Analysis of Digital Maturity Aspects in Hospitals: A Systematic Literature Review

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Abstract

Hospitals must continuously evolve in response to dynamic environments and rapidly changing demands. Digital transformation plays a pivotal role in reducing costs, increasing speed and transparency, and enhancing productivity and efficiency; however, it simultaneously introduces substantial organizational risks. Frameworks and tools are therefore essential to support organizations in navigating such profound transitions. Digital maturity assessment constitutes a critical preliminary stage for any digital transformation initiative, enabling both public and private healthcare institutions to determine their level of digital maturity and establish a foundation for subsequent transformation efforts. This study aims to identify and describe the dimensions applied in digital maturity assessments within hospitals. The research employed a systematic literature review of peer-reviewed publications from 2020 to 2024, examining maturity models designed to evaluate hospital digital maturity. A total of 29 relevant articles were reviewed, synthesizing 27 distinct maturity models. The articles were subjected to inductive analysis, through which the dimensions of maturity models were extracted and synthesized into a comprehensive digital maturity framework. The findings revealed a digital maturity framework consisting of seven dimensions: strategy, information technology capabilities, interoperability, governance and management, patient-centered care, human resource skills and behaviors, and data analytics. Each of these seven dimensions can be assessed through 24 specific indicators. The study concludes that the proposed digital maturity framework can serve as an evaluative tool for assessing hospital digital maturity and identifying critical areas for improvement.

Keywords: *Digital Maturity Index, Evaluation, Digital Transformation, Hospitals.*

A. INTRODUCTION

Formulating a strategic framework for the successful implementation of digital health transformation presents substantial challenges (Johnston, 2017) due to the inherent complexity of the healthcare landscape, which is shaped by diverse drivers of change and competitive dynamics (Eden et al., 2019; Krey, 2016; Cresswell et al., 2019). These challenges are further intensified by the proliferation of emerging technologies available to healthcare providers, which can be leveraged to advance digital health objectives. Despite the rapid global adoption of eHealth technologies (Eden et al., 2018) and the widespread perception of digital health as a critical solution (Rahimi, 2016) for achieving the "quadruple aim" in healthcare—namely cost reduction, improved patient experience, enhanced quality of life for healthcare professionals, and improved population health (Bodenheimer & Sinsky, 2014)—the outcomes of digital health transformation remain ambiguous and heterogeneous (Eden et al., 2017; Heng et al., 2018). One proposed strategy for developing a systematic digital health agenda involves adherence to a roadmap informed by digital maturity evaluations (Mettler et al., 2028; Krasuska et al., 2020).

In healthcare, digital maturity is conceptualized as the extent to which digital systems are employed to deliver high-quality healthcare services, thereby improving service provision and delivery while enhancing patient experience (Martin et al., 2019). Conducting digital maturity assessments is particularly crucial in hospital environments due to several factors: the financial implications and complexity of healthcare delivery, which necessitate collaboration among multidisciplinary teams in acute, high-cost care settings (Johnston, 2017; Eden et al., 2019, 2020); the urgent requirement for rapid digital transformation that leverages eHealth technologies to address the growing prevalence of chronic diseases (Klisecun, 2017); and the inherent challenges in justifying the business case for extensive implementation of electronic health record systems, which demand substantial initial and ongoing financial investments (Krey, 2016; Bassi & Lau, 2013).

Maturity models provide a mechanism for evaluating digital maturity by enabling organizations to assess their current digital capabilities across multiple dimensions (Johnston, 2017). Nevertheless, significant limitations exist in contemporary methodologies for assessing hospital digital maturity, as consensus on the specific dimensions to be evaluated remains elusive (Krasuska et al., 2020). Several scholars argue that existing digital maturity assessments are inadequate due to their predominant focus on technological aspects, with insufficient attention paid to organizational and human factors (Cresswell et al., 2019). This assertion is reinforced by Carvalho et al. (2019), who emphasize that most digital maturity models lack the necessary depth and breadth for comprehensive evaluation. Consequently, there remains a lack of consensus or convergence regarding the methodologies employed to measure digital maturity within healthcare contexts.

Failure to identify the appropriate dimensions for evaluating hospital digital maturity hinders the successful implementation of digital health transformation and adversely affects healthcare outcomes. To address this gap, a systematic literature review was conducted to identify the dimensions currently applied in hospital digital maturity assessments. Establishing a structured synthesis of these maturity model dimensions is imperative, as it provides significant value for healthcare executives and strategic decision-makers in evaluating and designing their transformation strategies.

In addition, this analysis serves as a valuable resource for researchers by consolidating diverse maturity dimensions and outlining prospective research domains aimed at improving and strengthening maturity models and their respective applications. Although digital health in hospital settings is widely regarded as a crucial mechanism for achieving the "quadruple aim" in healthcare, its outcomes remain inconsistent and ambiguous. To maximize the effectiveness of digital health initiatives, a comprehensive methodological approach is required, including robust digital maturity evaluations. Nevertheless, existing methodologies remain inadequate, characterized by considerable ambiguity regarding the specific dimensions that warrant evaluation. Accordingly, the objective of this study is to

identify and describe the dimensions currently employed in assessing hospital digital maturity.

B. METHOD

This study employed a Systematic Literature Review (SLR) approach, which was conducted in three distinct phases: planning, implementation, and reporting (Wahono, 2015). In the planning phase, the necessity of conducting a systematic review was first articulated, followed by the development of a detailed review protocol designed to guide the entire process and minimize potential researcher bias. The review protocol was carefully constructed, evaluated, and iteratively refined to ensure methodological rigor. During the implementation phase, the review protocol was operationalized through a series of systematic steps. These included formulating research questions, developing a search methodology, establishing inclusion and exclusion criteria, assessing the quality of selected studies, and conducting data extraction and analysis. Each stage of implementation was designed to maintain transparency, reproducibility, and consistency throughout the review process. The review protocol was also continuously assessed and refined during implementation to ensure alignment with the study objectives. In the reporting phase, the findings were systematically analyzed and presented in detail using both tabular and graphical formats to enhance clarity and comprehensibility. The research questions (RQ) were explicitly formulated to maintain focus and precision throughout the review. These RQs were constructed using the Population, Intervention, Comparison, Outcome, and Context (PICOC) framework proposed by Kitchenham and Charters (2007). Table 1 presents the PICOC framework for the research questions of this study.

Table 1. PICOC Framework of the Research Question

Structure	Description
Population	Hospitals (all levels of healthcare institutions)
Intervention	Dimensions/aspects of digital maturity in hospital management
Comparison	Not applicable (n/a)
Outcomes	(1) Identification of dimensions/aspects used to measure hospital digital maturity.
	(2) Identification of benefits and challenges associated with the implementation of hospital digital maturity.
Context	Healthcare sector, specifically digital health and digital transformation

The research questions used in this literature review are listed in Table 2.

Table 2. Research Questions

Research Question	Description
RQ1. What dimensions are used to measure hospital digital maturity?	Identification of the dimensions most frequently applied in measuring hospital digital maturity.
RQ2. What are the benefits and challenges of implementing digital maturity in hospitals?	Identification of the benefits and challenges associated with the implementation of hospital digital maturity.

To identify relevant sources that address the formulated research questions (RQs), a systematic search strategy was employed. The search was conducted using the Mozilla Firefox browser, targeting three primary academic databases and

repositories: Google Scholar (https://scholar.google.co.id/), PubMed (https://pubmed.ncbi.nlm.nih.gov/), and the Cochrane Library (https://www.cochranelibrary.com/). A Boolean search algorithm was developed to optimize keyword combinations and ensure comprehensive retrieval of relevant studies. The final search string was constructed as follows: ("Hospital Maturity Model") AND ("Healthcare Maturity Model") AND ("Digital Maturity" OR "Maturity Model") AND ("Health Maturity Model") AND ("Hospital Management")** This Boolean query was designed to capture studies focusing on hospital digital maturity models, healthcare-related maturity models, and digital maturity assessments within hospital management contexts.

Following the database search, inclusion and exclusion criteria were applied to determine the eligibility of identified articles. Articles that met the inclusion criteria were retained for further review, while those that did not meet the criteria were excluded. The criteria are summarized in Table 3.

Table 3. Inclusion and Exclusion Criteria

Criteria	Description
Inclusion	Journal articles published within the last five years (2020–2024).
	Data obtained from Google Scholar (https://scholar.google.co.id/), PubMed (https://pubmed.ncbi.nlm.nih.gov/), and the Cochrane Library (https://www.cochranelibrary.com/).
	Journal articles or conference proceedings.
	4. Open-access publications.
	5. Full-text articles available in English or Indonesian.
	Articles describing the dimensions of hospital digital maturity.
Exclusion	Articles addressing digital maturity dimensions outside the hospital context. Textbooks, undergraduate theses, master's theses, and doctoral dissertations.

In this SLR, all selected studies were evaluated based on predefined quality assessment questions (QAQs) to ensure reliability and relevance. Each article was assessed against the criteria listed below, and responses were coded as "Yes" (1) or "No" (0):

1. Is the journal article/conference proceeding openly accessible and available in full text? (QA1)
2. From which source was the data obtained? (QA2)
3. Was the journal article published in https://scholar.google.co.id/, https://pubmed.ncbi.nlm.nih.gov/, and https://www.cochranelibrary.com/?
4. Was the journal article published between 2020–2024? (QA3)
5. Does the journal article cover the dimensions of hospital digital maturity? (QA4)
6. Does the journal article discuss the benefits and challenges of implementing hospital digital maturity? (QA5)

Data collection is the stage in which the research data are gathered. The data collection process in this study was carried out through several steps, namely::

1. Searching for journal articles in https://scholar.google.co.id/, https://pubmed.ncbi.nlm.nih.gov/, and https://www.cochranelibrary.com/.

2. Ensuring whether the journals are openly accessible and available in full text in either English or Indonesian. If not, the journal articles were excluded from this study.
3. Storing the collected journal articles in the Mendeley application.

In the data analysis stage, the collected journal articles were examined to answer the research questions (RQs). The analysis focused on:

1. The aspects/dimensions used to measure hospital digital maturity (RQ1).
2. The benefits and challenges of implementing digital maturity in hospitals (RQ2).)

The final outcome was a summary table of the reviewed studies, which included a narrative synthesis of recent research and a structured knowledge map organized chronologically.

C. RESULT AND DISCUSSION

The search results were grouped by year of publication, dimensions, indicators, benefits, and challenges to identify relevant research trends. Most journal articles were published in 2024, 2023, 2022, 2021, and 2020. Based on the search strategy using the Boolean algorithm ("Hospital Maturity Model") AND ("Healthcare Maturity Model") AND ("Digital Maturity" OR "Maturity Model") AND ("Health Maturity Model") AND ("Hospital Management")**, a total of 17,300 articles were retrieved from Google Scholar, 106 articles from PubMed, and 69 articles from the Cochrane Library. These articles were further screened based on their titles, abstracts, and the inclusion and exclusion criteria. The quality assessment process yielded 330 journal articles that met the eligibility criteria. A subsequent evaluation of content relevance reduced the final selection to 29 articles. This process is illustrated in the PRISMA flow diagram. The selected articles were required to meet five quality assessment criteria (QA1–QA5). Articles that failed to meet any of these criteria were excluded. The distribution of journal articles at each stage of the selection process is presented in Figure 1.

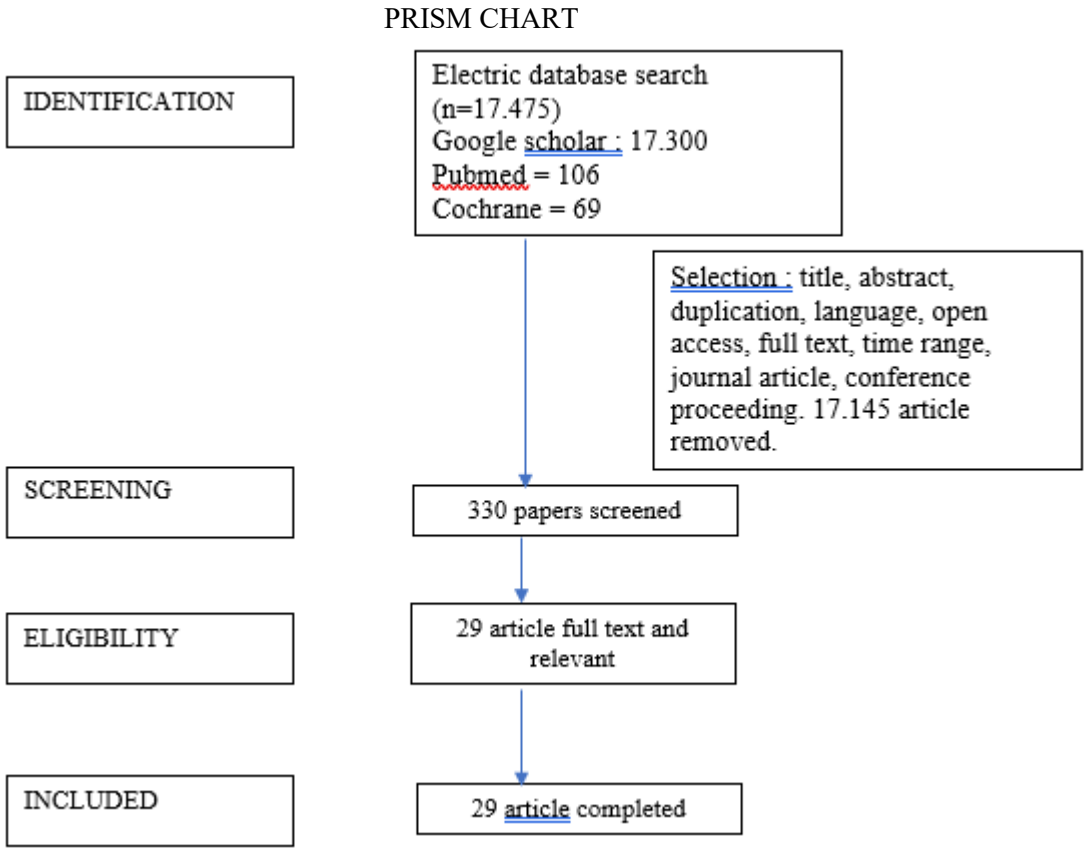

Figure 1. PRISMA Flow Diagram of the Study

The final selection results in the form of a narrative analysis are presented in Table 4. Table 5 provides the analysis of the benefits and challenges of hospital digital maturity. The results of the data analysis at this stage address the research questions (RQs).

Tabel 4. Narrative Analysis

No.	Dimension	Indicators	Description
1	Strategy	Strategic adaptation, strategic alignment, strategic focus	The extent to which the organization has developed and implemented strategic plans to achieve its goals and objectives.
2	Data Analytics	Descriptive analytics, predictive analytics	The extent to which the organization utilizes data for effective decision-making at the organizational, patient, and public health levels.
3	Governance and Management	Change management, data governance, leadership and management, risk management, standards, cultural values	The extent to which the organization applies leadership, policies and procedures, structures, risk management related to quality and safety, integrated workflows, relationship-building, and capacity development.
4	People, Skills, and Behaviour	Education and training, knowledge management,	The extent to which stakeholders (internal and external) are digitally literate and motivated to leverage technology.

		individual competence, technology usage	
5	Patient-Centered Care	Patient empowerment, patient focus	The extent to which patients, healthcare professionals, and families actively participate in health decisions, have access to health information and data, and co-create services and service delivery.
6	Interoperability	External interoperability, internal interoperability, semantic interoperability, syntactic interoperability	The extent to which data and information can be exchanged across systems within the organization, among different healthcare providers, and with patients, healthcare professionals, and families.
7	Information Technology Capability	ICT infrastructure, technical quality, systems and services	The extent to which the organization has adopted and implemented IT infrastructure, digital systems, technologies, and services that are usable and effective.

Table 5. Benefits and Challenges of Hospital Digital Maturity

No.	Benefits	Description	Challenges	Description
1	Benchmarking and Competitive Advantage	Identifying maturity models that support hospital managers with standardized frameworks for internal and external performance benchmarking, while highlighting areas for competitive advantage.	Resistance to Change	The maturity model approach may encounter resistance from individuals or teams during its implementation.
2	Supporting Decision-Making	Emphasizing data-driven approaches, maturity models enable strategic decision-making and clarify resource allocation within hospitals.	Resource Requirements	Implementation and effective utilization of digital maturity models may significantly increase demands for resources, expertise, and financial investment.
3	Improved Performance	By identifying areas for improvement and providing a roadmap for advancement, maturity models can yield tangible enhancements in hospital performance and outcomes.	Oversimplification and Complexity	Hospital management processes, combined with multidisciplinary capabilities, may be oversimplified or inadequately addressed, leading to complexity in application.
4	Risk Reduction	Proactively identifying and addressing weaknesses can help hospitals reduce risks associated with ineffective processes or inadequate capabilities.	Excessive Formalization over Substance	Emphasis on higher-level formalization may result in misalignment with outcome improvements.

In summary, we identified seven key aspects/dimensions of digital health maturity—namely strategy, governance and management, IT capability, interoperability, data analytics, people/skills/behaviour, and patient-centered care—that hospitals should consider when strategically planning their digital health agendas. In addition, this study identified 24 indicators that can be used to measure these dimensions (Figure 2). To operationalize these indicators, future research should focus on developing more specific and rigorous measurement items, accompanied by comprehensive assessments of both internal and external validity and reliability (McKenzie & Podsakoff, 2011).

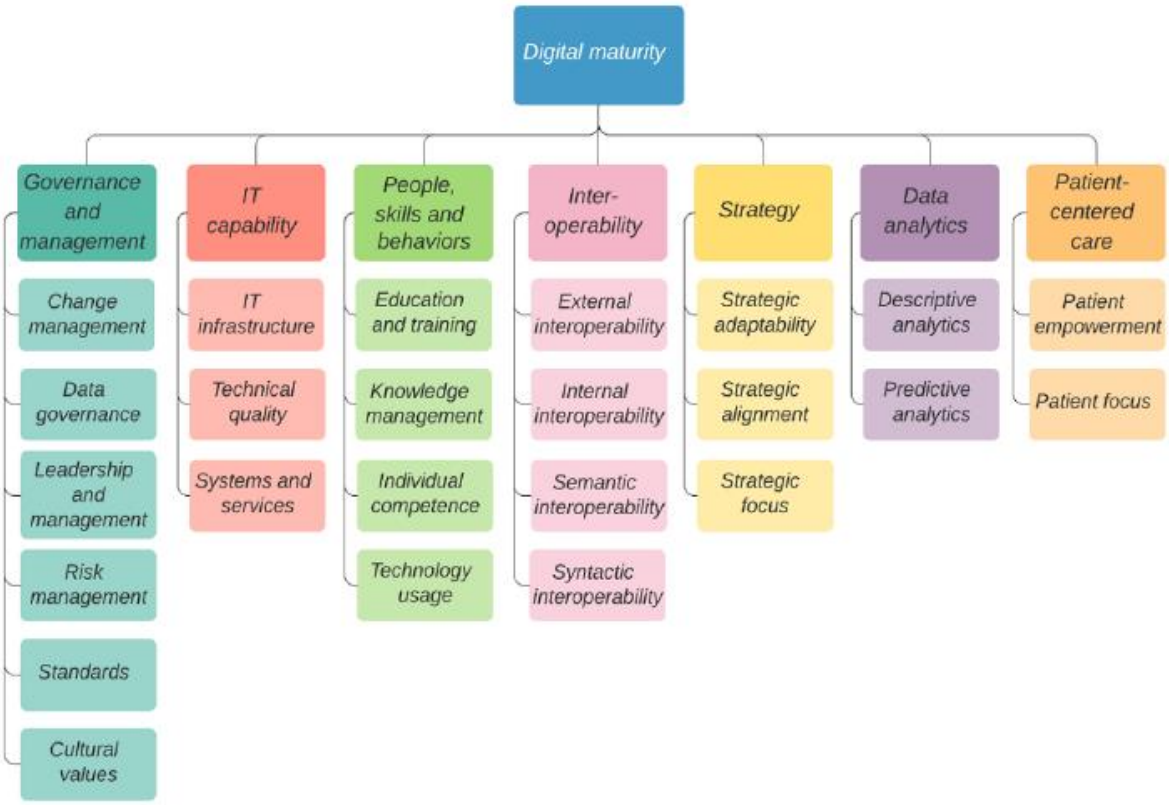

Figure 2. Dimensions of Digital Maturity in Hospitals

These dimensions have received varying levels of attention in the literature; however, in this paper, a comprehensive digital health maturity assessment must consider all dimensions in depth. Therefore, we assume that each dimension carries equal weight. Failure to account for any one dimension may potentially undermine the overall digital transformation agenda.

Our findings extend prior systematic literature reviews on digital health maturity models in three significant ways. First, previous reviews have primarily sought to identify and analyze maturity models individually. For example, Carvalho et al. (2016) examined 14 maturity models, while Gomes and Romão (2018) investigated 26 commonly used maturity models in healthcare, providing descriptive accounts of each. In contrast, this study integrates the dimensions from existing maturity models to propose a consolidated and comprehensive framework (Figure 2).

Second, while some reviews have analyzed maturity model dimensions, they often employed overly broad categories. For instance, Tarhan et al. (2020) developed an integrated list comprising only four dimensions: business processes, technology, people, and others. Their "business process" dimension encompassed government regulations; their "technology" dimension aligned with the IT capability dimension identified in this study; and their "people" dimension focused more on patient safety culture, which differs from the people, skills, and behaviour dimension highlighted in this study that evaluates factors at both the individual and organizational levels. The "others" category in their framework included various factors such as culture, strategy, governance, leadership, interoperability, and data.

Third, the maturity model framework developed in this paper provides a more detailed articulation of factors previously grouped under the broad "others" category, which we reclassified into distinct dimensions such as strategy, governance, interoperability, and data analytics. Such granularity is essential to enable more effective and accurate digital maturity assessments in hospitals

D. CONCLUSION

The findings of this study resulted in a digital maturity framework consisting of seven dimensions: strategy, information technology capability, interoperability, governance and management, patient-centered care, human resources/skills/behaviour, and data analytics. These seven dimensions can be evaluated through 24 specific indicators assigned to each dimension.

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