NATIONAL HEALTH PROGRAMS AND THE SDGS – ADVANCING HEALTH AND WELFARE AS STRATEGIC ASSETS OF NATIONAL SECURITY IN THE ERA OF ARTIFICIAL INTELLIGENCE

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ABSTRACT

This article examines the strategic role of Artificial Intelligence (AI) in strengthening Indonesia's National Health Programs (Prognas) and achieving Sustainable Development Goals (SDGs), particularly SDG 3 and SDG 2. The research employs a literature review method by analyzing various peer-reviewed sources from both national and international journals indexed in academic databases. The review aims to identify the current landscape, opportunities, and ethical dilemmas of AI utilization in healthcare services. The findings highlight that AI can support predictive and personalized healthcare systems, improve public service efficiency, enhance access equity, and contribute to policy reform. However, the ethical use of AI demands regulatory readiness, inclusive governance, and a strong emphasis on transparency, data protection, and algorithmic fairness. The study concludes that AI must be positioned not merely as a technical tool but as a moral and institutional force in transforming national health resilience

Keywords: artificial intelligence; health equity; national health program; public service; SDGs

1. INTRODUCTION

The digital revolution is no longer merely a hallmark of industrial advancement but a disruptive force that is reshaping paradigms across all sectors of public service, particularly in healthcare. As global and national health systems confront the compounded challenges of pandemics, non-communicable diseases, population aging, and access disparities, the deployment of Artificial Intelligence (AI) emerges not as an optional enhancement but a strategic imperative. For Indonesia—facing a double burden of disease, geographical health inequities, and constrained workforce capacity—AI offers an unprecedented opportunity to anticipate and respond to healthcare needs in real-time.

COVID-19 exposed systemic fragilities in reactive and fragmented health

systems. Recent studies (Abdelouahed et al., 2025) underscore the importance of integrating AI into health education and pandemic preparedness. AI-enabled models offer predictive capacity in epidemiology, individualized immune responses, and precision-based policy frameworks. Additionally, AI integration in medical training and workforce development can bridge interregional disparities and accelerate capacity-building, enhancing healthcare resilience nationwide.

Indonesia's demographic trajectory—transitioning toward a post-dividend era—intensifies the urgency for strategic interventions. As the proportion of elderly citizens increases (Wihardja & Siregar, 2024), the healthcare system must pivot from reactive service delivery to a more anticipatory and equitable model. Within this context, AI is not only a technological tool but a national defense mechanism, integral to safeguarding population health as a pillar of human security.

However, leveraging AI requires more than technological enthusiasm; it necessitates robust datasets, interoperable digital infrastructure, and ethically grounded governance systems. Developing countries, including Indonesia, often suffer from fragmented information systems and limited digital literacy among healthcare workers—barriers that must be addressed to enable effective AI adoption. Ethical considerations around data governance, transparency, and accountability must also be foregrounded (Abdelouahed et al., 2025).

For national health programs (Prognas), including initiatives targeting stunting, non-communicable disease prevention, and primary care strengthening, AI can catalyze transformation. Yet, such potential can only be realized through participatory ecosystems involving academia, government, civil society, and the private sector. The adaptive Learning Health System (LHS) model (Bajwa et al., 2021; Ankolekar et al., 2024) provides a valuable framework in which every patient interaction feeds back into a continuous quality improvement cycle.

Moreover, sustainable development cannot be pursued without health equity. AI offers mechanisms to identify underserved populations, optimize resource distribution, and support local risk mapping in remote areas (Vo & Fong, 2025). As highlighted by SDG targets, sustainable health must prioritize not only service access but also quality, equity, and dignity.

Demographic shifts, such as the emerging "grey tsunami" of aging populations, further necessitate AI interventions. Innovations in eldercare—ranging from robotic assistance to AI-supported telemedicine—can ensure inclusive and dignified service models. However, these must be deployed ethically, safeguarding against algorithmic discrimination and protecting patient autonomy.

This article thus investigates AI's strategic role in national health programs and the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) and SDG 2 (Zero Hunger). By synthesizing empirical evidence and theoretical discourse, the study argues that AI, if governed wisely, may serve as both

an institutional catalyst and moral compass in the pursuit of equitable, resilient, and intelligent healthcare systems. The argument is not for technology alone, but for an ethically grounded transformation that redefines health as a strategic asset of national security in the era of artificial intelligence.

2. METHOD

This study employs a qualitative literature review methodology with a critical-analytical approach to explore the strategic integration of Artificial Intelligence (AI) into Indonesia's national health programs (Prognas) and its alignment with the Sustainable Development Goals (SDGs). The method prioritizes conceptual synthesis and thematic exploration rather than empirical hypothesis testing, aiming to generate a strategic understanding of AI's potential as both a technological enabler and a governance instrument in the health sector.

2.1 Data Sources and Selection Criteria

The literature reviewed includes peer-reviewed academic journals, policy briefs, strategic frameworks, and institutional reports published between 2018 and 2025. Sources were retrieved from Scopus, PubMed, Web of Science, and Google Scholar databases, with supplementary searches conducted through institutional archives such as the World Health Organization (WHO), United Nations Development Programme (UNDP), and ASEAN Secretariat. Inclusion criteria focused on publications that discussed: AI applications in healthcare and public service innovation, Ethical, legal, and social implications (ELSI) of AI in health, Health system governance and SDG implementation, Digital transformation frameworks in Southeast Asia

Exclusion criteria omitted purely technical studies (e.g., algorithm development without policy discussion) and outdated reports not aligned with the AI deployment era post-2018.

2.2 Analytical Framework

The analysis was conducted using a hybrid conceptual framework grounded in four interrelated theoretical pillars:

Learning Health System (LHS) Model – to assess how AI facilitates iterative, data-driven improvements in healthcare services (Bajwa et al., 2021; Ankolekar et al., 2024).

Policy Triangle Framework – examining AI policy in terms of content, process, actors, and context (Walt & Gilson).

Strategic Adaptive Governance – applied to evaluate AI's role in dynamic and uncertain health policy environments (Armstrong & Kamieniecki, 2017).

Ethics of Digital Health Technologies – incorporating algorithmic fairness, data governance, and transparency (Farhud & Zokaei, 2021; Fotheringham & Smith, 2024).

This multi-theoretical lens enables the manuscript to move beyond surface-level analysis and interrogate how AI intersects with governance, ethics, and system resilience in health service delivery.

2.3 Data Extraction and Thematic Synthesis

The literature was categorized thematically across key areas relevant to national health priorities, such as tuberculosis (TBC), stunting, antimicrobial resistance (AMR), and maternal health. A thematic matrix was developed to code articles based on:AI use cases (diagnostic, predictive, administrative, strategic), Type of health program (preventive, promotive, curative, rehabilitative), Level of system intervention (individual, facility, population), Ethical or regulatory concerns (bias, privacy, accountability).

The synthesis process followed Thomas and Harden's (2008) thematic synthesis technique, allowing iterative comparison and integration of findings. Priority was given to triangulating insights from diverse global settings with the Indonesian context, ensuring relevance and transferability.

2.4 Limitations of the Method

While comprehensive, the literature review is limited by the availability of region-specific data on AI applications in Indonesia. Many national initiatives remain undocumented or in pilot stages, creating a reliance on comparative insights from similar low- and middle-income country (LMIC) contexts. Furthermore, this review does not include primary data or stakeholder interviews, which could offer deeper ground-truth validation. Nonetheless, by aggregating current literature and aligning it with national strategic documents (e.g., RAN SDGs, Strategic Plan of the Ministry of Health, National AI Strategy), this study provides a timely foundation for policy and academic engagement..

3. RESULTS AND DISCUSSION

This section presents the synthesized findings from the literature review, structured into major thematic clusters aligned with the objectives of national health programs and the SDGs. It integrates descriptive insights, assumption analyses, and theoretical discussions to explore how Artificial Intelligence (AI) functions as both a technical catalyst and institutional disruptor in Indonesia's public health system.

3.1 Strategic Value of AI in National Health Programs (Prognas)

The evidence suggests that AI has emerged as a pivotal enabler of Prognas, enhancing diagnostic accuracy, service personalization, predictive policy modeling,

and cross-sectoral integration. Notably, AI applications in tuberculosis (TBC) diagnosis via CAD systems and predictive analytics in maternal and child health demonstrate significant reductions in time-to-diagnosis and improvements in early risk detection (Melendez et al., 2016; Adams et al., 2020). These align with assumptions of increased efficiency and clinical precision in resource-limited settings.

The transformation from reactive to anticipatory systems is best illustrated in AI- driven epidemiological modeling for outbreak response. Predictive capacity enhances policy agility and permits real-time response, reinforcing findings from Walt & Gilson's policy triangle that underscore the role of actor networks and data-driven content in adaptive processes.

Assumption testing within the reviewed literature affirms that the integration of AI is more effective when aligned with a Learning Health System (LHS) model. Countries or institutions that embed iterative feedback loops and data governance into their service delivery demonstrate superior outcomes in terms of coverage, cost- efficiency, and community trust (Bajwa et al., 2021; Ankolekar et al., 2024).

3.2 Alignment with SDGs: AI as a Synchronizer of Goals 2 and 3

The deployment of AI in both SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-being) reveals synchronic benefits, particularly in nutritional surveillance and maternal-child interventions. Data mining of e-PPGBM records, when integrated with socioeconomic indicators, supports the development of geographic risk maps for stunting and wasting. These tools enable targeted intervention strategies that outperform conventional resource allocation models in both speed and precision (YARSI, 2022; WHO, 2023).

AI's integration in HIV/AIDS programs—using NLP to profile at-risk populations—reaffirms its utility in prevention-based models. In line with the SDG 3.3 target of ending epidemics, AI enables microtargeted outreach, particularly in previously underserved or stigmatized populations. These implementations echo the theory of social embeddedness, where technology must reflect the community's demographic and cultural fabric to be effective.

3.3 Ethical, Legal, and Algorithmic Challenges in AI Integration

Despite the benefits, the review highlights considerable risks tied to data governance, algorithmic bias, and regulatory lag. Algorithmic fairness remains a major concern, especially in heterogeneous societies like Indonesia. Systems trained on unrepresentative data may marginalize vulnerable populations, producing systemic biases in clinical decision-making (Farhud & Zokaei, 2021).

The phenomenon of "moral crumple zones" (Elish, 2019) arises where

accountability for AI-generated decisions remains unclear, with medical professionals often burdened with liability despite minimal control over algorithmic outcomes. Current legal frameworks are insufficient for distributing risk fairly, necessitating regulatory reform based on collective accountability or risk pooling (Smith et al., 2023).

A further limitation arises from the asymmetry of technological capacity across regions. Without uniform digital infrastructure and adequate training, AI tools risk amplifying rather than bridging inequities. This challenges the ethical principle of equity by design and calls for systemic investments in both digital readiness and human resources.

3.4 AI as Infrastructure for Health Security and Climate Resilience

The role of AI as an infrastructural component of national health security is substantiated by evidence on its use in early warning systems, climate-responsive health planning, and disaster risk management. Geospatially-driven AI systems have proven effective in anticipating disease outbreaks linked to climate variables, such as dengue and leptospirosis, and in mapping healthcare vulnerabilities in flood-prone areas (Marsboom, 2025; WHO, 2023).

The conceptual synergy between AI and the One Health framework illustrates the potential for cross-sectoral surveillance that integrates human, animal, and environmental health. This represents a paradigm shift from siloed to systems-based governance, wherein AI serves as the "neural network" of anticipatory governance.

3.5 Governance and Accountability in AI-Driven Health Systems

Effective governance structures are critical to ensure that AI is implemented transparently, ethically, and sustainably. Findings emphasize the need for risk-based governance frameworks that classify AI applications based on their clinical significance (Hassan et al., 2024). Such stratification can guide institutions in adopting AI responsibly and help regulators in prioritizing oversight.

Indonesia's fragmented regulatory environment underscores the urgency of a centralized AI governance framework. LAFKI, as a national accreditation body, can play a critical role in operationalizing AI audit mechanisms, institutionalizing explainability standards, and integrating AI ethics into accreditation indicators. This aligns with the trust-centric governance model proposed by Hassan et al. (2024), which places stakeholder engagement and transparency at the core of technological adoption.

3.6 Human Capacity, Digital Literacy, and Policy Translation

The literature confirms that no digital transformation can succeed without

transforming its human agents. A widespread literacy gap among healthcare professionals—especially in non-urban areas—limits the potential impact of AI. Educational reforms must embed AI within medical and public health curricula, using case-based learning to foster ethical reflexivity and critical computational thinking (Abou Hashish & Alnajjar, 2024; Božić & Poola, 2023).

Policy translation remains a crucial issue: many technical innovations fail to be scaled due to poor alignment with institutional structures, incentive systems, or sociopolitical norms. Strategic adaptive governance offers a path forward by enabling iterative, co-produced policy frameworks that accommodate uncertainty and local realities (Armstrong & Kamieniecki, 2017).

3.7 Limitations of the Study

This review is limited by its reliance on secondary data and the absence of empirical fieldwork. While thematic saturation was achieved through comprehensive literature coverage, primary data collection would have strengthened contextual understanding. Moreover, AI implementation remains uneven globally, with overrepresentation from high-income settings. Therefore, caution is warranted when extrapolating conclusions to Indonesia's diverse regions.

4. CONCLUSION

The integration of Artificial Intelligence (AI) into Indonesia's national health programs represents not merely a technological shift but a strategic reorientation of health governance toward resilience, equity, and anticipatory capacity. This study concludes that AI holds transformative potential when embedded within an ethical, inclusive, and policy-responsive ecosystem that aligns with Sustainable Development Goals (SDGs), particularly SDG 2 and SDG 3. However, realizing this potential requires a recalibration of regulatory frameworks, investments in digital and human infrastructure, and the establishment of multi-stakeholder trust mechanisms. AI must be framed as both a strategic infrastructure and a moral agent—an instrument that redefines public health as a pillar of national security in the digital age. Therefore, the Indonesian government, academic institutions, accreditation bodies like LAFKI, and healthcare providers must co-develop governance models that promote algorithmic fairness, data transparency, and participatory innovation. Strategic recommendations include institutionalizing AI governance audits, embedding ethical AI literacy in clinical education, establishing AI-accredited health service networks, and adopting agile policy tools for cross-sectoral risk management. In an era marked by uncertainty and complexity, AI must not only serve healthcare efficiency but also embody the values of justice, human dignity, and sustainable development.

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