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The Effect of Smart Hospital Implementation on Operational Efficiency and Physiotherapy Patient Satisfaction: A Literature Review

***Mohamad Reza Hilmy[1]**
Universitas Esa Unggul, Indonesia

Erlina Puspitaloka Mahadewi[2]
Universitas Esa Unggul, Indonesia

Fera Gusmi Nurba[3]
Universitas Esa Unggul, Indonesia

Alika Shameela[4]
Universitas Indonesia, Indonesia

***Corresponding author:**
Mohamad Reza Hilmy, Universitas Esa Unggul, Indonesia.
✉mohamad.reza@esaunggul.ac.id

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Abstract

Background: Digital transformation has been crucial to the evolution of healthcare organizations, with most hospitals in Asia having launched smart hospital initiatives to enhance service quality and operational efficiency. However, a significant gap remains, as there is still no established model demonstrating that smart hospital implementation contributes to operational efficiency and patient satisfaction, as described above.
Objective: This study aims to examine the implementation of affordable smart hospitals, operational efficiency, and patient satisfaction related to physiotherapy as a healthcare service highly dependent on direct contact and intensive physical therapy sessions.
Methods: We performed a systematic literature review (SLR) in accordance with the PRISMA protocol, including articles published between 2020 and 2026. A total of 25 articles were included in the synthesis through narrative analysis, and themes were identified across the literature.
Results: Smart hospitals, in combination with hospital information systems, electronic medical records, and telemedicine, have been found to improve operational efficiency. This improvement leads to faster service processes, higher levels of accuracy in data entry by medical professionals, better resource optimization, and ultimately greater patient satisfaction due to reduced waiting times and improved quality of service interactions.
Conclusion: Computing technology is a promising mechanism for maintaining process standards across all forms of operational performance, particularly in the domain of patient-centered care services primarily represented in physiotherapy settings. This study supports the use of such technologies to enhance patient comfort and operational robustness.

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INTRODUCTION

The present study is informed by two conceptual models: (1) behavior based on perceived usefulness and ease of use influencing technology adoption in healthcare settings, as postulated by the Technology Acceptance Model (TAM), and (2) one-dimensional patient satisfaction as part of the SERVQUAL model—an extensively used conceptual model that evaluates patient satisfaction through comparisons between service delivery expectations and patients'

perceptions. However, because these frameworks are best suited to raw data, such as physiotherapy patient satisfaction questionnaires and operational efficiency measures used in this study, they are discussed only as supporting theoretical foundations.

Hospitals have begun to scrutinize their methods of fulfilling their mission—particularly in contexts experiencing persistent demand growth and healthcare systems under pressure. Hospital operations rely on disaggregated processes at multiple levels; routine yet critical tasks that are delayed can negatively affect hospital metrics of high-quality care. This is especially true for services such as physiotherapy, which require repeated close face-to-face interactions between patients and therapists. These challenges gave rise to the concept of the smart hospital—technology-based healthcare delivery enhancements designed to support hospital transformation through structured and system-oriented approaches. A smart hospital system is facilitated by an integrated ecosystem.

We are now in an era in which electronic medical record systems, artificial intelligence (AI), and telemedicine are transforming hospitals and reshaping the healthcare industry, making discussions about digital transformation in healthcare more relevant than ever. These technologies not only advance healthcare systems but also reduce inefficiencies that burden providers and patients alike. Wulandari (2025) show that digital transformation in hospitals improves coordination and patient access to services; meanwhile, Stoumpos (2023) note that successful adoption requires acceptance and integration of technologies into routine practice. This also signifies that digital transformation is not merely a technological upgrade but an organizational change.

Throughout this transformation, operational efficiency has become a central concern because it reflects the effectiveness of healthcare service delivery. Poor operational performance may result in long waiting times, fragmented services, and poor-quality outcomes, all of which directly affect patient satisfaction. Demonstrate that digital systems improve data management and coordination, while Nurlatifah (2023) highlights their role in reducing administrative complexities through process automation. These improvements are essential for better resource utilization and timely service delivery, ultimately contributing to improved healthcare outcomes.

The second major aspect is patient satisfaction, which indicates service quality. Various factors influence satisfaction in physiotherapy services, including service availability, communication, and continuity of care. State that one reason for high patient satisfaction is that healthcare services are organized, easily accessible, and responsive, as also emphasized by (Teresa & Ridwan, 2025). Further note that structured service delivery arrangements significantly enhance both patient outcomes and satisfaction rates in physiotherapy services. This suggests that patient experience, operational efficiency, and digital transformation are closely interconnected.

Despite the increasing number of studies on digital transformation and sustainable efficiency in healthcare, few researchers have examined how smart hospital operations influence both operational effectiveness and patient satisfaction in service-specific contexts such as physiotherapy. Most existing studies focus either on technology adoption and efficiency or on patient satisfaction separately, without exploring how these dimensions complement one another. Therefore, because integrated studies in this area remain limited, a comprehensive literature review approach is needed.

Against this background, the problem addressed in this study is whether the implementation of smart hospital technologies is related to operational efficiency and how improvements in operational processes influence patient satisfaction in physiotherapy services. This study aims to identify relationships and patterns in the literature to support ongoing research. Specifically, this paper seeks to further examine the role of digital transformation in improving both service delivery and patient experience in physiotherapy through continuity of care, service efficiency, and patient engagement.

This research provides a comprehensive perspective on the impact and implementation of smart hospitals on the quality of physiotherapy service outcomes. The Discussion and Conclusion sections outline the study's contributions as well as its limitations.

METHOD

This study employed a systematic literature review method to assess the impact of smart hospital implementation on patient satisfaction as well as physiotherapy operational efficiency. A study design that used pre-existing literature instead of primary data reduced bias and centered the analysis on previously published work. The rationale behind this approach was that, rather than relying on observations from a single site, the study aimed to synthesize integrated evidence across multiple studies. This study aimed to enhance understanding of how digital transformation in healthcare impacted service outcomes by synthesizing evidence across multiple sources. The selected research articles examined innovations in smart hospitals and digital health practices during the 10-year period from 2020 onward to ensure that comparisons included only relevant and comparable studies.

This study framework was derived from existing literature on smart hospital systems, operational efficiency, and patient satisfaction in physiotherapy services. Smart hospitals referred to a transformation in healthcare institutions in which healthcare systems extensively adopted digital technologies such as Electronic Medical Records (EMR), artificial intelligence (AI), and telemedicine. Operational efficiency related to the timely utilization of healthcare resources with minimal delays and errors. Patient satisfaction in physiotherapy was commonly used as a measure of the extent to which a patient was satisfied with the healthcare services received in relation to expectations regarding quality, access, and continuity of care. Smart hospital implementation was conceptualized as a cascading process in which improved operational efficiency contributed to higher patient satisfaction, while also acknowledging an indirect relationship in which digital systems influenced patient experience.

A protocol for the current study was developed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, ensuring a systematic and transparent process. PRISMA facilitated standardization in the identification, screening, and selection of literature. This approach ensured the most transparent process possible and helped reduce bias in determining which studies were included in the review. A structured selection process was applied at each stage to ensure that only relevant and high-quality articles were included. The data from the selected articles were then analyzed using a qualitative methodology known as narrative synthesis, in which studies were identified, compared, and grouped thematically. This method was appropriate for synthesizing multidisciplinary literature on smart hospital implementation, operational efficiency, and patient satisfaction, as it highlighted thematic similarities and differences across studies without requiring quantitative aggregation.

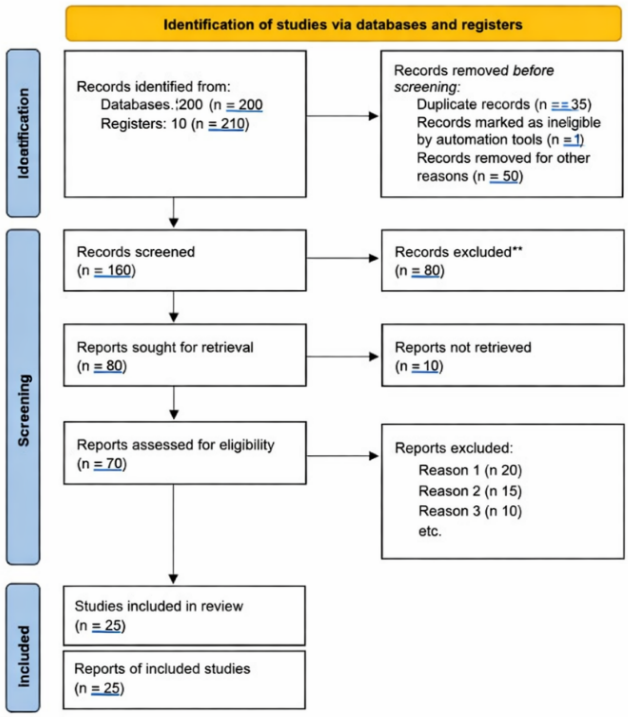

Figure 1. PRISMA Processs

The identification of studies began with a search of multiple electronic databases using terms such as smart hospital, digital transformation, operational efficiency, and physiotherapy services. The database search yielded 210 records, while other sources contributed an additional 10 records. The records were filtered to remove duplicates and for other eligibility reasons prior to screening, after which only a smaller subset was carried forward for further analysis. The initial processing step of removing duplicates ensured that only unique and relevant sources were included for analysis.

This was followed by an initial screening of titles and abstracts. Out of 160 screened records, 80 were excluded because they were not relevant to the review. The remaining records were assessed in full text for eligibility. Only studies published up to October 2023 were considered, and irrelevant records were excluded. This process narrowed the focus to studies aligned with the aim of examining smart hospital implementation and its impact on either operational efficiency or patient satisfaction. At the end of this stage, 70 articles were reviewed for potential inclusion.

This resulted in 25 studies meeting the inclusion criteria and being retained for analysis. The selection of included studies was based on their relevance to the relationships between the research variables, rather than publication year alone, and their contribution to understanding the relationship among digital transformation, operational efficiency, and patient satisfaction in relation to the research question. These articles covered both national and international contexts, contributing to a broader understanding of the topic.

Systematic reviews typically include a PRISMA flow diagram to visually represent the study selection process from identification through to inclusion. This schematic representation also shows studies excluded from the broader pool that were considered potentially relevant during screening. The study design followed a similar systematic approach to ensure that the findings were derived from credible sources and did not misrepresent causal relationships between operational efficiency and patient satisfaction in physiotherapy within smart hospital implementations.

Previous Studies

Table 1. Previous Studies

No	Research Title (Author, Year)	Research Method	Findings	Similarities / Differences
1	*Tinjauan konsep smart hospital pada desain interior lobby rumah sakit jantung Paramarta Bandung* (Zerlina & Primayudha, 2025)	Literature Review	Smart hospital concept improves service integration and patient experience	Similar: smart hospital / Different: design-oriented
2	*Desain smart hospital dalam mendukung pelayanan kesehatan pada rumah sakit berbasis teknologi informasi* (Gani, 2024)	Conceptual Study	Technology-based hospital design enhances service delivery	Similar: smart hospital / Different: no efficiency variable
3	*Implementasi strategi transformasi digital dalam meningkatkan kualitas pelayanan di rumah sakit: Studi kualitatif* (Wulandari et al., 2025)	Qualitative	Digital transformation improves service quality	Similar: digital transformation / Different: no physiotherapy focus
4	*Transformasi digital sebagai strategi keunggulan kompetitif rumah sakit di era JKN: Tinjauan literatur* (Septia et al., 2026)	Literature Review	Digital transformation improves competitiveness and performance	Similar: digital transformation / Different: macro perspective
5	*Evaluasi penerapan rekam medis elektronik di rumah sakit: Literatur review* (Monika et al., 2025)	Literature Review	EMR improves efficiency and data accuracy	Similar: operational efficiency / Different: EMR-specific
6	*The impact of healthcare administration digitalization on hospital service efficiency with healthcare worker satisfaction as a mediating variable* (Lado & Paramarta, 2025)	Quantitative	Digitalization improves efficiency and staff satisfaction	Similar: efficiency / Different: no patient satisfaction
7	*Patient outcomes and service delivery differences in physiotherapy care: A systematic review comparing hospital-based and private practice models* (Hilmy, Shameela, et al., 2026)	Systematic Review	Service model affects physiotherapy outcomes and satisfaction	Similar: physiotherapy / Different: no smart hospital
8	*Impact of psychological conditions and physical environment on hospitality services through patient experience* (Khodijah et al., 2025)	Quantitative	Environment influences patient satisfaction	Similar: patient satisfaction / Different: no efficiency
9	*Analysis of the relationship between digital*	Literature Review	AI improves diagnosis and	Similar: digital transformation /

	transformation influenced by technology and artificial intelligence diagnosis in hospital services (Hilmy et al., 2025)		service quality	Different: no satisfaction
10	*Analisis integrasi sistem informasi rumah sakit dan rekam medis elektronik sebagai respon terhadap Permenkes No. 24 Tahun 2022* (Hilmy, Putranto, et al., 2026)	Literature Review	System integration improves efficiency and compliance	Similar: efficiency / Different: regulatory focus
11	*Digital transformation in healthcare: Technology acceptance and its applications* (Stoumpos et al., 2023)	Literature Review	Digital transformation improves healthcare performance and service delivery	Similar: digital transformation / Different: general scope
12	*The digital transformation of healthcare through intelligent technologies: A UTAUT model for clinical decision support systems* (Marinescu et al., 2025)	Quantitative	AI enhances clinical decision-making and efficiency	Similar: efficiency / Different: no patient satisfaction
13	*Penggunaan sistem informasi manajemen rumah sakit (SIMRS) di Indonesia* (Athira & Sampetoding, 2024)	Descriptive	SIMRS improves coordination and data management	Similar: efficiency / Different: system-specific
14	*Pengaruh Sistem Informasi Manajemen Rumah Sakit (Simrs) Terhadap Efektivitas Kerja Pelayanan Fisioterapi Di Rsud Kesehatan Kerja* (Nurlatipah & Susanti, 2023)	Quantitative	SIMRS has a very strong effect on physiotherapy service effectiveness (correlation = 0.975) with 95% influence	Similarity: both discuss hospital technology and physiotherapy efficiency. Difference: this study focuses specifically on SIMRS with quantitative correlation analysis.
15	*Peran sistem informasi manajemen dalam meningkatkan efisiensi rumah sakit* (Maharani & Aisah, 2024)	Literature Review	Information systems improve operational performance	Similar: efficiency / Different: general system analysis
16	*Analisis implementasi sistem informasi rumah sakit terhadap pelayanan administrasi* (Siregar et al., 2024)	Quantitative	System integration reduces errors and improves coordination	Similar: efficiency / Different: no satisfaction variable
17	*Penerapan sistem informasi manajemen rumah sakit (SIMRS) dalam meningkatkan efisiensi pelayanan kesehatan di*	Literature Review	Real-time data improves service efficiency	Similar: efficiency / Different: no patient satisfaction

	Indonesia (Azizah, 2025)			
18	*Peran teknologi informasi dalam peningkatan mutu pelayanan rumah sakit: A literature review* (Teresa & Ridwan, 2025)	Literature Review	IT improves service quality and patient satisfaction	Similar: satisfaction / Different: no physiotherapy focus
19	*Evaluasi dampak transformasi digital terhadap manajemen rumah sakit: Tinjauan sistematis literatur* (Nugraheni, 2025)	Systematic Review	Digital transformation improves hospital management efficiency	Similar: efficiency / Different: managerial focus
20	*Digitalisasi administrasi rumah sakit: Transformasi sistem informasi dalam meningkatkan efisiensi pelayanan kesehatan* (Ayustya & Sitorus, 2025)	Literature Review	Digital administration improves operational efficiency	Similar: efficiency / Different: administrative focus
21	*Digital transformation of medical services in Romania: Does the healthcare system meet the current needs of patients?* (Păcuraru et al., 2025)	Quantitative	Digital transformation improves access, efficiency, and patient experience	Similar: efficiency & satisfaction / Different: general healthcare context
22	*A review of smart healthcare: Concept, drivers, characteristics, and challenges* (Almarri et al., 2025)	Literature Review	Smart healthcare integrates technologies to improve service delivery	Similar: smart hospital / Different: conceptual focus
23	*Digital health technologies in patient experience literature: A scoping review* (Aytekin et al., 2025)	Scoping Review	Digital technologies enhance patient engagement and experience	Similar: patient satisfaction / Different: no efficiency variable
24	*Digital health transformation through telemedicine (2020–2025): Barriers, facilitators, and clinical outcomes* (Rabbani et al., 2025)	Literature Review	Telemedicine improves access and patient satisfaction	Similar: satisfaction / Different: telemedicine focus
25	*Sustainable digital transformation in public hospitals: Strategic enablers for smart healthcare systems* (Chansanguan et al., 2025)	Literature Review	Leadership and digital strategy improve efficiency and system performance	Similar: efficiency / Different: organizational perspective

Source: Researcher (2026)

The literature review shows that fragmentation is a key characteristic of research development on both smart hospitals and digital transformation in our domain, with most papers addressing potential but limited scope (specific elements) under scrutiny in isolation instead of an integrated manner that takes into account the interplay between major variables. Studies that relate to smart hospitals particularly on elements of conceptual and design (2026)—reflect this tendency. Meanwhile, discussions of digital healthcare systems have been addressed by other Almarri (2025), who tend to remain at a high-level trajectory and do not focus on service outcomes in isolation. Given that the smart hospital theme is rather broad, studies focused on operational- and patient-oriented outcomes directly or indirectly affected by such innovative

hospitals have yet to be synthesized within an integrative analytic framework as of October 2023.

This research also relates to a second gap in the literature regarding the impact of operational efficiency, as most studies focus on efficiencies obtained from isolated implementations of digital systems. Research on EMR & HIS includes. For coordination, accuracy, and service speed, all scores showed improved averages (Maharani & Aisah, 2024). In this vein, Le et al. also contribute relevant findings. Nonetheless, these studies generally do not examine the impact of efficiency on consumer satisfaction. Even works involving high-tech technologies such as artificial intelligence, as cited in Marinescu (2025) are mostly neither clinically nor technically grounded and do not correlate these technologies with patient outcomes up to 2025. Therefore, this indicates that operational efficiency as a mediating variable has been insufficiently emphasized.

Some other limited research focuses on assessing patient satisfaction, which has often been investigated independently of operational or technological factors. Such studies include (Teresa & Ridwan, 2025). Despite this, the focus of this research is on satisfaction related to patient experience, access, and communication. Digitalization has had a less dominant impact on patient experience. Few studies explicitly address satisfaction in the literature, and even fewer link it to operational systems or intelligent hospital systems. Similarly, studies on physiotherapy services Hilmy (2025) primarily focus on service delivery or output models and pay limited attention to digital transformation and smart hospital implementation. This suggests that—especially in the physiotherapy context—patient satisfaction remains underexplored on a broader scale within digital healthcare.

Building on these gaps, the current study aims to fill the research void by examining how smart hospital implementation contributes to operational efficiency and patient satisfaction through the development of a holistic analytical framework for physiotherapy services. Although existing studies provide insights into each variable, they do not adequately investigate how these variables influence one another. Additionally, Chansanguan (2025) highlight organizational factors such as leadership and system integration. Digital transformation is ongoing across interconnected entities in this stage of research. Accordingly, addressing this gap by linking smart hospital implementation—directly and indirectly—to operational efficiency and physiotherapy patient satisfaction would provide a more nuanced understanding of these outcomes during digital transformation in healthcare services.

RESULTS AND DISCUSSION

Results

1) Implementation of Smart Hospital Technologies in Healthcare Services

With the piecemeal adoption of smart hospital technologies, the organization of healthcare service delivery has transitioned from non-digital systems to fragmented systems and, more recently, to interoperable digital ecosystems. Such smart hospitals should not be viewed as a single evolutionary stage, but rather as a combination of infrastructure, digital platforms, and service design. This perspective should be considered beyond a narrowly coordinated analysis. In these environments, shared spaces, digital system interfaces, and service workflows are orchestrated to enable information to flow freely across units.

Wulandari (2025) also contribute to this discussion. Though this can be categorized as such, it still represents only one component in an increasingly competitive environment where digital transformation shapes hospital strategies to meet growing service demands or, more fundamentally, to remain operational. This transition does not occur overnight; rather, it unfolds through iterative changes that reconfigure both clinical and administrative behavior, resulting in a more agile healthcare system.

At the operational level, efficiency and coordination occur at core systems such as electronic medical records (EMRs) and Hospital Information Systems (HIS). Provide examples of how digital records reduce redundancy and improve the accuracy of patient data, thereby supporting rapid clinical decision-making. The implementation of Sistem Informasi Manajemen Rumah Sakit (SIMRS), in accordance with Nurlatipah (2023), facilitates administrative processes and accelerates patient handling.

Aisah (2024) further emphasize that these systems function not only as technical tools but also as organizational mechanisms that reshape workflows across departments. These systems are designed to process and visualize real-time data using cloud-enabled data management infrastructures can be managed more efficiently (Ayustya & Sitorus, 2025). Collectively suggest that achieving a smart hospital operational model relies on the synergistic use of information systems for both clinical and administrative purposes.

Smart technologies in clinical practice and decision-making further highlight the importance of intelligent applications in diagnosis and treatment planning, particularly through advanced tools such as AI and data analytics. Marinescu (2025) emphasize that healthcare professionals trained in intelligent systems can leverage predictive decision support tools to enable timely and accurate interventions, regardless of the degree of decision-making autonomy in practice.

Hilmy (2026) note that technology-based diagnostic advancements improve service quality and reduce uncertainty in patient care. These improvements are closely linked to broader organizational developments, including digital transformation, managerial capability, and structured decision-making processes (Nugraheni, 2025). Stoumpos (2023) forthcoming; Wiley) describe this transformation as a broader digitally driven phenomenon in which technology and user interfaces collectively shape outcomes. Together, these perspectives illustrate the integration of smart hospital technologies within clinical environments and how they co-construct organizational processes related to care planning, delivery, and evaluation.

This also places patient experience as a central factor in evaluating the effectiveness of smart hospital implementation. Digital tools reshape relationships between patients and healthcare services, redefining traditional notions of quality, accessibility, and responsiveness. Digital health technologies provide pathways for shifting care toward patient-centered and personalized models, enabling patients to engage with services beyond the hospital setting. Păcuraru (2025) Note that digitalization improves accessibility and communication, directly influencing patient satisfaction, although findings regarding perceived service quality remain mixed. Comfort and clarity in care experiences result from combined environmental and psychological factors. This perception is supported by Teresa (2025), who argue that service quality improves through effective communication, while waiting times for information retrieval are reduced through information technology. This indicates that patient satisfaction is influenced not only by clinical outcomes but also by service delivery efficiency and transparency.

Equally important is the expansion of digital services beyond hospital boundaries. Telemedicine, remote monitoring, and mobile health technologies extend healthcare delivery beyond physical facilities, creating continuity between patients and providers. Rabbani (2025) Majeed et al. contribute to this discussion. Finally, the Possible-Mediators RCTs examine how different service delivery models facilitate or hinder access and outcomes in physiotherapy care. Almarri (2025) further support these advancements at a macro level by describing smart healthcare as a multi-technology system capable of synchronizing care processes across the continuum, with personalization at the point of service. Thus, digital services represent a shift toward more responsive and patient-centered healthcare delivery models.

However, implementing smart hospital technologies faces significant challenges. Organizational readiness, leadership, and workforce capacity are key determinants of successful adoption and deployment. Chansanguan (2025) identify talent as a major driver of digital maturity in healthcare organizations, influencing the speed of technological adaptation. Digital transformation lies at the intersection of strategy and execution, where sustained institutional commitment remains a major barrier. Resistance among healthcare providers or lack of familiarity with new systems can negatively affect implementation processes, underscoring the importance of clinician engagement. These findings suggest that the effectiveness or ineffectiveness of technology adoption depends as much on human and organizational factors as on the technologies themselves.

A recurring issue across studies is the incomplete and uneven implementation of smart hospital technologies, which often fall short of their promised benefits. Păcuraru (2025) Note that, unlike some contexts, Japan has limited case studies in this area, with early research indicating

that digitalization is primarily applied to administrative functions rather than advanced clinical applications. Ayustya (2025) identify two major barriers to implementation: limited infrastructure and a shortage of skilled human resources. Siregar (2024) add that weak system integration and inadequate data management further hinder progress Almodaresi & Shafiee. This issue is particularly critical in healthcare areas requiring consistency and accessibility, such as physiotherapy, as highlighted in the 2026 gap analysis (p. 26). Overall, this uneven development indicates that smart hospital systems remain in a maturing phase and require more time for full integration.

Taken together, these findings illustrate that smart hospitals are multifaceted and continuously evolving socio-technical systems in which technological, organizational, and human elements co-evolve. Almarri (2025) argue that while smart, converged healthcare systems often emphasize efficiency gains, they risk underprioritizing patient experience within their core objectives. Nugraheni (2025), further emphasize that digital transformation reshapes not only operational processes but also the structural foundations of healthcare delivery. A key conclusion across the literature is that a smart hospital cannot be defined solely by the presence of advanced technologies. Successful implementation depends on integration into daily practice, usability for healthcare professionals, and measurable improvements in patient experience.

2) The Effect of Smart Hospital Implementation on Operational Efficiency

Seeing digital systems re-jig the daily functioning of hospitals gives an early sense of a connection between smart hospital implementation and improved operational efficiency. Digital tools integrated into hospital workflows help early adopters transition from fragmentation to more streamlined operations with reduced redundancy and bottlenecks. Technological integration in the hospital improves levels of service, while Gani (2024) supports that system-based designs enable faster information exchange across functions. Wulandari (2025) provide an overview: digital transformation is recognized as a tool that hospitals apply to strategically meet increasing patient demand. In this sense, efficiency is less about speed and more about weaving resources, information, and people into a cohesive system.

A robust Hospital Information System acts as the backbone of day-to-day operational efficiency by managing and sharing data across units. Electronic medical records will eliminate duplicative documentation and therefore create a more productive workforce able to spend more time on care rather than paperwork. SIMRS (Sistem Informasi Manajemen Rumah Sakit) could enable interdepartmental coordination by maintaining up-to-date and timely patient data. However, Díaz (2025) states that digital systems ensure maximum administrative efficiency by automating common processes such as registration and invoicing. Aisah (2024) further support this view, noting that integrated systems reduce the risk of errors and miscommunication. Furthermore, Azizah (2025) revealed that real-time processing improves faster decision-making, also note that digital administration may reduce service delivery delays.

AI and data analytics technologies improve operational performance through seamless, accurate, and rapid clinical decision support. Research on Spiking Neural Networks for the Diagnosis of Cardiovascular Diseases Marinescu (2025) shows that smart systems help doctors interpret complex data for diagnosis and treatment planning. Hilmy (2026) similarly observe that technological diagnostic tools provide better value to patients and shorten clinical evaluation duration. This leads to higher organizational efficiency as digital transformation enables appropriate planning and resource allocation (Nugraheni, 2025). Stoumpos (2023) suggest that operational effectiveness is not simply a function of system availability but also depends on efficient deployment of clinical technology skills.

Smoother patient flow through hospitals and service provision is also an indicator of system efficiency. Digital systems can track patients, anticipate service needs, and improve resource allocation. Digital transformation may improve accessibility and reduce pressure on system bottlenecks in service delivery. Information technology improves service quality by reducing patient waiting times and enhancing person-to-person communication. Organized systems enable patients to move through services more efficiently, as workflows clearly define roles and timing. These improvements support the argument that operational excellence derives

from both technical systems and humane service management at the point of care.

Digital health services are also improving operational efficiency by reducing unnecessary hospital visits and enabling remote care delivery in distant locations. Rabbani (2025) report that telemedicine decreases hospital congestion and provides comparable clinical outcomes. Bozic et al. note that digital health technologies enable remote monitoring and follow-up care, reducing the burden on hospital capacity. Hilmy (2026) highlight that variability in physiotherapy service models supports efficiency through flexible scheduling and reduced waiting times. Coordinated movement toward smart hospital systems centered on accessibility and efficiency. These developments represent an effort to scale operational efficiency across interconnected digital health service networks.

Smart hospital technologies that assess efficiency based on organizational factors are fundamental for long-term success. Chansanguan (2025) emphasize that strong leadership and transformational knowledge management are vital for rapid digital transformation adoption and successful system utilization. Sustainable efficiency gains are only achievable through technological and organizational coherence. Marinescu (2025) further suggest that integrating digital systems into workflows enhances resilience in healthcare technology adoption. Higher-rated tools require adequate training and support to be fully effective. In other words, operational efficiency depends on how well technical implementation is executed and the level of organizational readiness.

Although the benefits are evident, challenges associated with smart hospital technologies significantly restrict their potential applications. Păcuraru (2025) Note that digital transformation is uneven across hospital functions, with some areas receiving more attention than others. Furthermore, implementation may be constrained by human resource and infrastructural limitations (Ayustya & Sitorus, 2025). Siregar (2024) highlight that system integration and data management issues can reduce efficiency gains from these technologies. Hilmy (2026) also note that these challenges can affect specific services such as physiotherapy, causing delays and inconsistencies that impact overall performance. These findings suggest that operational excellence is an ongoing process and spatial alignment cannot be treated as a one-time intervention but requires continuous adjustment.

Overall, the impact of smart hospital implementation on operational efficiency is not a simple linear relationship between technology and service delivery. Almarri (2025) emphasize that digital integration offers efficiency and quality in care, requiring healthcare systems to function as intelligent environments. Stoumpos (2023). similarly note that healthcare is shifting from traditional schemes toward modern, integrated, value-based and online-based processes, as also highlighted by (Nugraheni, 2025). The literature indicates that throughput improves when technological efficiencies align with the economic and organizational realities of healthcare systems.

3) The Impact of Operational Efficiency on Patient Satisfaction in Physiotherapy Services

If we look at the use in medicine, it means that, because of repeated-measure design based on mandatory data from usage models and/or continuous relationships with clients, operational efficiency is one of the most important determinants played in patients' perception of care quality. An efficient service does not just mean patients are treated in a timely fashion, but that the whole patient journey is as seamless and smooth as possible. The service's speed and clarity also help to strengthen patients' perception of higher care quality. Individuals are more confident when health communication occurs within the context of the broader healthcare system. In physiotherapy services, interactions with patients are more frequent and also more time-consuming; thus, they carry a higher weight in the aggregated satisfaction score.

This is evident in one of the most visible results of improving operational processes: less idle time and better scheduling. Adult physiotherapy is a lengthy treatment that requires numerous sessions for patients, and time management is a vital aspect in shaping the total burden of experience. As of October 2023, simplified administrative procedures introduce pre-scheduling to streamline allocation processes by reducing delays integrated WPC management systems that activate consultants as care coordinators ensure effective coordination within the team managing

appointment schedules and treatment cycles (Athira & Sampetoding, 2024). Aisah (2024) explain that workflows organized in an orderly manner enable healthcare providers to handle patients efficiently, avoiding congestion and long queues. Patients particularly value improvements that increase the reliability and predictability of care in a service characterized by ongoing clinical skill use.

Speed is also connected with communication between healthcare providers and patients. Digital solutions remove repetitive work, freeing physiotherapists to devote more time and energy to patients. Documenting in electronic medical records is easier, freeing time for direct clinician care. Siregar (2024) also noted that reduced interruptions and improved inter-departmental coordination result in a smoother treatment experience. As Azizah (2025) stated, the availability and accessibility of patient data allows for individualized care, which improves the patient–provider relationship. These changes have enhanced patient satisfaction in physiotherapy, which demands trust and open communication.

Among the most significant outcomes of operational efficiency is service delivery consistency. What drives patient choice far more than the quality of each individual session is continuity of care. Note that outpatient physiotherapy services that are structured and well managed tend to be more effective and successful. Furthermore, avoiding skipped treatments and ensuring continuity minimizes the risk of incorrect or fragmented sessions. Wulandari (2025) describe the Digital Transformation Value Concept, developed by GIZ, DSM, and SEP (2025), which conceptualizes how value can be realized through improved monitoring and coordination of care processes. This provides a more formal and standardized service for patients, increasing trust in the healthcare system.

Access to better services and improved operational efficiency also enhances patient satisfaction. Patients can schedule appointments, obtain information, and receive follow-up care through digital tools integrated into optimized workflows. Rabbani (2025) observe how telemedicine serves as a medium for patients to access healthcare services while maintaining satisfaction levels. Aytekin (2025) conclude that digital health technologies support higher patient engagement in care and improve the patient experience. Considering the need for continuity of care and feedback in physiotherapy, these tools act as adjuncts that enhance conventional face-to-face therapy. Improved access at the early stage of care contributes to a more positive perception of service.

Peer-reviewed literature also highlights another important aspect: efficiency, uncertainty, and transparency across the patient-care continuum. Patients tend to experience less anxiety when they understand what is happening and when disruptions are minimized. Păcuraru (2025) Note that reduced fear and improved communication contribute to a better patient experience as they navigate the healthcare system through technology. Well-established management systems provide greater transparency in decision-making and influence patients' perceptions of care quality (Nugraheni, 2025). Organized services give patients a sense of control and assurance over clinical practice delivery. This is especially critical in physiotherapy, where treatment courses can extend over weeks or multiple sessions.

However, the relationship between operational efficiency and patient satisfaction is more complex than a simplistic interpretation suggests, as challenges in translating efficiency gains at the institutional level into improved patient pathways can limit improvements in care experience. According to Ayustya (2025), it is not the absence of infrastructure that causes inconsistency in service delivery, but rather inefficiencies and lack of system integration. Siregar (2024) also caution that gaps in data management and coordination can lead to delays, errors, and ultimately reduced patient satisfaction (Azizah, 2025). Hilmy (2026) further emphasize that even in technology-enabled systems, strong management is required so that digital tools do not become distractions from patient care. Efficient implementation followed by structured improvement processes yields the best outcomes; efficiency is necessary but far from sufficient.

These results, in general, illustrate a strong clinical relationship between operational efficiency and patient satisfaction in physiotherapy services. A seamless patient experience can be achieved through well-designed systems and environments suitable for service delivery. Stoumpos (2023) support the concept of smart healthcare by combining patient-centered care

with efficient service delivery. Importantly, there is general agreement in the literature that service delivery should occur in a timely manner using systematic processes aligned with patient needs, and that physiotherapy represents an ongoing therapeutic alliance between provider and patient characterized by reciprocal trust and collaboration.

4) The Direct Effect of Smart Hospital Implementation on Physiotherapy Patient Satisfaction

The adoption of smart hospitals impacts the level at which patients experience care from the point they enter the health care system and, by extension, influences overall levels of patient satisfaction with physiotherapy service delivery. Key components of near-frictionless access in smart hospital ecosystems depend on improved communication methods and a more organized care process. The digital design of healthcare spaces is connected to the physical environment, which builds patient comfort through both system-based support and enhanced clarity in communication and collaboration. This enables easier interaction within service delivery systems, as noted by Gani (2024), contributing to the development of technology-based hospital systems. These characteristics influence patients' perceptions of care, especially in physiotherapy, where success often depends on multiple visits and extended periods of contact (a3).

Furthermore, digital transformation facilitates more personalized and responsive care, a process that has a direct impact on patient satisfaction. Wulandari (2025) emphasize that digital strategies enable healthcare providers to deliver services aligned with patient needs. Technology-enabled systems further promote patient-centred and responsive modes of care. This is particularly relevant in physiotherapy, where treatment plans may need to be adjusted based on patient progress. Hilmy (2026) note that service flexibility and responsiveness are critical, particularly where environmental factors, continuous patient monitoring, and individualized treatment approaches are involved.

The use of electronic medical data systems—such as Electronic Health Records (EHRs) and Hospital Information Systems (HIS)—promotes consistency and transparency, further enhancing patient satisfaction. Such digital records are inherently more reliable and accessible in electronic form, improving care coordination among stakeholders. This is further illustrated by Athira (2024), where these systems reduce administrative burdens and improve patient flow across services. Aisah (2024) highlight the importance of information systems in enabling communication between healthcare providers and patients; however, Siregar (2024) note that integrated systems reduce confusion and delays. These improvements result in a more consistent and reliable care journey, which is a key expectation in physiotherapy services.

Smart hospital technologies also enhance patient experiences by enabling active participation and greater ownership of care. Patient experience is best optimized when psychological and environmental factors are addressed, including improved digital environments and supportive care settings. Similarly, Teresa (2025) Explain that technological advancements improve communication, strengthening patient understanding and trust in healthcare providers. This is particularly important in physiotherapy, where treatment effectiveness depends on interactive engagement. Patients benefit from active participation in their care, supported by clear and continuous communication.

Importantly, digital health services such as telemedicine and remote monitoring further enhance patient satisfaction. Rabbani (2025) state that telemedicine improves accessibility without compromising quality of care, particularly for patients undergoing long-term therapy. Aytekin (2025) highlight that digital health technologies enable patients to take a more active role in managing their conditions, improving overall experience. Almarri (2025) describe smart healthcare systems as technologies that enable seamless, continuous, and patient-centred care. These tools play a key role in maintaining consistent treatment protocols, improving satisfaction, and advancing physiotherapy practice.

Smart hospitals, when integrated into smart city ecosystems, provide additional value through improved coordination of services across sectors. Păcuraru (2025) Note that implementation levels vary across institutions, and that digital transformation is not only consumer-facing but also improves access and coordination. Better management systems form

the foundation of improved service delivery, which is a major determinant of patient-perceived quality. Emphasize that advances in systems such as OPUS cytoscreening will only benefit patients if users actively adopt and engage with the technology in clinical practice.

Conclusion — The findings indicate that fully adopted smart hospital systems provide a more stable and systematic environment for patients.

The moderating effects of organizational readiness and leadership on the relationship between smart hospital implementation and patient satisfaction were also highlighted. Chansanguan (2025) describe a scalable model supported by strong leadership and knowledge management, enabled through automated technologies. Proper technology–organization alignment leads to improved service delivery. Marinescu (2025) argue that regulatory adjustments are needed to ensure that incentive structures do not hinder the delivery of evidence-based care. They also note that when healthcare professionals properly adopt and use personal health information technologies, system effectiveness improves. However, these factors may negatively affect patient satisfaction if poorly implemented.

Overall, the implementation of smart hospital systems positively influences patient satisfaction in physiotherapy due to improved accessibility, participation, and organizational efficiency. Technology-focused healthcare systems reduce diagnostic and treatment stages, leading to improved patient experiences. Digital administration systems reduce delays and errors Azizah (2025), thereby increasing satisfaction. Overall, the literature suggests that patients prefer healthcare environments that are efficient, responsive, and supported by digital tools, particularly in services such as physiotherapy that rely on continuous patient interaction and trust.

5) Integrative Analysis of Smart Hospital Implementation, Operational Efficiency, and Physiotherapy Patient Satisfaction

The linkage between smart hospital implementation, operational efficiency, and consumer satisfaction in physiotherapy services appears more like an in-progress development rather than a completed product. Digital technologies fundamentally transform the way health services are organized and delivered. Space and technology together form a more integrated service environment, while Gani (2024) found that the synergy of an integrated, technology-assisted system makes operational processes smoother. These developments set the stage for improved efficiency, which ultimately drives the patient experience. Wulandari (2025) also emphasize that digital transformation represents a form of strategic change. Pathway away from institutionalized routines toward systems better aligned with patient needs—especially in services requiring repetitive, ongoing contact, as is typically seen in physiotherapy.

A key explanatory mechanism linking technology implementation to patient outcomes is operational efficiency. This results in reduced delays and improved coordination and service flow in hospitals with integrated systems. Electronic medical records reduce duplication of tests, increasing data accuracy and enabling faster decision-making. Hospital information systems have also been shown to improve efficiency in service-oriented workflows as well as administrative processes (Athira & Sampetoding, 2024). Aisah (2024) Further note that improved coordination minimizes errors and misunderstandings, directly enhancing service quality. Azizah (2025) add that real-time data processing improves responsiveness, making healthcare systems more reliable. These changes collectively contribute to improved patient satisfaction within the broader system of care.

A key mechanism in physiotherapy services is continuity and consistency in care delivery. This is one of the most sensitive aspects of physiotherapy patient experience, as patients often require multiple visits and long-term follow-up. Hilmy (2026) emphasize the need to provide patients, regardless of geographic context, with a highly structured service environment. When considered within national and international comparisons (2027), satisfaction with local implementation must remain high. Patients generally prefer clinical setups with efficient scheduling, short waiting times, and smooth treatment delivery. Stability in care is reassuring for patients and families and helps foster trust. Teresa (2025) Note that organized and responsive services enhance patient confidence and comfort, thereby strengthening perceptions of care quality. In this context, operational efficiency serves as a key mechanism through which smart

hospital implementation influences patient satisfaction.

This trend is further strengthened by digital health applications that extend care beyond traditional hospital settings. Telemedicine and remote monitoring systems provide greater flexibility and accessibility, thereby improving both efficiency and patient satisfaction. Rabbani (2025) highlight this expansion of care delivery. Digital tools can enhance patient engagement and accessibility while supporting higher-quality healthcare experiences. Almarri (2025) emphasize continuous, personalized care within integrated smart healthcare environments that combine human-centered and technological approaches. These advances strengthen the relationship between efficiency and satisfaction by improving access and responsiveness to patient needs.

At the same time, advances such as artificial intelligence and data analytics introduce additional complexity. Smarter systems support improved clinical decision-making, enhancing both efficiency and quality of care. Hilmy (2026) further explain that technology-driven diagnostics reduce uncertainty and improve treatment planning. This reflects a "doing more with less" approach, as described by Nugraheni (2025), who situates digital transformation within a broader organizational improvement framework that enhances managerial capability and resource management. Stoumpos (2023) emphasize that the success of such technologies depends on strong user acceptance and integration into daily clinical practice. These findings suggest that the benefits of smart hospitals are mediated by efficiency gains and effective technological adoption in clinical settings.

The interaction of these factors is also shaped by organizational and human elements. Mishra et al. (2025) highlight the importance of leadership and knowledge management in digital transformation to ensure effective system implementation. Successful digital strategy must align closely with organizational objectives. The more effectively healthcare employees adapt to new technologies, the more likely efficiency gains will translate into improved patient experience. Without adequate training and supervision, some system capabilities may remain underutilized. This indicates that the relationship between technology, efficiency, and satisfaction is both structural and human-centered.

Although many relationships among these variables have been identified, significant barriers remain that may hinder integration. Koch, Klier & Weyh (2025), indicate that not all hospitals are equally digitally mature or capable of optimizing digital transformation outcomes. Ayustya (2025) identify poor infrastructure and limited resources as key barriers to implementation. Siregar (2024) further highlight that systemic integration and data management challenges hinder efficiency gains.

Hilmy (2026) stress that continuity of care is essential; inconsistency in Physiotherapy Services (PGH service context) creates a need for structured service delivery over time to meet patient needs. These challenges indicate that fully realizing smart hospital potential is a long and iterative process.

In conclusion, smart hospital implementation, operational efficiency, and patient satisfaction form a logically connected framework within physiotherapy services. Well-designed systems provide a strong foundation for improved healthcare delivery. Almarri (2025) further support the evolution of smart healthcare systems as central to this relationship. Overall, the literature indicates broad agreement that digital technologies enable more efficient, intelligent, and patient-centered services across the care continuum. This integration is particularly important in physiotherapy, where extended contact and continuity of care significantly influence both patient satisfaction and service quality.

Discussion

These findings reveal a logical chain between the influence of such smart hospital networks and their application in health care. Venture firms that combine Integrated Digital Technologies of Tomorrow to compose and integrate new tools in a bespoke coded system entice hospitals into constructing data systems or upgrades as IDT-only solutions. These hospitals frequently begin service redesign with a blank slate. This leads to a smoother pipeline, faster transfer of information, and improved coordination between departments. For instance, the integration characteristics and linkages were reviewed such integration can generate a more

connected service environment. This kind of system is less about the latest technological trend and more about how hospitals can better cater to patient needs. Lastly, it is worth highlighting that smart hospital implementation extends beyond technology itself to how it transforms care organization.

The most direct evidence of impact comes from the way these systems improve performance. Generally, many common processes are expedited, enabling physicians to reduce errors when using digital platforms such as electronic medical records and integrated information systems. These electronic records are considerably more user-friendly for administrative purposes such as registration, documentation, and data sharing (Athira & Sampetoding, 2024). Previously, Aisah (2024) Have discussed similar transitions. This increased integration leads to redesigned processes with minimal errors and reduced communication inefficiencies due to knowledge sharing across the system. Another benefit of real-time data is that it assists staff in making quick yet reliable decisions (Ayustya & Sitorus, 2025). All these improvements help establish greater order and control in hospital management, observable by both staff and patients.

These gains are also reflected in the experience of patients receiving physiotherapy services. Physiotherapy is by no means a minor intervention; it typically requires multiple visits, continuous monitoring, and highly detailed interaction between patient and physiotherapist. This means that even relatively small efficiency gains can have a significant impact on cost and outcomes. Hilmy (2026) found that the provision of more integrated, coordinated services resulted in increased patient satisfaction. Teresa (2025) also note that efficient service management, reduced waiting times, simpler communication, and smoother service flow contribute positively to patient comfort. Within this paradigm, efficiency is not only about speed but also about building patient confidence and trust over time.

Smart hospital systems also directly influence patient satisfaction outcomes beyond efficiency. In digitizing patient–healthcare interactions, digital tools have a more immediate impact. Rabbani (2025) highlight that telehealth and digital communication technologies make it easier to access and connect with care providers. Digital systems improve data organization and accessibility for future use. Stoumpos (2023) further note that users tend to feel more comfortable with technologies they are familiar with. By making healthcare less intimidating, these systems simplify processes and contribute to more positive patient experiences.

Taken together, these findings reveal a clear pattern. The implementation of smart hospitals—through systematic processes and integrated applications—improves service functionality within hospitals, which enhances efficiency and ultimately increases patient satisfaction in physiotherapy care. Improved access and interaction through digital technologies also measurably enhance patient experience.

Chansanguan (2025) describe this as a transformation toward a more empowered healthcare system. However, this also underscores the importance of careful and effective leadership in determining whether such systems are successfully implemented. Hospital systems are transformed from within, integrating computational tools into service delivery in a transformative manner. These changes not only generate efficiency gains but also influence patient perceptions of care continuity and long-term treatment compliance, particularly in physiotherapy services.

This phenomenon can be explained using the Technology Acceptance Model (TAM) and the SERVQUAL framework. In healthcare, TAM is widely applied to systems such as electronic medical records and hospital information systems, supporting efficiency improvements when users perceive systems as useful and easy to use. This finding addresses the first research objective by showing that smart hospitals enhance operational efficiency. SERVQUAL further explains patient outcomes: physiotherapy patients evaluate service quality by comparing expectations (continuity, responsiveness) with actual service delivery. Smart systems include Interval Time to Reduce Waiting Times (ITRWT), which helps meet expectations, and Care Coordination Functionality, which supports patient self-management and may further enhance satisfaction by reducing gaps between expectation and perception. This directly addresses the second research objective, demonstrating that operational efficiency mediates the relationship between smart hospital implementation and patient satisfaction.

This review expands the current evidence base beyond previous studies. Unlike earlier research (2022–2024) that focused on single technologies such as telemedicine or patient engagement tools Rabbani (2025), this study synthesizes multiple integrated technologies and shows how their interaction produces compounded efficiency gains. Similarly, unlike prior work on individual technology acceptance, this study emphasizes that organizational and systemic factors—such as aligned leadership and digital infrastructure readiness—are essential for realizing efficiency benefits.

This paper theoretically contributes by establishing a chain relationship between TAM and SERVQUAL in smart healthcare: service quality perceptions must be achieved before sustained acceptance and efficient use of technology occurs. From a practical perspective, these findings emphasize the need for hospital managers to move from purchasing standalone tools toward integrated digital infrastructure systems. Electronic health record (EHR) users, including physiotherapists and other clinical staff, require systematic training to improve usability and acceptance. Policymakers should also develop standardized frameworks linking digital infrastructure investment directly to measurable patient experience outcomes. This is particularly relevant in physiotherapy, where repeated patient–provider interactions depend heavily on system consistency and continuity of care rather than solely on face-to-face clinical practice.

CONCLUSION

The results imply that smart hospital technologies may play a critical role in operational efficiency and in improving patient satisfaction within physiotherapy services, thereby supporting the provision of healthcare services. With the help of digital systems, hospitals are better equipped to detect delays in workflows and improve interdepartmental coordination, which ultimately leads to improvements in service delivery efficiency. All of these mechanisms converge to produce a higher-performing system: reduced wait times, a clearer and more streamlined treatment pathway, and improved patient experiences. In fact, digital technologies and the convenience of just-in-time accessibility across the care continuum have a more pronounced impact on patient satisfaction. This impact is especially important in physiotherapy services, which are often characterized by ongoing or multiple patient encounters (a key feature of a smart hospital environment, where responsive healthcare delivery can be achieved).

As a result of these findings, future work should focus on advancing technological diffusion and technology–service fit rather than merely expanding digital infrastructure. Hospitals must ensure that digital systems are effectively utilized through relevant training, clear workflows, and strong organizational commitment. This could be further advanced through research investigating the impacts of more specific digital modalities within healthcare services in different settings (e.g., whether public or private hospitals demonstrate greater impact). Such work may help improve understanding of how different types of digital transformation affect patients' health outcomes. Further exploration is also needed into how patient characteristics may interact with their experience of smart healthcare systems, including factors such as age and digital literacy. These considerations may shape perspectives on how technology should be designed and implemented to enhance utility and maximize patient satisfaction.

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AUTHOR CONTRIBUTION STATEMENT

The main author was responsible for the conceptualization and research design. Data collection and analysis were conducted collaboratively by all authors. The manuscript was jointly written and revised, and all authors contributed to the final validation and approval of the manuscript prior to publication.

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