (Mehl et al., 2023).

   In the long term, regulations should explicitly authorize and support appropriate uses of AI while establishing guardrails against inappropriate deployment. The goal is neither to inhibit innovation nor to permit unvalidated systems to reach patients but rather to enable responsible innovation (Intani & Annisa, 2024).

2. **Infrastructure and Workforce Development**

   Accelerating broadband expansion to rural and remote regions through a dedicated National Digital Health Infrastructure Fund, with explicit targets for 3T region connectivity, is the uppermost action. Priority should be given to healthcare facilities—puskesmas (primary health centers) and district hospitals—rather than general broadband expansion, ensuring that healthcare institutions can reliably deploy digital systems (Mangoma & Sulistiadi, 2024; Wasir et al., 2025).

   Furthermore, mandatory AI health literacy training should be established as a component of healthcare professional licensure and continuing education. Training should encompass: (1) technical operation of AI systems; (2) understanding of algorithmic capabilities, limitations, and failure modes; (3) recognition of algorithmic

bias and its clinical implications; (4) ethical frameworks for AI-supported decision-making; and (5) critical evaluation of AI research evidence (Ahmadi & Wening, 2025). Medical schools should integrate AI competencies into core curricula, with particular emphasis on understanding AI as a tool for decision support rather than as a means of autonomous clinical judgment (Utomo & Yan, 2025).

Moreover, healthcare institutions should be supported in developing AI governance committees, establishing patient informed consent procedures for AI-supported care, implementing AI algorithm documentation standards (e.g., model cards and training data summaries), and instituting safety monitoring protocols (Puspitasari & T, 2025). This effort requires substantial investment in institutional informatics expertise and IT security capacity (Sumarsono et al., 2022).

3. Equitable Implementation Strategy

Rather than pursuing uniform implementation of standardized AI solutions, deployment strategies should be designed to remain sensitive to local contexts. This includes: (1) partnering with community health workers and bidan desa (village midwives) who understand local health beliefs and behaviors; (2) designing systems that function with limited connectivity (offline-capable designs); (3) developing culturally appropriate interfaces and communication strategies; and (4) establishing local technical support networks to provide troubleshooting and maintenance (Nurfadhila et al., 2026; Sumarsono et al., 2022).

Next, developing sustainable financing models to ensure that AI healthcare benefits reach underserved populations is another crucial step. These models should include: (1) incorporating AI system deployment into Jaminan Kesehatan Nasional (JKN) financing; (2) establishing subsidized licensing arrangements for rural public health facilities; (3) creating innovation funds to support local AI health technology development; and (4) leveraging development partner support for priority implementation areas (Wasir et al., 2025).

Furthermore, it is essential to commit to implementation science research that examines how to extend AI benefits equitably across geographic and socioeconomic divides. This should include community-based participatory research involving rural patients and healthcare workers in solution design and evaluation (Sumarsono et al., 2022).

4. Research and Innovation Ecosystem Development

To build long-term self-reliance in AI-driven healthcare, Indonesia should prioritize the development of a robust domestic innovation ecosystem. This begins with establishing dedicated research funding streams and institutional support specifically for Indonesian researchers and technology developers working on solutions tailored to the country's unique health challenges. Key focus areas should include artificial intelligence applications addressing tropical infectious diseases, maternal and child health priorities, and prevalent nutritional disorders; AI tools deliberately designed for settings facing severe shortages of medical specialists; and decision-support systems that are culturally sensitive, incorporating local health beliefs, traditional practices, and prevailing social structures (Mulijono, 2025).

A critical foundation for such innovation is the creation of a National Health Data Commons, a secure, ethically governed repository that provides approved researchers and developers with responsible access to de-identified health datasets. Strong governance mechanisms must be established to protect privacy, prevent

monopolization of benefits by private actors, and ensure that the infrastructure remains under public ownership while serving the broader public interest (Zahra, 2025).

At the same time, Indonesia should actively pursue strategic international collaboration. Partnerships with regional leaders such as Singapore and Malaysia, as well as with global centers of excellence, can accelerate technology transfer and capacity building. Importantly, emphasis should remain on thoughtful adaptation and local refinement of solutions rather than wholesale importation (Heriyana & Agustina, 2025). Equally valuable is South–South cooperation through structured learning and joint initiatives with other middle-income countries that face comparable epidemiological, infrastructural, and resource constraints (Sone & Ebune, 2025).

5. Alignment with Golden Indonesia 2045 Vision

Ultimately, artificial intelligence in healthcare should never be pursued as an end in itself. Instead, it must function as a powerful enabling technology embedded within Indonesia's broader transformation toward universal health coverage, higher service quality, and genuine health equity. Implementation efforts should therefore be deliberately aligned with concrete national health system objectives: extending specialist-level diagnostic capacity to remote and underserved regions, strengthening chronic disease management and long-term treatment adherence, supporting truly evidence-based clinical decision-making, and building more robust health information systems that enable data-informed planning and resource allocation (Cheng et al., 2025).

As Indonesia prepares to capitalize on its demographic dividend while simultaneously confronting population aging and the rising burden of non-communicable diseases, AI offers practical means to amplify healthcare worker productivity and extend scarce specialist expertise. By doing so, it directly contributes to the realization of a key pillar of the Golden Indonesia 2045 vision—a high-income, developed nation characterized by long life expectancy, a healthy population, and high human capital productivity (Malia et al., 2025; Musthafa et al., 2025).

For these benefits to materialize equitably and sustainably, healthcare AI initiatives must be carefully coordinated with the wider digital transformation agenda outlined in the Rencana Pembangunan Jangka Panjang Nasional (RPJPN) 2025–2045. This requires deliberate alignment and synergy across multiple domains: digital government infrastructure (Sistem Pemerintahan Berbasis Elektronik – SPBE), nationwide efforts to build 21st-century digital competencies through education, the continued strengthening of the national research and innovation ecosystem, and the establishment of robust frameworks for cybersecurity and personal data protection (Maspul & Putri, 2025; Wahyu et al., 2025). Only through such integrated and purposeful action can AI become a genuine catalyst—rather than a disconnected add-on—in Indonesia's journey toward a healthy, prosperous, and self-reliant future by 2045.

CONCLUSION

Indonesia is at a crucial moment to harness the transformative potential of artificial intelligence (AI) to achieve a more advanced and equitable health system aligned with the vision of Golden Indonesia 2045. This review shows that while AI has proven its clinical effectiveness in various areas—such as diagnostics and chronic disease management—its national implementation remains hampered by several fundamental challenges. These obstacles include a fragmented and immature regulatory framework, significant disparities in digital infrastructure between urban areas and 3T (terdepan, terluar, tertinggal) regions, and

limited human resource capacity in AI literacy and governance. Without coordinated and strategic interventions, Indonesia risks falling further behind regional counterparts, experiencing technological dependency, and deepening existing health inequalities. Therefore, successful AI integration requires simultaneous and sustained action: establishing a comprehensive ecosystem that provides legal certainty and supports responsible innovation; investing substantially in digital infrastructure and health system capacity development; and implementing equity-centered design strategies so that AI can truly serve as a catalyst for expanding access to quality healthcare, supporting universal health coverage, and realizing a healthy and productive population as the foundation of Golden Indonesia 2045.

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