



Mapping Infrastructure and Human Resource Gaps in the Implementation of Indonesia's Digital Health Policy: A Literature Review

Mujtahidah ^{1*}, Suci Dwi Yanti ²

¹Department of Health Administration, Faculty of Sport and Health Science, Universitas Negeri Makassar, Indonesia

²Department of Hospital Administration, Faculty of Science, Technology, and Health, Institut Sains Teknologi dan Kesehatan

Aisyyah Kendari, Indonesia

*Email (corresponding author): mujtahidah@unm.ac.id

Abstract. *The implementation of digital health policy in Indonesia has encountered various challenges related to both infrastructure and human resources. This literature review aimed to map gaps in digital health infrastructure and workforce capacity across urban, rural, and remote healthcare settings by systematically analyzing relevant national and international studies. Sources included peer-reviewed articles, scoping reviews, and preprints that examined electronic medical records, telemedicine, and other digital health interventions in various geographic and organizational contexts. The analysis revealed that urban areas generally have more advanced digital infrastructure, including integrated health information systems and electronic record platforms, whereas rural and remote regions face limited internet connectivity, insufficient hardware, and low digital literacy among healthcare personnel. Human resource gaps were also observed, including inadequate technical competencies, uneven distribution of staff, and organizational cultures that are not fully prepared to adopt digital health technologies. These disparities highlight the critical need for context-sensitive strategies, such as hybrid solutions combining cloud-based systems in urban centers with offline-capable platforms in low-connectivity regions, comprehensive training programs for healthcare staff, and supportive policies at both local and national levels. By synthesizing the current evidence on infrastructure and human resource gaps, this review provides a comprehensive overview that can guide policymakers, healthcare managers, and researchers in designing targeted interventions, prioritizing resource allocation, and promoting equitable adoption of digital health solutions across Indonesia.*

Keywords: Digital health, health policy, human resources, infrastructure, literature review

1. Introduction

The digital transformation of health in Indonesia, which is prioritized as part of efforts to improve national health services, includes initiatives such as the implementation of the Electronic Medical Record (RME) system and the SATUSEHAT application. RME has received great attention from the Indonesian Ministry of Health, which sets policies through Permenkes No. 24 of 2022 and makes the use of RME an obligation for health facilities (1,2). RME aims to improve operational efficiency and provide instant access to data, which is expected to support clinical decision-making and improve the professionalism of health workers (3,4). However, major challenges remain, especially related to the readiness of human resources who are often undertrained in the use of technology (4,5).

Meanwhile, the SATUSEHAT application released by the Indonesian government serves as a tool to track the spread of Covid-19 and provide vaccination information. This application not only helps coordinate efforts to handle the pandemic but also encourages

changes in people's behavior related to health and vigilance. In a study conducted by [NO_PRINTED_FORM] (6), it was found that public acceptance of SATUSEHAT is closely related to the perceived benefits and ease of use of the application.

The importance of infrastructure and Human Resources (HR) as a pillar of the success of digital health policies cannot be ignored, especially in the context of Indonesia which is trying to improve health services through digitalization. Infrastructure gaps and lack of quality human resources are often obstacles to the effective implementation of health technologies.

The digital divide in Indonesia, especially related to the disparities in access to and utilization of health technology between urban and rural areas, is a significant challenge in achieving equity in health services. This condition directly affects the effectiveness of digital health policies launched by the government, including its use in the context of the Outermost, Frontier, and Disadvantaged (3T) regions (7,8).

One of the key issues in the digital divide is the disparity between urban and rural areas. Research shows that people in urban areas are more likely to access health services compared to their counterparts in rural areas. This is due to better health infrastructure in urban areas, such as more complete and easily accessible medical facilities. For example, in urban areas, the quality of health facilities includes access to relatively adequate hospital care, in contrast to rural areas that often experience a lack of adequate medical facilities and personnel (9).

Further, research also shows that populations living in 3T areas face additional challenges, including physical distances from healthcare facilities and a lack of reliable transportation (8). This condition is exacerbated by the high costs that must be incurred to achieve health services in the city, which results in a lack of visits to health facilities by people in rural areas (10). The use of telemedicine technology, although it has offered solutions in overcoming some geographical limitations, is still hampered by the limitations of digital infrastructure and public knowledge about the technology (Saputra, 2024).

Seeing these facts, it is important for the government to implement policies that not only focus on the development of technological infrastructure but also increase digital literacy among the community, especially in rural areas and 3T. The development of training programs, collaborations with telemedicine service providers, and increasing public awareness of the importance of digital health are important steps to reduce the digital divide and ensure that digital transformation in the health sector brings benefits to all levels of society in Indonesia (12,13).

Strong policy support can create a conducive environment for infrastructure development and strengthening human resource capabilities, as stated by (14), which show that a good digital environment is also more beneficial with supportive regulations. This shows that the success of digital health policies is not only determined by technical and human aspects, but also the extent to which existing regulations are able to encourage readiness and adaptation to change.

Thus, adequate infrastructure and quality human resources will be the two main pillars in achieving the success of digital health policies in Indonesia. Joint efforts from the government to improve these two aspects are urgently needed to realize more efficient, effective, and affordable health services for the entire community.

Although various studies have discussed the implementation of digital health policies in Indonesia, most of the research tends to focus on one aspect, such as technological

infrastructure or human resource capacity separately. Until now, there is still limited research that integrates the mapping study of the two aspects comprehensively to provide a comprehensive picture of readiness and challenges in the implementation of digital health policies.

Based on the literature gap, this study aims to comprehensively map the infrastructure and human resources gap in the implementation of digital health policy in Indonesia through literature review. The results of this study are expected to be a reference for policymakers and stakeholders in formulating strategies to strengthen digital health transformation that is more equitable and sustainable.

2. Methods

2.1 Study Design

This study uses a narrative literature review approach to identify and map infrastructure and human resources (HR) gaps in the implementation of digital health policies in Indonesia. This approach was chosen because it allows the synthesis of findings from various relevant studies and provides a comprehensive picture of the issues under review.

2.2 Data Sources and Search Strategies

Literature searches were conducted on four main databases: PubMed, Scopus, Web of Science, and Google Scholar. In addition, national policy documents and official reports from the Ministry of Health of the Republic of Indonesia are also included as secondary data sources. The search strategy uses a combination of keywords and Boolean operators:

("digital health" OR "e-health" OR "telemedicine") AND ("Indonesia") AND ("infrastructure" OR "human resources" OR "capacity building") AND ("policy" OR "implementation").

2.3 Inclusion and Exclusion Criteria

Articles are included in studies when they meet the following criteria:

- Discuss the implementation of digital health policies in Indonesia.
- Contains information about infrastructure and/or human resources.
- Published between January 2015 and July 2025.
- Written in English or Indonesian.

Exclusion criteria included: only discussing the technical aspects of the system without policy context, Focus on regions outside Indonesia and in the form of opinions or editorials without empirical data.

2.4 Data Selection and Extraction Process

The researcher independently selected the titles and abstracts based on inclusion/exclusion criteria. Articles that meet the criteria are then read in full to ensure relevance.

- Identification: 221 records retrieved.
- Screening: 85 titles/abstracts screened for relevance.
- Eligibility: 35 full texts assessed.
- Inclusion: 9 articles met all criteria and were included in the final synthesis.

Reviewers independently conducted screening and extraction; discrepancies were resolved by consensus. Extracted data included author name, year of publication, study

location, research objectives, infrastructure aspects discussed, HR aspects discussed, study methods, and recommendations given.

2.5 Data Analysis

The data was analyzed using a thematic analysis approach to identify the main patterns and themes related to infrastructure and human resource gaps. The findings are then mapped into tables to facilitate visualization of the distribution of issues by region and type of health facility.

3. Results and Discussion

3.1. Results

The articles that passed the selection procedure and met the inclusion and exclusion criteria totaled 9 research studies

Table 1. Literature Review Results

No	Author (Year)	General Objectives/ Focus	Findings Related to Infrastructure	Findings Related to HR	Relevance to Gap Mapping
1	I Gede Eka Handrean, Ivanda Rian Pratama, Dita Rahma Sumarna, Ricky Fakhrazi, Saperyanus Rejauw, Vip Paramarta (2025)	Evaluation of the digital readiness of hospitals in the era of Society 5.0	Emphasizing the need for a strong technological infrastructure for hospital digitalization	The need for competent health workers and an adaptive organizational culture	Unify the infrastructure and human resources dimensions at the institutional level
2	Bevaola Kusumasari, Widodo Agus Setianto, Li Li Pang (2018)	Case study of e-Health implementation in Surabaya	Policy support and basic infrastructure exist, but there is still a digital divide	Cultural, psychological, and digital literacy barriers are still high	Giving concrete examples of gaps in big cities and the importance of local political commitment
3	Ashfiya Vi'aqila El-Tsana, Rizka Ayu Alvianty, Princess Octaviani,	Evaluation of the six pillars of national health system transformation	Digital infrastructure is still limited in many facilities	Inequality in the distribution of health workers; Rigid financing system	Providing a structural context for the gap in human resources and infrastructure on a national scale

No	Author (Year)	General Objectives/ Focus	Findings Related to Infrastructure	Findings Related to HR	Relevance to Gap Mapping
	Raisha Syahidah, Riswandy Hemorrhoids (2025)				
4	Rasyid Juliansyah, Bukhori Muhammad Aqid, Andien Putri Salsabila, Kurnia Nurfiyanti (2024)	Examining the benefits and constraints of EMR adoption	The use of EMR speeds up service (~15-20 minutes), cost efficiency, data security increases	-	Concrete examples of the benefits of digital infra even though there is still a gap
5	Ben Rahman (2025)	Evaluation framework for digital health systems in limited areas	Added <i>Infrastructure Index</i> dimensions to assess infra readiness	Focus on <i>Community Engagement Fit</i> and policy compliance	Provide a systematic framework to map the gap between human resources and infra
6	Riswandy Wasir, Fadilah Aulia Rahma, Januar Ariyanto, Syamikar Baridwan Syamsir, Suparni, Agung Raharjo, Farahul Jannah, and Ray Wagiu Basrowi (2025)	Digital health survey in rural & remote areas	Low connectivity and limited digital infrastructure	Low digital literacy and significant sociocultural barriers	Provide a geographical dimension and the need for contextual intervention

No	Author (Year)	General Objectives/ Focus	Findings Related to Infrastructure	Findings Related to HR	Relevance to Gap Mapping
7	Ardanawati Ayu Pitaloka (2021)	An overview of health digitalization during the pandemic	Basic infrastructure is not even across the country	Digital literacy and data security awareness still low	Highlighting gaps in crisis situations and potential emergency transformations
8	Aslinda (2025)	Qualitative study of rural nurses' experience of telehealth	Infrastructure is often an emotional and technical burden on nurses	Professional adaptation, techno-humanitarian balance, identity challenges	Adding the psychosocial dimension of HR—practice is crucial in gap mapping
9	Irma Nuraeni Salsabila, Shinta Meilinda, Riska Rahayu, Dina Nurul Fathiya, Aldo Hermaya Aditiya Nur Karsa (2024)	A telemedicine study in two remote villages in Sumatra	Telecommunications connections and technology are very limited	Low digital understanding of society	Emphasizing the need to strengthen infrastructure and community education as the basis for adoption

3.2 Discussion

Mapping the infrastructure and human resource gap in the implementation of digital health policies in Indonesia is an important step to ensure the effectiveness and efficiency of health systems in the digital era. As shown in Table 3.1, while there is great potential for the development of digital health technologies, there are still many challenges, especially in terms of infrastructure and the availability of skilled human resources.

3.2.1 Infrastructure Gap: Urban vs Rural

The biggest challenge in the implementation of digital health policies in Indonesia is inadequate infrastructure. First, the basic infrastructure for digital health, including the necessary telecommunications framework and integrated information systems, is still not adequately developed. Hospitals often lack robust technology platforms to facilitate the seamless exchange of patient data as well as improve communication between departments, which is critical to improving the quality of patient care (15).

The absence of an integrated system is an obstacle in the implementation and sustainability of digital health solutions that can respond effectively to patient needs, especially in countries with geographical inequalities that complicate access to health services (15). Many regions, especially in rural areas, face serious problems related to stable internet access and the availability of health facilities that support the adoption of digital technology. According to Sumarno, limited infrastructure slows down the adoption of digital technology in public management, including in the health sector (16).

Studies in big cities show better infrastructure readiness than remote areas. For example, the implementation of *electronic medical records* (EMR) in healthcare facilities has been proven to speed up services (~15-20 minutes to reduce waiting time) and improve data security (17). In addition, the HOT-FIT-BR framework underscores the importance of *the infrastructure index* to measure readiness where areas with low indices are at high risk of failure in digital health implementation (18).

On the other hand, a scoping review study in rural areas revealed that internet limitations, poor digital infrastructure, and low digital literacy are strong barriers to the adoption of digital health interventions (19). People in remote areas often have inadequate access to internet connectivity, which is crucial for digital healthcare. National statistical data even shows a striking gap in internet access, namely Jakarta has access of up to 85%, while Papua is only about 26% (20). These gaps create a disadvantage in access to important health information so that people do not have the information they need to make informed decisions about their health. This gap underscores the need for government intervention to improve telecommunications systems and ensure that rural areas are not left behind in the progress of health services (21).

Furthermore, research by [NO_PRINTED_FORM] (22) on the maturity of information and communication technology (ICT) in primary health services shows that there is significant variation in ICT maturity in various provinces and health facilities in Indonesia. These findings suggest that facilities that are less mature in ICT mastery tend to operate less efficiently and do not take advantage of the full potential of new technologies. Assessments to improve infrastructure need to be carried out so that the adoption of e-health can be realized effectively.

3.2.2. The Role of Human Resources and Organizational Culture

While infrastructure provides a technical foundation, the availability and competence of human resources is the main driving force. Research in Surabaya on e-Health reveals major challenges in terms of organizational culture, digital literacy, and managerial readiness (23). This is exacerbated in areas with minimal training, such as in rural Indonesia where health workers are not ready to manage and interpret digital data effectively (23,24).

Community nurses in rural Indonesia stated that although they are aware of the potential benefits of telehealth, they often feel unprepared and lack confidence to fully adopt this technology. These doubts are largely due to limited training in digital health systems, which ultimately reduces their participation in the transformation process (Aslinda, 2025).

For the successful implementation of digital health policies, health workers who have adequate digital competence are needed. There is still a shortage of training and capacity of medical personnel in using digital technology effectively. The results of a study by (25) show that the development of a resilient national e-health strategy must involve the development

of human resources who understand and are able to utilize information technology to improve health services.

Based on research by (26), users' reluctance to adopt digital tools, such as mobile banking for health needs, is largely influenced by a lack of awareness of the benefits and availability of digital resources. This shows that there is not only a need for adequate infrastructure but also training and capacity building strategies that directly target health workers to improve their ability to use digital technology in their daily practice.

The implementation of digital technology in health also faces challenges related to unprepared work culture and resistance to changes in health institutions. Many healthcare staff may be more comfortable with traditional methods than switching to a new system that requires additional adaptation and training. Therefore, creating an organizational culture that supports digitalization is very necessary to support the success of this transformation (El-Tsana et al., 2025). A supportive organizational culture is essential one that includes strong leadership commitment to change, clear communication of digital transformation goals, structured change management strategies, and incentive systems that encourage adoption and innovation.

In addition, ethical considerations related to data privacy and security are significant challenges in the implementation of digital health solutions. The relationship between healthcare workers and patients is changing along with the integration of digital health devices. The sector faces a double challenge: increasing user trust while guaranteeing the protection of individual data, as a lack of attention to these issues can lead to health inequalities (24).

To address this infrastructure and human resource gap, it is important for governments and stakeholders to reform existing policies. The implementation of an integrated and community-oriented approach can reduce these gaps. First, there is a need for collaboration between the public and private sectors to invest in better digital infrastructure, especially in underserved areas. Second, a comprehensive training program must be developed to ensure that health workers can adapt and utilize digital technology (28)

Based on research by (29) shows that people in rural areas often have a low understanding of digital technology and its benefits, leading to hesitancy in using telehealth services. The results of interviews in the study revealed that the public's low understanding of digital technology is a barrier to the adoption of telemedicine. To address this, counseling and education efforts are needed that clarify how health technology can improve accessibility and quality of care, as well as explain how to use it simply.

Overall, to address the infrastructure and human resources gap in health digital transformation in Indonesia, a comprehensive and integrated approach is needed. The first step is to strengthen technology infrastructure across the country, especially in remote areas, accompanied by training programs for healthcare workers to ensure they have the necessary skills and confidence to implement and leverage new technologies. Encouraging public participation through education and understanding of digital health technology is also an important step to achieve the goal of equitable access and improve the quality of health services.

Conclusions

This review highlights that the implementation of electronic medical records (EMR) plays a significant role in improving service quality and patient satisfaction within healthcare

facilities. However, notable gaps remain in infrastructure readiness, user adaptation, and policy alignment, particularly in diverse regional contexts. Future research should explore longitudinal evaluations of hybrid (online–offline) digital health models in remote Indonesian settings and conduct in-depth qualitative studies on socio-cultural barriers to technology adoption among healthcare workers in Eastern Indonesia, ensuring more equitable and effective EMR implementation nationwide.

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Conflicts of Interest

The authors declare no conflict of interest.

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