INDONESIAN HEALTH JOURNAL
Volume 5 Number 3, November 2026
pp. 970-989
E-ISSN: 2963-3036
DOI: 10.58344/ihj.v5i3.946

From Manual to Digital: A Systematic Review of Simrs Planning as a Foundation for E-Hospital Implementation in the World and In Indonesia

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Keywords:
Digital maturity; E-Hospital; Hospital management information system; Information system planning; Technology-Organization-Environment

Abstract

Hospital digital transformation requires comprehensive planning that aligns technological capabilities, organizational readiness, and environmental support. However, evidence regarding Hospital Management Information System (HMIS) planning remains fragmented, particularly concerning differences between international contexts and Indonesia. This systematic literature review aimed to identify key planning factors supporting electronic hospital (e-hospital) implementation and compare their application across different healthcare settings. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, literature searches were conducted in PubMed, Scopus, ScienceDirect, and Google Scholar for studies published between 2021 and 2026. Of the 738 records initially identified, 27 studies met the eligibility criteria, comprising 14 studies conducted in Indonesia and 13 international studies. The findings were synthesized narratively using the Technology–Organization–Environment (TOE) framework. Technological factors included infrastructure readiness, system interoperability, usability, and cybersecurity. Organizational factors encompassed workforce competencies, leadership commitment, strategic alignment, and change management. Environmental factors involved regulatory requirements, financing mechanisms, institutional incentives, and digital maturity assessments. The findings indicated that hospitals in more digitally advanced settings increasingly emphasized interoperability and system optimization, whereas Indonesian hospitals continued to encounter interconnected challenges related to infrastructure, workforce capabilities, financial resources, and system integration. The synthesis further suggested that regulatory compliance and system adoption alone were insufficient indicators of digital maturity. Effective planning therefore requires an integrated approach across technological, organizational, and environmental dimensions, supported by coordinated investment, stakeholder participation, measurable implementation roadmaps, and periodic digital maturity assessments. These findings provide an evidence-informed foundation for sustainable e-hospital implementation and the development of more integrated, efficient, and responsive hospital information systems.

INTRODUCTION

Digital transformation in the healthcare sector extends beyond the acquisition of technological devices and involves organizational changes driven by digital technologies that reshape business processes, operational activities, and patient experiences (Nadiyah & Prayoga, 2024; Naurah et al., 2024). This transformation is closely associated with the principles of Industry 4.0, which emphasize digitalization, interconnected systems, and the integration of processes, services, and stakeholders to support patient-centered healthcare delivery (Budiyatno, 2022). Its primary objectives include improving operational efficiency, enhancing patient experiences, and reducing healthcare costs (Naurah et al., 2024). In hospital settings, digital transformation encompasses seven major areas: integrated health information technology management, medical imaging, electronic medical records, wearable technologies, electronic health (e-health) services, telemedicine, and medical data privacy and security (Budiyatno, 2022). Electronic medical records (EMRs), known in Indonesia as Rekam Medis Elektronik (RME), have become a major priority of the Indonesian government, which has established policies promoting their implementation across healthcare facilities (Kassiuw et al., 2023; Muhajir et al., 2023). Previous studies have associated healthcare digitalization with reduced operational costs, faster service delivery, greater transparency, and improved accountability (Muhajir et al., 2023; Nadiyah & Prayoga, 2024). Nevertheless, challenges related to healthcare workforce competencies, digital disparities, organizational resistance to change, and inadequate technological infrastructure continue to hinder effective implementation (Muhajir et al., 2023; Widiarini & Ramadhaningtyas, 2023).

Globally, the adoption of digital health technologies remains uneven across countries and healthcare systems. According to Porrello et al. (2025), national electronic health record (EHR) systems were available in approximately 47% of countries worldwide. In the United States, the adoption of basic EHR systems increased from 6.6% to 81.2%, while comprehensive EHR adoption rose from 3.6% to 63.2% over approximately one decade (Jiang et al., 2023). Similarly, more than 95% of hospitals in Ireland reportedly used EHR systems (Walsh et al., 2021). The expansion of EHR adoption in the United States was supported by the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, which introduced financial incentives totaling approximately US$27 billion to encourage the meaningful use of certified EHR technology (Beauvais et al., 2021). In South Korea, more than 90% of medical institutions had adopted EHR systems, with adoption reaching 100% among tertiary hospitals by 2021 (Jung et al., 2024). Estonia has also demonstrated substantial progress in healthcare digitalization, with electronic prescribing exceeding 99% adoption in 2018 (Khadka et al., 2024). However, significant disparities persist between high-income and low-income countries in the availability of e-health governance policies, digital infrastructure, and institutional capacity (Okpechi et al., 2022). These differences indicate that although digital health systems have become increasingly embedded in healthcare delivery, their adoption and maturity remain strongly influenced by national policies, financial resources, and organizational readiness.

Indonesia has established a regulatory framework to accelerate hospital information system adoption and healthcare digital transformation (Binsar et al., 2026). Regulation of the Minister of Health of the Republic of Indonesia Number 82 of 2013 concerning Hospital Management Information Systems requires hospitals to implement a Hospital Management Information System, known as Sistem Informasi Manajemen Rumah Sakit (SIMRS) (Hidayatuloh & Mulyanti, 2023). This regulatory framework was further strengthened by Regulation of the Minister of Health Number 24 of 2022 concerning Medical Records, which mandates the implementation of electronic medical records across healthcare facilities (Ayu & Lazuardi, 2023; Lakhmudien et al., 2023; Ministry of Health of the Republic of Indonesia, 2022). Additionally, Regulation of the Minister of Health Number 21 of 2020 concerning the Ministry of Health Strategic Plan for 2020–2024 established strategic targets for strengthening integrated electronic medical record implementation (Fitriyah, 2022). Despite these regulatory initiatives, comprehensive and consistently reported national data on the extent of fully operational SIMRS implementation remain limited in the reviewed literature. Consequently, evidence regarding implementation challenges has frequently been obtained from individual hospital case studies. At Praya Regional General Hospital, SIMRS utilization remained suboptimal because the system had not been implemented across all hospital units (Beny, 2021). Similarly, Dr. Sam Ratulangi Tondano Regional General Hospital encountered challenges involving insufficient computer equipment, inadequate internet connectivity, limited budget allocations, and shortages of qualified information technology personnel (Tangel et al., 2023). These findings illustrate the continuing challenges of translating national digital health policies into effective hospital-level implementation.

The persistent gap between regulatory requirements and actual hospital information system implementation raises important questions regarding the factors influencing digital transformation outcomes. Previous research suggests that unsuccessful health information system initiatives cannot be attributed solely to technological limitations. Instead, implementation difficulties have frequently been associated with inadequate planning, insufficient digital infrastructure, and misalignment among stakeholder expectations (Samra, 2025). Other contributing factors include limited senior management commitment, inaccurate requirements specification, ineffective change management, and insufficient investment in human resources (Gomes & Romão, 2025). These challenges indicate that hospital digital transformation depends on readiness at the individual, organizational, and technological levels. Accordingly, systematic assessments of e-health readiness, encompassing technical capabilities, governance structures, and stakeholder attitudes, have been identified as important components of implementation planning (Melhem et al., 2025). Evidence from Ethiopia further demonstrates that inadequate training, weak managerial commitment, and poor network infrastructure contributed to difficulties in electronic medical record implementation (Bisrat et al., 2021). Collectively, these findings emphasize the importance of comprehensive planning that integrates needs assessment, infrastructure readiness, workforce competencies, organizational governance, and stakeholder engagement before and during hospital information system implementation (Gomes & Romão, 2025; Samra, 2025).

Although numerous studies have examined SIMRS adoption and electronic hospital (e-hospital) implementation, the reviewed literature indicates that evidence specifically addressing planning factors as a foundation for successful digital hospital transformation remains fragmented. Existing research has frequently concentrated on system adoption, implementation barriers, user acceptance, and postimplementation evaluation, while the relationships among technological preparedness, organizational readiness, and external environmental conditions during the planning stage have received comparatively limited integrated attention. Furthermore, differences between international healthcare settings and Indonesian hospitals have not been consistently examined within a common analytical framework. This fragmentation creates a research gap concerning how planning factors interact across institutional contexts and how lessons from international digital health implementation can inform hospital information system planning in Indonesia.

To address this gap, the present study aimed to systematically review and synthesize the factors influencing SIMRS planning as a foundation for e-hospital implementation in international and Indonesian healthcare settings. The review applied the Technology–Organization–Environment (TOE) framework developed by Tornatzky et al. (1990) to organize the identified planning factors into three interconnected dimensions: technological readiness, organizational capabilities, and environmental conditions. Specifically, the study sought to identify critical planning factors, compare their characteristics across international and Indonesian contexts, and examine their implications for sustainable hospital digital transformation. The expected theoretical contribution was to provide an integrated understanding of hospital information system planning through the TOE framework, while its practical contribution was to inform hospital administrators, healthcare policymakers, and health information technology practitioners in developing evidence-informed digital transformation strategies. Ultimately, the review sought to support more systematic, context-sensitive, and sustainable planning approaches for the transition from conventional hospital information management toward integrated e-hospital systems.

METHOD

Research Design and Protocol Review

This study employed a systematic literature review (SLR) design to examine Hospital Management Information System (Sistem Informasi Manajemen Rumah Sakit, SIMRS) planning as a foundation for electronic hospital (e-hospital) implementation, with a comparative focus on international and Indonesian healthcare settings. The review followed the PRISMA 2020 reporting guidelines (Page et al., 2021), encompassing literature identification, screening, eligibility assessment, and final study selection. The research question was structured using the Population, Exposure, Comparison, and Outcome (PECO) framework. The population (P) included hospitals, healthcare facilities, and relevant stakeholders, including healthcare professionals, information technology personnel, and hospital management. The exposure HER encompassed SIMRS, electronic medical record (EMR), and e-hospital planning and implementation, including strategic information systems and information technology (IS/IT) planning, organizational readiness assessments, enterprise architecture, digital maturity assessments, change management, and regulatory requirements.

The comparison HER involved an analytical comparison between international and Indonesian healthcare contexts without a predefined control group. The outcomes (O) included critical planning success factors, digital readiness and maturity, system adoption, user experiences, implementation barriers, and healthcare service quality and patient safety outcomes.

Criteria Article Eligibility

Included articles is study original discussing planning, readiness, adoption, or SIMRS implementation, record medical electronics, and E-Hospital, incl studies enterprise architecture, assessment digital maturity, as well as obstacle interoperability and data security. Article issued when in the form of editorials, opinions, or comment without primary data; only available as abstract; no can accessible full; discuss technology health outside context system information House sick; or is duplicate inter- database. Range publication limited to 2021–2026 with Indonesian and English.

Table 1 Criteria Inclusion and Exclusion Study

Aspect	Inclusion	Exclusion
Type of study	Study original (cut) cross-sectional, survey, cohort, qualitative, *mixed methods*, development system) and official data reports government	Editorials, opinions, comments and articles without primary data
Topic	planning, plan strategic IS/IT, enterprise architecture, RME readiness, digital maturity, and implementation *E-Hospital*	Outside context system information House Sick or No discuss planning and implementation
Population	Hospitals, facilities health, energy health, IT personnel, and leadership management	Focus only on the patient as users application health independent
External	Planning factors, readiness, adoption, digital maturity, experience users, obstacles, and quality and safety	Not reporting external relevant or nature descriptive technical solely
Publication	Published 2021–2026, text complete, Indonesian or English	Outside range year, duplicate inter-database, or only available as abstract

Search Strategy Literature

Search done via PubMed, Scopus, Sciencedirect, and Google Scholar Keywords arranged from combination term free and MeSH, covering hospital information systems, electronic medical records, e-hospitals, planning, readiness, digital maturity, and digital transformation, as well as equivalent Language Indonesian such as “SIMRS”, “ SIMRS planning”, “plan strategic system information House sick”, “readiness record medical electronics”, and “digital transformation of the home sick”. After article collected, done deletion duplication, filtering title and abstract, then review text complete.

Data Selection and Extraction

Selection ongoing four stages: identification, removal duplicate, filtering title-abstract, and assessment text complete. Articles that are not discuss system information House sick, no touch on aspect planning or implementation, or No report external relevant extracted. Data extracted to in standard format containing author, year, country, purpose, sample, method, and findings main. Quantitative value in the form of percentage adoption, score readiness, level digital maturity, AOR, OR, β coefficient, and 95% confidence intervals were recorded. Intact in accordance reporting article original, then verified repeated by other researchers.

Data Synthesis and Analysis

Analysis done in a way descriptive narrative. Findings study grouped to in three theme, namely description planning and implementation of E-Hospital in the world, overview in Indonesia, and factor key planning along with comparison second context the third theme discussed with contextualize findings on the Technology-Organization-Environment (TOE) framework, which regulates factor planning to in dimensions technology, organization, and environment. Because it uses secondary data that has been published, approval ethics No necessary, but all over source still cited in accordance rules scientific.

RESULTS AND DISCUSSION

Search systematically on four electronic databases produced 738 articles, consisting of on Scopus as many as 244 articles, PubMed 82 articles, ScienceDirect 122 articles, and Google Scholar 290 articles. At the stage identification, as many as 548 articles issued Because duplication (n = 83), no published in the range 2021–2026 (n = 315), no can accessible in a way open (n = 125), and No is study original (n = 25), so that 190 articles remaining for stage filtering title and abstract. At stage this, 152 articles issued Because no relevant with focus study. Of the 38 articles assessed eligibility text in full, 11 articles issued Because the context No relevant. With Thus, a total of 27 articles fulfil criteria inclusion and inclusion in review end (Figure 1, Table 1).

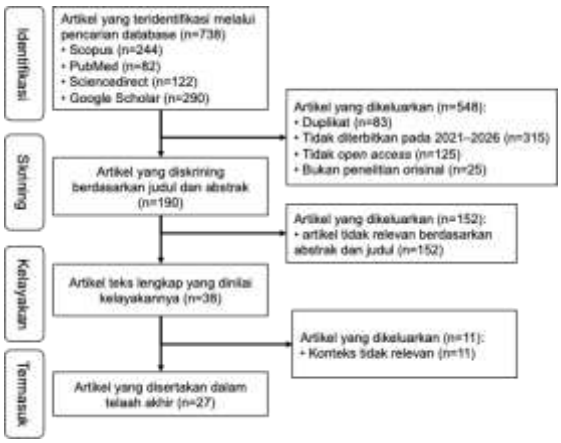


Figure 1PRISMA Flow Diagram

Reviewed from country of origin, as many as 14 articles originate from Indonesia and 13 articles from outside Indonesia, namely the United States (5 articles), Ethiopia (2 articles), and one each article from Germany, Portugal, the Netherlands, South Korea, Malaysia, and South Africa. Composition This allows comparison between the context of developed countries, developing countries, and Indonesia as become objective study.

From the side design, reviewed articles dominated by studies quantitative cut latitude and survey national (13 articles), followed by studies qualitative in the form of studies case, interview in-depth, action research, and compilation enterprise architecture (11 articles), and one each article designed cohort, development systems, and dashboard data analysis national. Range big the sample is very wide, starting from from study on one House Sick until analysis against 33,901 facilities health, and from 4 informants up to 8,638 respondents. Variation this

is what it is base election analysis descriptive narrative. Distribution year publication relatively evenly, namely 2021 (5 articles), 2022 (4 articles), 2023 (6 articles), 2024 (3 articles), 2025 (6 articles), and 2026 (3 articles), so that synthesized findings reflect development latest.

In a way substance, the article being reviewed can grouped to in four focus main. Group First highlight level digital adoption and maturity at scale national. Group second evaluate readiness source Power humans and leaders operational before system applied. Group third discuss the planning process That itself, includes compilation plan strategic IS/IT, enterprise architecture, maps road digital transformation, and measurement readiness organization. Group fourth study obstacle post-implementation that is rooted in planning, such as interoperability, usability system, structure financing, and data security. Overall results extraction presented in Table 2

Table 1 Research Article Extraction

Researcher, Country Year	Research purposes	Sample	Method	Key Findings
(Astari et al., 2025) Indonesia	Evaluate fidelity RME data delivery to national platforms	33,901 facilities health	Dashboard data analysis national	In October only 58% of facilities fulfil 50% data delivery threshold; achievement decreased in December when the target is raised to 100%; there is disparity intersex facilities and inter-regional
(Barker & Chang, 2026) United States of America	Map trend home HER adoption Sick for 17 years	2,253 houses non-federal hospital	Analysis survey national recurring (AHA IT Supplement)	Adoption increased from <10% (2008) → 99% (2018) → 99.4% (2024); vendor usage is the same care inpatient care road 62% → 90%; top 3 vendor share 35% → >80%, Epic 50.8%
(Basulo-Ribeiro et al., 2026) Portugal	Making a map road balancing digital transformation aspect technology and humans	House manager sick Portugal	Qualitative; study theoretical + semi-structured interviews	Dimensions man assessed manager as determinant success; humanization treated as a measurable target through indicator experience patients and staff; roadmap not yet field tested
(Everson & Richwine, 2025) United States of America	Identifying obstacle acquisition and use information interoperable	2,420 houses Sick	Cross-sectional analysis survey national	81% of houses Sick experienced ≥1 minor obstacle and 62% major obstacles (2023); the most major obstacles related vendor differences and capabilities partners data exchange
(Geissler et al., 2024) German	Evaluate digital maturity of the home Sick in a way national	515 houses Sick	national self-assessment	69% of houses Sick Not yet fulfil EMRAM level 1 criteria and still is at level 0, even though the national digital funding program has walk
(Gelchu et al., 2025) Ethiopia	Evaluate readiness power health and factors that influence it	384 power health	Cross-sectional	Readiness 60.4% (95% CI 55.5–65.3%); factor significant : ownership computer personal (AOR 3.54), attitude support (AOR 2.77), literacy computer (AOR 2.67), knowledge (AOR 2.56), skills computer (AOR 2.49), age young (AOR 2.66)
(Hailegebreal et al., 2023) Ethiopia	Evaluate readiness power health to	400 power health	Cross-sectional	Readiness overall 65.25%; readiness involvement 68.75%; core readiness 69.75%; factor significant: skills computer (AOR 3.06), attitude (AOR

Researcher, Country Year	Research purposes	Sample	Method	Key Findings
	implementation of RME			3.00), EMR training (AOR 2.00), knowledge (AOR 2.021)
(Hossain et al., 2025) Indonesia	Review culture management post- RME mandate hospital records and readiness	Hospitals in Java and Sulawesi	Qualitative exploratory; interviews and FGD	Hospitals in Java are proactive with infrastructure and training more good; hospitals in Sulawesi adopted RME primarily to meet regulations; constraints in the form of connectivity No stable, low digital literacy, and dependence on recording paper
(Lee et al., 2022) South Korea	Map institutional ICT infrastructure and services medical national	42 tertiary hospitals, 311 general hospitals	Cross-sectional, survey national	EMR implemented in 90.5% of homes sick and 100% tertiary hospitals since 2015; PHR implementation is far more unequal, ranging from 61.9% to 2.4% depending size House Sick
(Melnick et al., 2021) United States of America	Measure RME usability and its relationship with fatigue professional	8,638 nurses	Cross-sectional, survey random national	usability score 57.6 (SD 16.3), classified as grade "F"; each 1 point increase score usability relate with 2% decrease in the odds of burnout (OR 0.98; 95% CI 0.97–0.99; $p<0.001$)
(Mustafa et al., 2024) Malaysia	Develop instrument gauge factor success critical reception system	106 doctors	Cross-sectional pilot study; exploratory factor analysis	Analysis component main produced 9 components that explained 84.07% of the total variance, exceeding minimum threshold of 60%; HOT-fit and TAM frameworks are proven worthy as base planning
(Neprash et al., 2022) United States of America	Measure frequency and characteristics ransomware attacks in the sector health	374 attacks ransomware on organizations service health	Cohort study (2016–2021)	Amount attack annual increase more from double, from 43 to 91; expose information health personal almost 42 million patient; attack increasingly target organization big with Lots facility
(Rachmani et al., 2026) Indonesia	Test connection digital competence and quality interface to experience users	704 power health	Cross-sectional multi-site	Quality interface is correlate strongest experience users ($\beta = 0.374$; $p<0.001$); digital competence is not relate directly ($\beta = -0.044$; $p = 0.232$) as well as No direct ($\beta = 0.002$; $p = 0.928$); weakest item : stability system 3.10 (SD 1.097), input assistance 3.61, status visibility 3.69, recovery error 3.75
(Schiffelers et al., 2025) Dutch	Review method House Sick organize digital transformation	8 houses Sick	Case study qualitative multi-case; semi-structured interviews	Structure team different However barriers and facilitators similar; financing model create incentive negative for digital services because focus on activities No results; ROI is long and not sure; culture organization, resources Power financial and infrastructure technical become element foundational
(Snowdon et al., 2024) United States of America	Test connection digital maturity with external	1,026 houses Sick	Cross-sectional observational	Hospital with advanced digital maturity (EMRAM level 6–7) is 3.25 times more likely big get ranking safety more high (OR 3.25; 95% CI

Researcher, Country Year	Research purposes	Sample	Method	Key Findings
	quality and safety			2.33–4.55), accompanied by decline number infections and events No expected
(Steenkamp et al., 2025) South Africa	Evaluate digital readiness of leaders operational service health	143 leaders service health in 11 homes Sick	Cross-sectional; E-Ready 2.0 scale	77% (n=110) believe digital devices improve efficiency work , but only 64% (n=92) rated device suitable with routine work ; readiness >70% in attitude Work but more low on condition changes in place Work
(Kurniawan, 2021) Indonesia	Make a plan strategic which supports IS/IT development at Grhasia Mental Hospital.	25 respondents	Qualitative, action research	The implementation of IS/IT is still limited with constraint manual reports, insufficient IT human resources (quality / quantity), limited bandwidth (10 Mbps), and lack of SOP; annual IS/IT budget only around 1% of the total budget House illness (example: 1.69% in 2018).
(Mutawalli et al., 2021) Indonesia	Building a data warehouse and dashboard for addressing data analysis gaps due to migration system information House sick (SIMRS).	318,333 patient data	Development system	dashboard system is successful integrate data from two different SIMRS with level feasibility 86%. Test results show score quality system 86%, quality information 88%, and quality 85% service. Dashboard is capable visualize trend patient, method pay (highest JKN Jamkesmas 13,579 patients stay), and regional distribution (highest Praya District 44,654 patients).
(Praptana et al., 2021) Indonesia	Analyze level readiness implementation system information based record medical electronic	30 respondents	Qualitative, mentoring and assessment	Readiness score overall is 69.38 (category Enough ready). Score per component: Leadership 2.51; Human Resources 2.36; Infrastructure 2.36; and Organizational Work Culture 2.34 (lowest).
(Zanuwar, 2023) Indonesia	Produce planning enterprise architecture using the TOGAF ADM framework for building an integrated IS at Soreang Regional Hospital.	1 house Sick	Qualitative	Planning produce a blueprint that includes architecture business, data, applications, and technology; identification beginning show problem duplication of data and reports that are not efficient; migration roadmap arranged for 16 months divided in 4 stages (Key Operational, Support, High Potential, and Strategic Application).
(Tangel et al., 2023) Indonesia	Analyze implementation system information management House sick at Dr. Sam Ratulangi Tondano	4 informants	Case study qualitative ; interview in-depth and observation	The implementation of SIMRS is still lacking in indicators infrastructure (lack of computers and internet networks are not adequate consequence limitations budget) and human resources (lack of competent IT staff and low discipline), but SOP indicators are already Good in accordance standard leadership; time

Researcher, Country Year	Research purposes	Sample	Method	Key Findings
	Regional Hospital.			data response to the user is around 2-3 seconds (when slow 6-7 seconds).
(Muhajir et al., 2023) Indonesia	Describe implementation, identifying factors determinants, and digital transformation strategies at Prof. Dr. HM Anwar Makkatutu Regional General Hospital.	15 people	Descriptive qualitative; interview in-depth, observation, and documentation	Since 2017, 95% of units connected SIMRS application Khanza. Determinant factors covering competence officer, work team, regulation, and cooperation, while obstacle main is the comfort zone, sectoral ego, and lack of literacy technology. Digital transformation improves efficiency through online registration (SI PANDAI), data integration without photocopy files and reporting valid and accountable automatic.
(Pujihastuti, 2021) Indonesia	Do study system information House pain in the aspect users in support taking decision management.	All officers involved in implementation system information	Descriptive evaluative with cross-sectional approach	SIMRS "PILAR" has 10 modules However Not yet own module polyclinic so that service still manual; average transaction response time 15-30 minutes; synchronization with SISMADAK 0.3 yet automatic; there is constraint security in the form of use one shared password per section and bandwidth limitations (1 MBPS per PC) which causes fail send BPJS claim data; no SOP rights available access, edit, and develop data.
(Radjab & Mandasari, 2022) Indonesia	Analyze utilization system information House hospital (SIMRS) at Ibnu Sina Hospital YW-UMI Makassar for increase quality data services and management.	99 people	Descriptive evaluative with cross-sectional approach	The use of SIMRS has not yet maximum; frequency data entry by officers: 64.73% sometimes, 25.15% not input, and only 12.12% always inputting. SIMRS helps taking decisions and improve performance management through the billing system, but there is constraint operational (system trouble) and lack of specialized human resources data input (only 1 person).
(Pamungkas, 2022) Indonesia	Analyze System Information Hospital Management in the Outpatient Installation at Puri Husada Regional General Hospital Tembilahan 2020.	7 subjects study	Descriptive with approach qualitative	The implementation of SIMRS is not optimal yet constraint networks, applications, and electricity No stable; part registration still manual and pharmaceutical stopped since 2019. SOP has been available However Not yet distributed to unit, budget available every year, as well as adequate human resources but need training SIMRS only. Waiting time patient exceeding 90 minutes in the polyclinic and 60 minutes in the pharmacy, exceeding the Minimum Service Standards (≤60 minutes).
(Lumingkewas et al., 2023)	Analyze implementation	5 informants	Qualitative, study case	Implementation of SIMRS from side infrastructure Already available

Researcher, Country Year	Research purposes	Sample	Method	Key Findings
Indonesia	System Information Hospital Management (SIMRS) at Manembo - Nembo Bitung Regional Hospital .		with interview deep	However Not yet reach all over installation (maintenance) accommodation and nutrition), components network Not yet connected to pharmacy, radiology, and lab. Systems application use open source However its development not optimal because limitations qualification HR competency. Main constraints is limited funds and frequent disturbance network that causes patient must wait 10-20 minutes.
(Wafidah et al., 2023) Indonesia	Analyze and describe implementation Minister of Health Regulation Number 82 of 2013 concerning SIMRS at Kertosono Regional Hospital use George C. Edward III's theory .	4 informants	Qualitative descriptive	SIMRS has walk since 2011 but there is constraint communication and socialization that is not sustainable for employee new. Source Power adequate with available IT budget and infrastructure covers 234 PC units and 5 servers. Commitment towards SOP still not enough so that the data is often invalid (operator not enter diagnosis/ outgoing data with Correct).

Overview of SIMRS Planning and E-Hospital Implementation in the World Based on Technology-Organization-Environment

SIMRS planning and implementation of E-Hospital in the world can depicted through three TOE dimensions, namely technology, organization, and environment.

Dimensions technology covers level adoption, maturity infrastructure, interoperability, usability, and data security. Adoption system information House Sick show wide gap, even between fellow developed countries. United States take notes increase adoption record medical electronics at home non-federal hospital from not enough from 10% in 2008 to 99% in 2018 and 99.4% in 2024, without difference meaningful intercategory House sick (Barker & Chang, 2026). South Korea achieved achievements similar. Survey national against 42 houses Sick tertiar, 311 houses Sick public, and 1,431 locations House Sick find that 90.5% of houses sick and 100% home Sick tertiary has implement record medical electronic since 2015, while level implementation of personal health records varies between 61.9% to 2.4% depending size House sick (Lee et al., 2022). Germany actually show different results. Assessment national digital maturity through the DigitalRadar program got 515 responses complete from 1,616 invitations (31.9%) and found 69% of the house Sick Not yet fulfil EMRAM level 1 criteria (Geissler et al., 2024). Maturity infrastructure impact directly on quality service. Study of 1,026 homes sick in the United States find House Sick with advanced digital maturity (EMRAM level 6 or 7) is 3.25 times more likely big reach ranking safety more high (OR 3.25; 95% CI 2.33–4.55),

accompanied by decline number infections and events No expected (Snowdon et al., 2024). Implementation standard interoperability become prerequisite data exchange between systems, although standard the Not yet fully remove obstacle technical. Survey against 2,420 houses sick United States found 81% of homes Sick experience at least One minor obstacles and 62% major obstacles in exchange information in 2023, with most major obstacles related with vendor differences and capabilities partners data exchange (Everson & Richwine, 2025). Resistance users generally sourced from usability system, not from personal reluctance. Usability record medical bad electronics proven relate with fatigue professionalism in nurses in the United States (Melnick et al., 2021). Data security is becoming challenge technology next. Cohort study recorded 374 ransomware attacks on organizations provider service health in the United States throughout 2016 to 2021, with amount annual increase more from double and exposure information health personal reach almost 42 million patients (Neprash et al., 2022).

Dimensions organization covers readiness source Power human, readiness leadership operational, analysis need users, and management change. Developing countries face more problems based on dimensions this. In Ethiopia, studies against 400 workers home health Sick Gamo Zone public records level readiness overall by 65.25%, with factor meaningful in the form of skills computer (AOR 3.06; 95% CI 1.49–6.29), EMR training (AOR 2.00; 95% CI 1.06–3.67), knowledge (AOR 2.021; 95% CI 1.19–3.39), and supportive attitude (AOR 3.00; 95% CI 1.76–4.97) (Hailegebreal et al., 2023). A follow-up study in South Oromia of 384 health workers health find readiness by 60.4% (95% CI 55.5–65.3%), with pattern factor similar that is ownership computer personal (AOR 3.54), attitude support (AOR 2.77), and literacy computer (AOR 2.67) (Gelchu et al., 2025). Readiness leadership participate determine success planning. Survey in 11 houses Western Cape Hospital, South Africa, received 143 respondents with level response of 56.1%, and found that 77% (n = 110) believed digital devices improve efficiency work, but only 64% (n = 92) rated device the suitable with routine work (Steenkamp et al., 2025). Analysis needs and acceptance users measured in a way systematically in several countries. Malaysia developed instrument based HOT-fit framework and Technology Acceptance Model for system information House Sick nationally, with analysis factor exploratory against 106 valid respondents (level response rate of 84.8%) resulted in 9 components explaining 84.07 % of the total variance (Mustafa et al., 2024). Management change become element organization next. House manager sick in Portugal assess dimensions man as determinant success and treat humanization as a measurable target through indicator experience patients and staff (Basulo-Ribeiro et al., 2026). Qualitative study on eight from eleven House invited sick in the Netherlands found that House Sick organize digital transformation with structure different teams, but face similar facilitators and barriers, with culture organization, sources Power financial and infrastructure technical as element foundational (Schiffelers et al., 2025).

Dimensions environment covers regulations along with incentives, vendor market structure, schemes financing, and national target pressures. United States go through track paired mandate with incentives and certification, as shown surge adoption post -HITECH Act (Barker & Chang, 2026). The pathway bring consequences on market structure. Market share three developer top increase from 35% in 2010 to more from 80% by 2024, with Epic

controlling 50.8% of the market (Barker & Chang, 2026). Germany placed evaluation maturity national as instrument planning at a time base allocation support (Geissler et al., 2024). Financing scheme become factor environment that is not lost determine. A study in the Netherlands found that that the applicable financing model create incentive negative for digital services because focus on activities and not results, accompanied by level return long -term and non-recurring investments certain (Schiffelers et al., 2025).

Third dimensions the each other related. Policy the right environment push adoption technology, but readiness organization still become conditions for adoption the changed become maturity the real system.

Overview of SIMRS Planning and E-Hospital Implementation in Indonesia based on Technology-Organization-Environment

planning and implementation of E-Hospital in Indonesia can depicted through three TOE dimensions, namely environment, technology, and organization.

Dimensions environment covers runway regulations and national target pressures. The implementation of SIMRS in Indonesia has runway relative regulation strong. Law Number 44 of 2009 concerning Hospitals requires every House Sick organize system information management (Radjab & Mandasari, 2022; Zanuwar, 2023). Provisions the Then strengthened through Regulation of the Minister of Health Number 1171/MENKES/PER/VI/2011 concerning System Hospital Information, as applicable for all over House Sick general and special, good owned by government and private sector (Zanuwar, 2023). In 2013, published Minister of Health Regulation Number 82 which is explicit obligatory every House Sick implementing SIMRS (Lumingkewas et al., 2023; Wafidah et al., 2023). Basis regulations the accompanied by a deadline target. The government obligatory all over facility service health adopt record medical electronics no later than December 31, 2023 (Hossain et al., 2025). This target pressure reflected in compliance data. Analysis of dashboard data from 33,901 facilities health show that in October only 58% of the facilities fulfil 50% threshold of data submission to the SatuSehat platform, and the figure the decreased in December when the target is raised to 100%, with disparity intersex facilities and inter-regional (Astari et al., 2025).

Dimensions technology covers maturity system, coverage implementation, infrastructure, and integration intersystem. The extent coverage implementation No necessarily reflect maturity adequate system. One of the instruments used for evaluate level maturity the is the NIMM (NHS Infrastructure Maturity Model), which divides maturity system information to in five levels, starting from Level 1 which is ad-hoc to Level 4 which has been reach optimization infrastructure (Radjab & Mandasari, 2022). In practice, a number of House the pain that has adopting SIMRS still face constraint Operational. At Puri Husada Regional Hospital Tembilahan, for example, the pharmaceutical unit even has stop use of SIMRS since 2019, while the data search process is in progress registration Still done manually (Pamungkas, 2022). Condition similar found at Manembo -Nembo Bitung Hospital, which implemented SIMRS Not yet reach all service units, including care road, care inpatient, nutrition, pharmacy, radiology, and laboratory (Lumingkewas et al., 2023). A number of House other sick choose use application open-source based, such as SIMRS Khanza, which has been implemented at Praya Regional Hospital, Central Lombok, since in 2019 (Mutawalli et al., 2021), as well as at

Bantaeng Regional Hospital since 2017 (Muhajir et al., 2023). From the aspect of infrastructure, limitations network Still found in a number of House Sick area. At Dr. Sam Ratulangi Tondano Regional Hospital, the quality of network the internet assessed Not yet adequate (Tangel et al., 2023), while at Grhasia Mental Hospital, it is not yet all over the building connected fiber optic and servers available Not yet functioning optimally (Kurniawan, 2021). Inter-system integration participate become obstacles. Praya Regional Hospital is experiencing constraint data integration during the migration process from the old SIMRS system to the Khanza SIMRS (Mutawalli et al., 2021). At PKU Muhammadiyah Hospital, Sukoharjo, the module care the road on SIMRS is still need evaluation more continued, accompanied by constraint server disruption in the synchronization process with BPJS INA-CBG (Pujihastuti, 2021). Manembo -Nembo Hospital, although device hard supporters has available, up to moment This Not yet integrated with system Sisrute , Satu Sehat, and BPJS (Lumingkewas et al., 2023).

Dimensions organization includes the planning process, readiness source Power human resources, internal budget, and availability of SOPs. The SIMRS development process in Indonesia is generally follow relative stages standard, namely planning, analysis, design, implementation, and maintenance. In a study at Condong Catur Hospital, Sleman, the stages planning the explained more carry on to in sub- stages analysis readiness, analysis needs and design system, with component main covers source Power human, leadership, culture organization, and infrastructure (Praptana et al., 2021). Level of readiness House Sick the measured use DOQ-IT (Doctor's Office Quality-Information Technology) method, and obtained score amounting to 69.38 which is categorized as " enough" ready " (Praptana et al., 2021). Other approaches are also used is TOGAF (The Open Group Architecture Framework) framework for compile enterprise architecture in general comprehensive, covering architecture business, data, technology, and applications, which results in a technology blueprint information in the form of a roadmap (Zanuwar, 2023). As For example, Grhasia Mental Hospital in the Special Region of Yogyakarta has prepared a development roadmap. System information and technology the information to in three stage, namely identification needs and preparation of SOPs, improvement of SIMRS and integration system, and optimization data utilization for taking decision managerial (Kurniawan, 2021). Although framework planning has available, readiness source Power man Still become consistent obstacles. At Dr. Sam Ratulangi Tondano Regional Hospital, it was recorded lack competent IT staff accompanied by problem discipline time work (Tangel et al., 2023). At Manembo -Nembo Hospital, competence personnel in develop application open-source based is also considered Still need improved (Lumingkewas et al., 2023), while at Grhasia Mental Hospital, HR in the IT sector was assessed Not yet adequate Good from aspect quality and quantity (Kurniawan, 2021). Conditions that are more limited found at RSD Kertosono, where the SIMRS installation only manned by two graduates computer, two technicians, and one administrative staff (Wafidah et al., 2023). Limitations internal budget also become factor inhibitors. At Dr. Sam Ratulangi Tondano Regional Hospital, the lack of allocation budget cause lack of computer units (Tangel et al., 2023), while at Puri Husada Regional Hospital Tembilahan, although budget has available, facilities and infrastructure supporters Still need addition (Pamungkas, 2022). Internal communication and socialization regarding the use of SIMRS at Kertosono Regional

Hospital is still less than optimal, especially for employee new (Wafidah et al., 2023). The availability of SOPs becomes problem separately. In a number of House sick, the SIMRS SOP has arranged However Not yet distributed to the related units (Pamungkas, 2022), even at Grhasia Mental Hospital, the SOP for management system information and technology information Not yet available the same once (Kurniawan, 2021).

Based on description said, can concluded that the implementation of SIMRS in Indonesia has show considerable progress significant in dimension environment, especially from side regulation and coverage adoption. However Thus, the dimensions technology and organization Still left behind. Hospitals in Indonesia are still faced with challenges fundamentals that include inequality infrastructure interregional, limitations readiness source Power human, the minimum allocation budget, as well as integration system that has not been walk in a way comprehensive (Kurniawan, 2021; Lumingkewas et al., 2023; Pamungkas, 2022; Tangel et al., 2023; Wafidah et al., 2023).

Key Factors SIMRS planning as Foundation E-Hospital Success: A Global and Indonesian Comparison

Third TOE dimensions become point meeting at a time point different between global and Indonesian contexts. Similarities and differences the most obvious seen when third dimensions compared to side by side.

In dimension technology, maturity infrastructure in developed countries proven relate direct with quality services, as has described in parts of the world (Snowdon et al., 2024), while interoperability still become obstacle even though adoption has reach point saturated (Everson & Richwine, 2025). Indonesia on the other hand Still dwelling on the problem more integration basis, as has described in the Indonesian section. The equation precisely appear in the problem usability. The bad thing usability record medical electronics in the United States relate with fatigue professionalism in nurses (Melnick et al., 2021), and patterns similar found in Indonesia. A study of 704 workers health in 20 homes Semarang hospital found that quality interface is correlate strongest to experience users ($\beta = 0.374$; $p < 0.001$), whereas competence digital health no show connection directly ($\beta = -0.044$; $p = 0.232$) as well as No direct through interface ($\beta = 0.002$; $p = 0.928$) (Rachmani et al., 2026). The study also mapped priority repair in a way Details. Items with score lowest is stability system (3.10 out of 5; SD 1.097), followed by availability help moment users No know method inputting data (3.61), system status visibility (3.69), and localization error accompanied by suggestions for improvement (3.75) (Rachmani et al., 2026). Findings This confirm that usability No resolved issues after adoption, but rather work sustainable in both context.

In dimension organization, readiness source Power people in developing countries proven can measured and intervened through meaningful factors in a way statistics, as has described in parts of the world (Gelchu et al., 2025; Hailegebreal et al., 2023). Readiness leadership operational also not automatic means readiness operate system everyday life (Steenkamp et al., 2025). Indonesia shows consistent pattern but at a higher level beginning. Instrument planning such as DOQ-IT and TOGAF have available, as has described in the Indonesian section, but not yet supported adequate budget and SOPs. The gap This show that availability framework planning No necessarily means framework the walk.

In dimension environment, location the most obvious difference. Developed countries blend mandate with incentives and assessments maturity periodically. United States take notes increase adoption record medical electronic from not enough from 10% in 2008 to 99% in 2018 and 99.4% in 2024 after mandate paired with incentives and certification (Barker & Chang, 2026), while Germany places evaluation maturity national as instrument planning at a time base allocation support through the DigitalRadar program (Geissler et al., 2024). Indonesia relies on the mandate regulatory with deadline time, as has described in the Indonesian section, without mechanism measurement equal maturity. Response to deadline also not uniform interregional. Hospitals in Java show involvement proactive with support more infrastructure and training good, whereas House sick in Sulawesi adopted record medical electronic especially for fulfil condition regulations, with constraint internet connectivity is not consistent, low digital literacy of staff, and the ongoing dependency continue on recording medical paper (Hossain et al., 2025).

Comparison third dimensions show location the real gap. Developed countries has complete part big problem dimensions environment, so that remaining obstacles shift to dimensions technology advanced in the form of interoperability, usability, and data security. Indonesia on the other hand Still bear obstacles on the third dimensions in a way simultaneously. Third dimensions the each other lock. The hospital that has compile a roadmap not can run it without budget, and internal budgets do not will available without scheme funding from outside House Sick.

More differences fundamental lies in the orientation planning. Developed countries direct planning on maturity the system being measured periodically, because ownership system No automatic means maturity system (Geissler et al., 2024; Snowdon et al., 2024). Indonesia still direct planning on 985ulfilment deadline regulations, and formal compliance No continue become continuous data integration, as has described in the Indonesian section (Astari et al., 2025; Hossain et al., 2025).

Based on comparison said, four implications can submitted for Indonesia. SIMRS planning is necessary directed beyond 985ulfilment obligation regulation, because formal compliance does not continue become continuous data integration. Improvements quality interface need get ahead or at least accompany generic digital training, because digital competence without repair interface No repair experience users (Rachmani et al., 2026). Policy national need include funding and mentoring for House Sick area, because inequality infrastructure interregional is source the most consistent gap (Hossain et al., 2025). Assessment digital maturity is necessary executed in a way periodically as instrument planning, not as reporting administrative (Geissler et al., 2024).

Six recommendations can submitted according to TOE dimension. On the dimension technology, (1) requirements usability based need users entered to in document procurement, testing acceptance and evaluation post-implementation (Rachmani et al., 2026), and (2) integration with a national platform planned as a monitored, gradual process, not as 985ulfilment deadline single (Astari et al., 2025). In the dimension organization, (3) home Sick compile plan integrated IS/IT strategy with plan strategic organization and loading stages measurable (Basulo-Ribeiro et al., 2026), and (4) human resource strengthening programs focused on skills scored low as well as accompanied by support concrete leadership

(Hailegebreal et al., 2023; Steenkamp et al., 2025). In the dimension environment, (5) government complete mandate regulations with incentives and support funding, no only sanctions administrative (Barker & Chang, 2026; Schiffelers et al., 2025), and (6) assessment digital maturity is carried out periodically with instruments that can compared to interinstitutional (Geissler et al., 2024; Snowdon et al., 2024).

CONCLUSION

Successful electronic hospital (e-hospital) implementation depends on comprehensive planning rather than technological availability alone. The Technology–Organization–Environment (TOE) framework highlights three interrelated dimensions essential to hospital digital transformation. The technological dimension emphasizes infrastructure readiness, system interoperability, and usability, while the organizational dimension focuses on workforce competencies, leadership commitment, and institutional preparedness. The environmental dimension encompasses regulatory support, financial incentives, and periodic digital maturity assessments. In more digitally advanced countries, established regulatory and institutional support has increasingly shifted implementation challenges toward technological integration and system optimization. In contrast, Indonesian hospitals continue to face interconnected challenges across all three dimensions, with implementation efforts often prioritizing regulatory compliance over long-term digital maturity. Therefore, future Hospital Management Information System (Sistem Informasi Manajemen Rumah Sakit, SIMRS) planning should simultaneously address technological, organizational, and environmental factors to support sustainable, integrated, and effective e-hospital implementation.

REFERENCES

Astari, L. A., Amalia, I., Indra, L., Sanjaya, G. Y., & Fuad, A. (2025). Assessing the fidelity of electronic health record implementation using SatuSehat platform in Indonesia. *Studies in Health Technology and Informatics, 329*, 1614–1615. https://doi.org/10.3233/SHTI251128

Ayu, R. J. I. D., & Lazuardi, L. (2023). Evaluation of the implementation and digital maturity level of electronic medical record services at Mataram City Hospital. *Jurnal Manajemen Pelayanan Kesehatan, 26*(3). https://doi.org/10.22146/jmpk.v26i3.8710

Barker, W., & Chang, W. (2026). *Hospital electronic health record adoption, 2008–2024* (ONC Data Brief No. 83). Office of the National Coordinator for Health Information Technology. https://healthit.gov/data/data-briefs/non-federal-acute-care-hospital-electronic-health-record-adoption-2008-2024/

Basulo-Ribeiro, J., Rocha-Goncalves, F., Freitas, A., & Teixeira, L. (2026). Change management in hospital digital transformation: A roadmap to support planning and implementation for humanization and efficiency through technology. *PLOS ONE, 21*(4), Article e0344555. https://doi.org/10.1371/journal.pone.0344555

Beauvais, B., Kruse, C. S., Fulton, L., Shanmugam, R., Ramamonjiarivelo, Z., & Brooks, M. (2021). Association of electronic health record vendors with hospital financial and quality performance: Retrospective data analysis. *Journal of Medical Internet Research, 23*(4), Article e23961. https://doi.org/10.2196/23961

Beny, B. B. (2021). Evaluation of the implementation of the hospital management information system (SIMRS) at Praya Regional Hospital, Central Lombok Regency, West Nusa Tenggara. *Journal of Information Systems for Public Health, 5*(3), 13. https://doi.org/10.22146/jisph.41428

Binsar, F., Hamsal, M., Ichsan, M., Abdinagoro, S. B., & Dwidienawati, D. (2026). Environmental Dynamics and Digital Transformation in Lower-Middle-Class Hospitals: Evidence from Indonesia. *Healthcare*, *14*(2), 182.

Bisrat, A., Minda, D., Assamnew, B., & Abegaz, T. (2021). Implementation challenges and perception of care providers on electronic medical records at St. Paul's and Ayder Hospitals, Ethiopia. *BMC Medical Informatics and Decision Making, 21*(1). https://doi.org/10.1186/s12911-021-01670-z

Budiyatno, K. C. (2022). Digital transformation as part of marketing strategy at Siloam Hospital Palangka Raya in 2020. *Jurnal Administrasi Rumah Sakit Indonesia, 8*(2). https://doi.org/10.7454/arsi.v8i2.5547

Everson, J., & Richwine, C. (2025). Barriers to obtaining and using interoperable information among non-federal acute care hospitals. *Journal of the American Medical Informatics Association, 32*(1), 20–27. https://doi.org/10.1093/jamia/ocae263

Fitriyah, Y. (2022). Analysis of the readiness level of digital signature implementation for authentication of electronic medical record documents in the outpatient installation of Yogyakarta City Hospital. *Journal of Information Systems for Public Health, 7*(2), 53. https://doi.org/10.22146/jisph.73666

Geissler, A., Hollenbach, J., Haring, M., Amelung, V. E., Thun, S., & Haering, A. (2024). A nationwide digital maturity assessment of hospitals: Results from the German DigitalRadar. *Health Policy and Technology, 13*(4), Article 100904. https://www.sciencedirect.com/science/article/pii/S2211883724000674

Gelchu, M., Chala, G., Tuke, G., Wodessa, G., Ayele, A., Yambo, T., & Fikrie, A. (2025). Health professionals' readiness for and factors influencing electronic medical record systems implementation in Southern Oromia, Ethiopia, 2024: A cross-sectional study. *Frontiers in Digital Health, 7*, Article 1531315. https://doi.org/10.3389/fdgth.2025.1531315

Gomes, J., & Romão, M. (2025). Evaluating maturity models in healthcare information systems: A comprehensive review. *Healthcare, 13*(15), Article 1847. https://doi.org/10.3390/healthcare13151847

Hailegebreal, S., Dileba, T., Haile, Y., & Abebe, S. (2023). Health professionals' readiness to implement electronic medical record system in Gamo zone public hospitals, southern Ethiopia: An institution based cross-sectional study. *BMC Health Services Research, 23*, Article 773. https://doi.org/10.1186/s12913-023-09745-5

Hidayatuloh, C., & Mulyanti, D. (2023). Analysis of SIMRS on improving healthcare services in the digital era to support the implementation of electronic medical records. *Jurnal Ilmu Kedokteran dan Kesehatan Indonesia, 3*(2), 65–71. https://doi.org/10.55606/jikki.v3i2.1603

Hossain, M. K., Sutanto, J., Handayani, P. W., Haryanto, A. A., Bhowmik, J., & Frings-Hessami, V. (2025). An exploratory study of electronic medical record implementation and recordkeeping culture: The case of hospitals in Indonesia. *BMC Health Services Research, 25*(1), Article 249. https://doi.org/10.1186/s12913-025-12399-0

Jiang, J., Qi, K., Bai, G., & Schulman, K. A. (2023). Pre-pandemic assessment: A decade of progress in electronic health record adoption among US hospitals. *Health Affairs Scholar, 1*(5). https://doi.org/10.1093/haschl/qxad056

Jung, S., Lee, H. S., Lee, H., Yune, I., Park, D. S. M., Tejerina, L., & Kang, D. (2024). *The digital transformation of Seoul National University Bundang Hospital*. Inter-American Development Bank. https://doi.org/10.18235/0005682

Kassiuw, J. F. M., Hidayat, B., & Oktamianti, P. (2023). Implementation of electronic medical records with the technology acceptance model approach. *Syntax Literate: Jurnal Ilmiah Indonesia, 8*(6), 4074–4085. https://doi.org/10.36418/syntax-literate.v8i6.12547

Khadka, A., Adhikari, S., & Shrestha, S. (2024). *A review of implementation challenges and potentials of an interoperable e-health system in LMICs* [Preprint]. Research Square. https://doi.org/10.21203/rs.3.rs-5674022/v1

Kurniawan, A. (2021). Drafting the strategic plan for information systems and information technology at Grhasia Mental Hospital, Special Region of Yogyakarta. *Journal of Information Systems for Public Health, 6*(3), 43. https://doi.org/10.22146/jisph.46182

Lakhmudien, L., S, R. I., Nugraha, E., & Setiyono, I. A. (2023). Understanding of medical recorders on the implementation of electronic medical records based on Minister of Health Regulation Number 24 of 2022. *Jurnal Cakrawala Ilmiah, 2*(9), 3601–3606. https://doi.org/10.53625/jcijurnalcakrawalailmiah.v2i9.5803

Lee, K., Seo, L., Yoon, D., Yang, K., Yi, J.-E., Kim, Y., & Lee, J.-H. (2022). Digital health profile of South Korea: A cross sectional study. *International Journal of Environmental Research and Public Health, 19*(10), Article 6329. https://doi.org/10.3390/ijerph19106329

Lumingkewas, P. H., Umboh, A., & Manampiring, A. E. (2023). Analysis of hospital management information system implementation in Manembo-Nembo General Hospital, Bitung City. *Gema Wiralodra, 14*(2), 832–839. https://doi.org/10.31943/gw.v14i2.536

Melhem, S. J., Nabhani-Gebara, S., Bulatova, N., Alabbadi, I., Almomani, H., Mousa, R., Almousa, A., Alrashdan, Y., Nimri, O., & Kayyali, R. (2025). Scaling holistic e-health solutions in cancer care using a qualitative realist framework. *Frontiers in Public Health, 13*. https://doi.org/10.3389/fpubh.2025.1617857

Melnick, E. R., West, C. P., Nath, B., Cipriano, P. F., Peterson, C., Satele, D. V., Trockel, M., & Dyrbye, L. N. (2021). The association between perceived electronic health record usability and professional burnout among US nurses. *Journal of the American Medical Informatics Association, 28*(8), 1632–1641. https://doi.org/10.1093/jamia/ocab059

Ministry of Health of the Republic of Indonesia. (2022). *Regulation of the Minister of Health of the Republic of Indonesia Number 24 of 2022 concerning medical records*.

Muhajir, M., Akib, H., & Niswaty, R. (2023). Digital transformation at Prof. Dr. H.M. Anwar Makkatutu Regional General Hospital, Bantaeng Regency. *Jurnal Altifani Penelitian dan Pengabdian kepada Masyarakat, 3*(1), 129–139. https://doi.org/10.25008/altifani.v3i1.327

Mustafa, N. K., Ibrahim, R., Aizuddin, A. N., Aljunid, S. M., & Awang, Z. (2024). Critical success factors and acceptance of the casemix system implementation within the total hospital information system: Exploratory factor analysis of a pilot study. *JMIR Formative Research, 8*, Article e56898. https://doi.org/10.2196/56898

Mutawalli, L., Zaen, M. T. A., & Bagye, W. (2021). Development of a smart dashboard for monitoring patient data at Praya Regional General Hospital, Central Lombok Regency. *Jurnal Informatika dan Rekayasa Elektronik, 4*(1), 40–50. https://doi.org/10.36595/jire.v4i1.321

Nadiyah, S. N. A., & Prayoga, D. (2024). Digital transformation as part of hospital marketing strategy: Literature review. *Media Publikasi Promosi Kesehatan Indonesia (MPPKI), 7*(2), 265–272. https://doi.org/10.56338/mppki.v7i2.4283

Naurah, G., Simarmata, M., & Jambak, R. S. (2024). Patient rights and privacy in the digitalization era. *Comserva: Jurnal Penelitian dan Pengabdian Masyarakat, 3*(12), 4798–4805. https://doi.org/10.59141/comserva.v3i12.1295

Neprash, H. T., McGlave, C. C., Cross, D. A., Virnig, B. A., Puskarich, M. A., Huling, J. D., Rozenshtein, A. Z., & Nikpay, S. S. (2022). Trends in ransomware attacks on US hospitals, clinics, and other health care delivery organizations, 2016–2021. *JAMA Health Forum, 3*(12), Article e224873. https://doi.org/10.1001/jamahealthforum.2022.4873

Okpechi, I. G., Muneer, S., Ye, F., Zaidi, D., Ghimire, A., Tinwala, M. M., Saad, S., Osman, M. A., Lunyera, J., Tonelli, M., Caskey, F., George, C., Kengne, A. P., Malik, C., Damster, S., Levin, A., Johnson, D. W., Jha, V., & Bello, A. K. (2022). Global eHealth capacity: Secondary analysis of WHO data on eHealth and implications for kidney care delivery in low-resource settings. *BMJ Open, 12*(3), Article e055658. https://doi.org/10.1136/bmjopen-2021-055658

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, Article n71. https://doi.org/10.1136/bmj.n71

Pamungkas, R. K. (2022). Analysis of the hospital management information system in the outpatient installation at Puri Husada Regional Hospital Tembilahan 2020. *Jurnal Olahraga dan Kesehatan (ORKES), 1*(1), 40–54. https://doi.org/10.56466/orkes/vol1.iss1.5

Porrello, E. E., Peden, A. E., Nunan, M., & Joshi, R. (2025). National electronic health record coverage in Pacific Island countries and territories: Environmental scan. *Journal of Medical Internet Research, 27*, Article e71212. https://doi.org/10.2196/71212

Praptana, Ningsih, K. P., Santoso, S., & Sevtiani, I. (2021). Mentoring evaluation of the readiness for electronic medical record system implementation using the DOQ-IT method at Condong Catur

Hospital, Sleman. *Journal of Innovation in Community Empowerment, 3*(2), 98–104. https://doi.org/10.30989/jice.v3i2.634

Pujihastuti, A. (2021). Implementation of management information systems in supporting hospital management decision-making. *Jurnal Manajemen Informasi Kesehatan Indonesia (JMIKI), 9*(2), 200. https://doi.org/10.33560/jmiki.v9i2.377

Rachmani, E., Widiawati, E., Dewi, D. A., Shabbir, S. A., Chen, F.-Y., Kurniadi, A., Anjani, S., Rimawati, E., Yuantari, M. G. C., & Fahmi, A. (2026). Person-centered hospital care in Indonesia: The role of digital health competency, user interface quality, and user experience in a multi-hospital study. *Frontiers in Health Services, 6*, Article 1827781. https://doi.org/10.3389/frhs.2026.1827781

Radjab, E., & Mandasari, N. F. (2022). Analysis of the utilization of the hospital information system (SIMRS) at Ibnu Sina YW-UMI Hospital Makassar. *Paradigma: Jurnal Masalah Sosial, Politik, dan Kebijakan, 26*(2), 118. https://doi.org/10.31315/paradigma.v26i2.7463

Samra, H. (2025). A lifecycle-based evaluation framework for health information systems in Saudi Arabia aligning global standards with national implementation needs. *International Journal of Reliable and Quality E-Healthcare, 14*(1), 1–15. https://doi.org/10.4018/ijrqeh.390789

Schiffelers, T., Kapteijns, K., Hochstenbach, L., Kietselaer, B., Talboom-Kamp, E., & Spreeuwenberg, M. (2025). Best practices in organizing digital transformation: Qualitative case study in Dutch hospital care. *Journal of Medical Internet Research, 27*, Article e63576. https://doi.org/10.2196/63576

Snowdon, A., Hussein, A., Danforth, M., Wright, A., & Oakes, R. (2024). Digital maturity as a predictor of quality and safety outcomes in US hospitals: Cross-sectional observational study. *Journal of Medical Internet Research, 26*, Article e56316. https://doi.org/10.2196/56316

Steenkamp, I., Peltonen, L.-M., & Chipps, J. (2025). Digital health readiness: Insights from healthcare leaders in operational management—A cross-sectional survey. *BMC Health Services Research, 25*(1), Article 240. https://doi.org/10.1186/s12913-024-12129-y

Tangel, P. T., Manampiring, A. E., & Kapantow, N. H. (2023). Implementation of the hospital management information system at Dr. Sam Ratulangi Tondano Regional General Hospital. *e-CliniC, 12*(2), 121–133. https://doi.org/10.35790/ecl.v12i2.52755

Tornatzky, L. G., Chakrabarti, A. K., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington Books.

Wafidah, A., Marwanto, I. G. G. H., Pramono, T., & Muzaqi, A. H. (2023). Implementation of Permenkes Number 82 of 2013 concerning hospital management information systems (SIMRS) (Study at Kertosono Regional Hospital, Nganjuk Regency). *JKMP (Jurnal Kebijakan dan Manajemen Publik), 11*(1), 29–37. https://doi.org/10.21070/jkmp.v11i1.1743

Walsh, B., Mac Domhnaill, C., & Mohan, G. (2021). *Developments in healthcare information systems in Ireland and internationally* (Survey and Statistical Report Series No. 105). Economic and Social Research Institute. https://doi.org/10.26504/sustat105

Widiarini, R., & Ramadhaningtyas, K. N. (2023). Hospital human resource profile in the JKN era and readiness to face the challenges of 4.0 disruption in health care. *JPKM: Jurnal Profesi Kesehatan Masyarakat, 4*(2), 95–102. https://doi.org/10.47575/jpkm.v4i2.505

Zanuwar, A. (2023). Enterprise architecture planning of the regional general hospital information system (Case study: Soreang Regional Hospital). *DIMMENSI (Digital Journal of Human Capital, Business, Marketing, Entrepreneurship, Finance & Business Strategy), 3*(1), 23. https://doi.org/10.32897/dimmensi.v3i1.2439