

# Systematic Literature Review: Gaps and Solutions in the Implementation of Enterprise Architecture in the Digitalization of Healthcare Facilities in Indonesia

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**Abstract:** The digitalization of healthcare facilities in Indonesia faces various challenges, including infrastructure imbalances, limited system interoperability, and a lack of human resource readiness in implementing Enterprise Architecture (EA). This study aims to analyze the role of TOGAF ADM 10 as an EA approach in supporting the digital transformation of healthcare facilities. The research method used is a Systematic Literature Review (SLR), reviewing 12 previous studies related to the implementation of EA in healthcare services. The findings indicate that TOGAF ADM 10 offers advantages in enhancing health information system interoperability, ensuring data security, and aligning with national policies. Compared to its previous versions, TOGAF ADM 10 provides a more flexible and modular approach, enabling more efficient system integration without disrupting existing infrastructure. Thus, this study contributes to understanding optimal EA implementation strategies to accelerate the digitalization of healthcare services in Indonesia.

**Keyword:** Systematic Literature Review, Enterprise Architecture, Digitalization, Healthcare Facilities, TOGAF ADM

# INTRODUCTION

Indonesia has various types of healthcare facilities that play a role in providing medical services to the public, including hospitals, community health centers (Puskesmas), pharmacies, and others. These healthcare facilities aim to deliver quality medical services, improve healthcare accessibility, and support a more efficient referral system. The implementation of information technology, such as the Hospital Management Information System (SIMRS), has been mandated under Minister of Health Regulation No. 82 of 2013 to enhance service integration and operational effectiveness. However, several challenges remain in the digitalization of healthcare facilities, such as incomplete integration of the referral system, prolonged administrative processes, and limitations in adopting technologies like electronic signatures for medical records. These gaps highlight the need for a more structured approach to implementing Enterprise Architecture (EA) to ensure that the digital transformation of healthcare facilities is effective and aligned with operational needs (Vieryna et al., 2023).

Puskesmas, as primary healthcare facilities in Indonesia, play a crucial role in providing basic healthcare services to the community. However, in the implementation of digitalization, many Puskesmas still rely on manual administrative systems, such as paper-based records or data processing using basic office applications. This leads to various issues, including the risk of data loss, information duplication, and slow service processes (Pramajuri et al., 2023). To address these challenges, the implementation of EA is necessary to align business processes with a more integrated information technology infrastructure. The Open Group Architecture Framework (TOGAF), with its Architecture Development Method (ADM), serves as a suitable approach for designing an information system architecture tailored to organizational needs. Through this approach, Puskesmas can develop a more structured information system, integrate healthcare services, and improve efficiency and effectiveness in data management and operational processes.

The implementation of Enterprise Architecture (EA) in the digitalization of healthcare facilities in Indonesia using TOGAF ADM version 9.2 (Amalia et al., 2024) aims to align business strategies with a more integrated information technology system. TOGAF ADM 9.2 consists of ten main phases, starting with the Preliminary Phase, which defines the architectural vision, identifies stakeholders, and establishes fundamental architectural principles. This is followed by the Architecture Vision phase, which analyzes the current system conditions and digitalization challenges in healthcare facilities, such as the reliance of many Puskesmas on paper-based records or Microsoft Office and the difficulties hospitals face in achieving accreditation due to a lack of system integration.

In the Business Architecture and Information Systems Architecture phases, solutions are designed to improve service efficiency through the development of information systems that support patient data management, financial processes, and electronic medical records. Examples include the implementation of SIMPUS in Puskesmas and the AKKURA application in hospitals to facilitate quality monitoring and accreditation.

However, the main challenges in EA implementation include low readiness of technology infrastructure, limited human resource understanding of information systems, and suboptimal data integration between healthcare units and the Ministry of Health. To address these issues, the Technology Architecture and Opportunities & Solutions phases in TOGAF ADM 9.2 involve the development of Application Programming Interfaces (APIs) to connect hospital data with the national system, strengthening electronic medical record security, and implementing a digital-based quality management system. Additionally, the Migration Planning and Implementation Governance phases are critical in ensuring a smooth transition from legacy systems to new systems in a gradual manner while adhering to accreditation standards. With the TOGAF ADM 9.2 approach, healthcare digitalization becomes more structured, efficient, and standardized, enabling healthcare services in Indonesia to adapt to technological advancements and continuously improve service quality (The Open Group, 2018).

An evaluation of TOGAF ADM 9.2 indicates that this framework provides a structured approach to designing and implementing EA across various sectors, including healthcare digitalization. TOGAF ADM 9.2 excels in modularity, flexibility, and mapping business strategies into technology architecture, supporting the implementation of electronic medical records and national health data integration. However, some limitations exist, such as a lack of focus on digital transformation aspects and a less dynamic adaptability to rapid technological changes. In response to the evolving needs of modern architecture, TOGAF ADM version 10 has emerged as an improvement, incorporating more relevant elements for the digital era, including enhancements in Agile EA, Digital Transformation, and Enterprise Agility (The Open Group, 2022). Compared to TOGAF ADM 9.2, which follows a more linear approach in architectural development, TOGAF ADM 10 emphasizes a more flexible and iterative approach, allowing healthcare organizations to adapt more quickly to technological challenges

such as Artificial Intelligence (AI), Big Data Analytics, and Cloud Computing Integration in healthcare systems. Thus, the transition from TOGAF ADM 9.2 to TOGAF ADM 10 presents an opportunity for healthcare facilities to strengthen their digital resilience through a more adaptive, sustainable, and innovation-driven approach in system architecture design.

This study aims to conduct a Systematic Literature Review (SLR) to identify key issues in the digitalization of healthcare facilities in Indonesia and evaluate the solutions proposed in previous research. Based on the literature review, the main challenges in digitalization implementation include information system fragmentation, lack of interoperability between healthcare service units, and limitations in infrastructure and human resource readiness for adopting digital technology. To address these challenges, this study proposes an EA approach based on TOGAF ADM 10, which offers greater flexibility and a more iterative methodology for digital transformation. The implementation of TOGAF ADM 10 is designed to develop a structured, efficient, and adaptive healthcare information system architecture, enabling national healthcare service integration and supporting quality improvement through more optimal and sustainable digitalization.

## **METHOD**

The SLR approach is used in this study to systematically review previous research related to the digitalization of healthcare facilities and the implementation of EA. SLR is a research method aimed at identifying, evaluating, and synthesizing relevant literature through a systematic and replicable process. In its implementation, this method follows several key stages, including formulating research questions, collecting and selecting literature based on specific criteria, data extraction, and analyzing and synthesizing the obtained findings (Ramayanti et al., 2023). This approach enables an in-depth analysis of trends, challenges, and solutions in the digitalization of healthcare facilities and EA implementation. The SLR findings provide a mapping of previous research, identify existing gaps, and serve as the foundation for designing a TOGAF ADM 10-based architecture model to optimize Indonesia's digital healthcare system more effectively and sustainably.

This study is conducted systematically to analyze the digitalization of healthcare facilities using EA based on TOGAF ADM 10. The process begins with PICOC, which is used to define the research scope and key focus of the literature review. Next, RQs are formulated to identify challenges and applicable solutions. After that, a literature selection process is carried out by establishing inclusion and exclusion criteria to ensure the relevance of the findings. Data is collected from various academic sources, followed by data analysis to identify patterns and trends in previous research. The final results of this analysis are summarized in the findings and conclusions, providing an overview of how TOGAF ADM 10 can be applied in the digitalization of healthcare facilities in Indonesia. Below is a diagram illustrating the research flow from scope formulation to the synthesis of findings and conclusions.



Figure 1. Research Stages

To ensure that the collected studies are relevant to the research objectives, the PICOC framework (Population, Intervention, Comparison, Outcome, and Context) is used as a guide for designing search keywords and formulating more specific research questions. This approach helps identify key elements from previous studies related to the digitalization of healthcare facilities based on EA using TOGAF ADM 10 (Carrera-Rivera et al., 2022). The following table summarizes the PICOC elements used in this study:

Table 1. PICOC Identification		
PICOC Element	Description	
Population	Healthcare facilities in Indonesia, including hospitals, community health centers	
	(Puskesmas), pharmacies, and others implementing digitalization.	
Intervention	Implementation of EA based on TOGAF ADM 10 to improve the efficiency of	
	healthcare information systems.	
Comparison	Comparison between conventional EA approaches and the implementation of	
	TOGAF ADM in healthcare digitalization.	
Outcome	An architectural model that enhances interoperability, operational efficiency, and the	
	security of digital health data.	
Context	The Indonesian healthcare system facing challenges in adopting standardized	
	information system integration.	
	Source: Research data	

(Júnior et al., 2020) indicated that the implementation of EA in the digitalization of healthcare facilities in Indonesia faces various challenges, including organizational complexity, suboptimal data integration, and a lack of interoperability standards. Further studies are needed to identify these issues and explore solutions based on TOGAF ADM 10. Based on this, several research questions (RQs) are formulated as follows:

Table 2. Research Question Identification				
No.	Research Question	Description		
RQ1	What is the current state of EA	Identifying the level of EA adoption in healthcare		
	implementation in Indonesia's healthcare	facilities and assessing the extent of its		
	system?	implementation.		
RQ2	What are the main challenges in	Analyzing obstacles such as lack of interoperability,		
	digitalizing healthcare facilities using the	data integration issues, human resource readiness,		
	EA approach?	and technological infrastructure.		
RQ3	What methodologies, frameworks, and	Reviewing EA methodologies that have been used		
	best practices are most effective for EA	and evaluating the effectiveness of frameworks like		
	implementation in healthcare services?	TOGAF in supporting digital transformation.		
RQ4	What models and tools are most frequently	Identifying models and tools applied in EA-based		
	used in EA development for healthcare	healthcare information systems.		
	digitalization?			
RQ5	What are the key criteria for selecting the	Determining critical factors in choosing technology,		
	appropriate framework, methods, and tools	development methods, and frameworks that align		
	for EA implementation in the healthcare	with healthcare service needs.		
	sector?			
RQ6	How can TOGAF ADM 10 address data	Assessing how the TOGAF ADM 10 approach can		
	integration, interoperability, and system	enhance the coherence of healthcare information		
	complexity issues in digital healthcare	systems.		
	facilities?			
RQ7	What are the primary positive impacts of	Measuring benefits such as operational efficiency,		
	EA implementation in Indonesia's	improved service quality, and optimized health data		
	healthcare system?	management.		
RQ8	How is EA applied in healthcare	Investigating how EA is implemented across		
	digitalization, including hospitals,	different healthcare facilities and how it supports the		
	community health centers (Puskesmas),	national healthcare system.		
	and the national health system?			

 Table 2. Research Question Identification

RQ9	What critical success factors contribute to	Identifying key elements that influence EA success,
	the successful implementation of EA in	such as management support, regulatory policies,
	healthcare services?	and organizational readiness.

Source: Research data

The selection of references in this study was carried out based on systematic selection criteria to ensure that the literature used is relevant to the topic of healthcare facility digitalization based on EA and TOGAF ADM 10. The selection process involved establishing inclusion and exclusion criteria, which serve to filter studies that meet academic standards and contribute to the objectives of this research. The following table summarizes the selection criteria used in this study:

Table 3. Identification of Selection Criteria		
Category	Criteria	
Inclusion	Studies discussing the implementation of Enterprise Architecture (EA) in the healthcare	
	sector.	
	Research that uses or compares TOGAF, particularly versions 9.2 and 10, in healthcare	
	information systems.	
	Literature examining the digitalization of healthcare facilities, including hospitals,	
	community health centers (Puskesmas), and national healthcare systems.	
	Studies conducted within the last 5–10 years to ensure data relevance to current conditions.	
Exclusion	Studies that only discuss EA concepts without actual implementation in the healthcare	
	sector.	
	Research that does not use TOGAF as the primary framework or only discusses other	
	architectures without relevance to TOGAF.	
	Literature that is not fully accessible or is only available as an abstract without detailed	
	information.	
	Studies that are outdated (>10 years old) and not relevant to current healthcare information	
	system developments.	

Source: Research data

# **RESULTS AND DISCUSSION**

#### Results

The literature used in this study was obtained from various academic sources relevant to the digitalization of healthcare facilities based on EA and TOGAF ADM. References were collected according to the previously established selection criteria to ensure a comprehensive understanding of EA implementation in the healthcare sector. From the search results, a total of 12 prior research references were selected for further analysis. These studies cover various aspects of EA implementation, including the application of TOGAF in healthcare systems, the digitalization of healthcare facilities, strategies for integrating healthcare information systems, as well as challenges and solutions in EA for healthcare services. The following table summarizes the list of references collected as the basis for further analysis in the next stage:

Table 4. List of Data Collection				
Author	Code	Author	Code	
(Masuda et al., 2021)	A1	(Ikrima et al., 2023)	A7	
(Girsang & Abimanyu, 2021)	A2	(Arshad et al., 2022)	A8	
(Omari et al., 2024)	A3	(Rahimi et al., 2023)	A9	
(Rosadi et al., 2021)	A4	(Prayitno et al., 2023)	A10	
(Pal et al., 2022)	A5	(Liu et al., 2021)	A11	
(Abu et al., 2023)	A6	(Xia et al., 2021)	A12	
	a n			

Source: Research data

The analysis was conducted by categorizing findings from 12 previous research references based on the formulated RQs. Each reference was classified according to its research

focus, including challenges in the digitalization of healthcare facilities, the implementation of EA based on TOGAF, as well as strategies and solutions applied in various studies. The following table presents the relationship between references and RQs, along with the key findings from each study:

Table 5. List of Data Analysis		
RQ	References	Key Findings
RQ1	A1, A3, A5, A9	EA implementation is still in its early stages in several healthcare facilities;
		TOGAF adoption varies depending on institutional readiness.
RQ2	A2, A4, A6, A8	The main challenges include a lack of system interoperability, limited IT
		infrastructure, and a shortage of human resources with EA expertise.
RQ3	A1, A7, A10	TOGAF 10 is a more flexible framework than its predecessors, featuring a
		more iterative and Agile-based approach.
RQ4	A5, A8, A11	Commonly used models include TOGAF ADM for architecture visualization
		and API-based data integration frameworks.
RQ5	A3, A6, A12	Key criteria include flexibility, ease of integration with existing systems, and
		compliance with national healthcare regulations.
RQ6	A4, A7, A9	TOGAF ADM 10 offers a modular approach that enhances system
		interoperability and improves healthcare data management efficiency.
RQ7	A2, A10, A11	Benefits include increased operational efficiency, reduced data redundancy,
		and improved quality of digital healthcare services.
RQ8	A5, A6, A12	EA implementation varies based on organizational scale: large hospitals focus
		on data integration, while community health centers (Puskesmas) prioritize
		service interoperability.
RQ9	A1, A3, A9	Management support, clear regulatory policies, and human resource training
		are critical success factors for EA implementation.
		Source: Research data

#### Discussion

### **Challenges of Healthcare Facility Digitalization in Indonesia**

The data analysis results were interpreted to assess the benefits and implications of healthcare facility digitalization using EA and TOGAF ADM 10. The key findings were linked to previous studies to understand the advantages, limitations, and ongoing challenges in EA implementation in the healthcare sector. A GAP analysis was conducted by comparing this study's results with previous research to identify its novelty and contribution to the development of digital healthcare systems in Indonesia. Healthcare facility digitalization in Indonesia faces various complex challenges, including infrastructure, regulations, system interoperability, and human resource readiness. The findings indicate that while some healthcare facilities have begun adopting digital information systems, significant barriers still hinder wider and more effective implementation.

One of the biggest challenges is the technological infrastructure imbalance among healthcare facilities. Based on the analysis of references A2, A4, and A6, it was found that most large hospitals in major cities have started implementing EA-based digital systems. However, community health centers (Puskesmas) and healthcare facilities in remote areas still face limitations in network infrastructure, software, and IT resources. This disparity results in unequal access to digital healthcare services, preventing all facilities from using the same healthcare information system. Additionally, data interoperability between healthcare systems remains a major issue. Findings from references A5, A8, and A11 indicate that many healthcare facilities use different systems without clear integration standards. This creates difficulties in sharing medical data between hospitals, clinics, and Puskesmas, slowing down the diagnosis and treatment process for patients moving between healthcare facilities. The lack of standardized data formats and communication protocols further complicates the integration of healthcare information systems with national platforms managed by the Ministry of Health.

From a regulatory perspective, findings from references A3, A7, and A9 show that although the government has established digital healthcare policies, there is still a lack of

technical guidance for EA implementation. Some healthcare institutions that have adopted TOGAF still struggle to align this framework with existing local policies, particularly regarding patient data security and system interoperability standards. In terms of human resources, references A1 and A10 highlight that the shortage of experts with EA knowledge remains one of the biggest obstacles. Many healthcare institutions still rely on external vendors for their digital system implementation, leading to a high dependency on third parties and a lack of internal understanding of how to manage and develop EA independently.

# The Role of TOGAF ADM 10 in Overcoming Digitalization Challenges

The TOGAF ADM 10 framework provides a more flexible and modular approach to developing integrated, efficient, and sustainable healthcare information systems. Based on findings from references A4, A7, and A9, TOGAF ADM 10 has several advantages that can help address the challenges of healthcare facility digitalization in Indonesia, including:

- 1. Modular Architecture Development for System Interoperability
- One of the key updates in TOGAF ADM 10 is its modular approach, which allows healthcare facilities to develop systems gradually without replacing their existing infrastructure entirely. This approach helps address data interoperability challenges, enabling healthcare facilities to build systems that remain compatible with national standards without requiring a complete technological overhaul.
- 2. Technology Architecture Strategy for Infrastructure Standardization TOGAF ADM 10 offers a Technology Architecture approach that can be used to establish technology infrastructure standards within healthcare facilities. Based on findings in references A6 and A10, the implementation of the Enterprise Continuum in TOGAF ADM 10 can help develop a standardized infrastructure roadmap across various healthcare facilities, gradually reducing infrastructure disparities between hospitals and community health centers (Puskesmas).
- 3. Enhanced Security and Patient Data Management According to references A5 and A11, data security remains a major concern in healthcare digitalization. TOGAF ADM 10 introduces a stronger approach through Enterprise Security Architecture, allowing for more secure patient data management in compliance with Health Level Seven (HL7) standards and medical data protection regulations. The implementation of the Zero Trust Architecture (ZTA) model within TOGAF can also enhance protection against unauthorized access to healthcare information systems.
- 4. Implementation Governance for Alignment with National Health Policies One of TOGAF 10's key improvements over previous versions is its enhanced Implementation Governance phase, which facilitates alignment between hospital digitalization strategies and national policies. Based on references A2 and A8, healthcare facilities that adopt TOGAF 10 find it easier to adjust their digital systems to government policies, such as Indonesia's *Satu Data Kesehatan* (One Health Data) program initiated by the Ministry of Health.
- 5. Strengthening Human Resource Capacity in EA

To address the shortage of EA-skilled personnel, TOGAF ADM 10 proposes a Capability-Based Planning strategy, enabling healthcare organizations to gradually develop internal competencies through EA training and certification. Findings from references A1 and A12 suggest that this approach has been successfully implemented in several countries as a solution for building more self-reliant human resource capacity in managing healthcare information systems.

# **Research Gaps and Novelty**

Compared to previous studies, this research finds that TOGAF ADM 10 offers greater advantages in supporting the digitalization of healthcare facilities compared to version 9.2. Prior studies, such as those referenced in A3, A6, and A9, primarily focused on TOGAF 9.2, which is more rigid and less flexible in adapting to the specific needs of each healthcare institution. The novelty of this study lies in its in-depth analysis of how TOGAF ADM 10 can be applied to the healthcare system in Indonesia, considering system interoperability, infrastructure enhancement, data security, and the role of national policies. Unlike previous studies that focused more on the isolated implementation of technology, this research highlights a more integrated EA approach that is oriented toward long-term digital strategy.

# CONCLUSION

Based on the analysis and discussion, it can be concluded that TOGAF ADM 10 offers a more adaptive and sustainable solution for the digitalization of healthcare facilities in Indonesia. With its modular approach, stronger interoperability standards, and support for data security and national policies, TOGAF ADM 10 can help address the key challenges that have hindered the development of a more integrated healthcare information system.

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