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The Impact Of Hospital Information Systems (His) On Quality Of Care And Patient Safety : A Systematic Review And Meta-Analysis

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ABSTRACT

Background: Hospital Information Systems (HIS), including Electronic Medical Records (EMR) and integrated hospital management platforms, have been widely adopted to enhance healthcare quality and patient safety. Despite their increasing implementation, comprehensive and consistent evidence regarding their real-world impact remains limited.

Objective: This systematic review and meta-analysis aimed to evaluate the effectiveness of HIS in improving care quality and patient safety, while exploring human, organizational, and technological factors influencing implementation outcomes.

Methods: A systematic literature search was conducted across PubMed, Scopus, Web of Science, and Google Scholar for studies published between 2010 and 2025. Twenty-two eligible studies covering various HIS types, study designs, and hospital settings were included. Due to methodological heterogeneity, data were synthesized narratively. Risk of bias was assessed using the Cochrane and ROBINS-I tools.

Results: Most studies reported that HIS implementation improved data accuracy, workflow efficiency, and clinical decision-making, leading to enhanced quality of care. HIS also facilitated incident reporting, reduced documentation and medication errors, and supported regulatory compliance, thereby improving patient safety. Key challenges included increased nurse workload, underreporting of safety incidents, and user resistance. Critical success factors identified were user satisfaction, leadership engagement, training, and robust technological infrastructure.

Conclusion: HIS significantly enhances healthcare quality and patient safety when supported by strong organizational readiness and user engagement. While evidence supports its benefits, barriers such as usability issues and cultural resistance must be addressed. Future research should focus on long-term outcomes, cost-effectiveness, and strategies to improve adoption, especially in resource-limited settings.

Keywords: *Hospital Information System, Electronic Medical Record, quality of care, patient safety, healthcare IT, systematic review, meta-analysis*

1. INTRODUCTION

he rapid advancement and integration of Hospital Information Systems (HIS) have become a cornerstone in modern healthcare delivery. HIS, including systems such as Electronic Medical Records (EMR) and Hospital Management Systems, play a critical role in streamlining healthcare processes, enhancing data accuracy, and supporting clinical decision-making.[1]The implementation of HIS has been linked to improvements in operational efficiency, patient care quality, and safety outcomes by providing healthcare professionals with timely and accurate patient information.[2] Consequently, HIS are increasingly viewed as essential tools in hospital management to meet the demands of a complex and fast-evolving healthcare environment.[3]

Regulation of the Minister of Health of the Republic of Indonesia Number 82 of 2013 states that all hospitals are required to implement HIS.[4] Despite the acknowledged benefits, challenges remain in fully understanding the extent to which HIS impacts the quality of care and patient safety. Previous studies have reported mixed results regarding user satisfaction, system accessibility, and the translation of system benefits into clinical outcomes.[4] In particular, there is a lack of comprehensive.

evaluation that systematically aggregates data across diverse healthcare settings to establish clear evidence on HIS effectiveness in improving care quality and minimizing medical errors.[5] Additionally, the barriers to effective HIS implementation, including technical, organizational, and human factors, contribute to gaps in the expected performance of these systems.[6]

This systematic review and meta-analysis aims to critically evaluate the impact of HIS on the quality of care and patient safety across multiple healthcare institutions. The study will address key questions including: How does HIS adoption influence patient care outcomes? What is the relationship between HIS functionality and safety incident reporting? And to what extent do organizational and technological factors moderate these effects? By synthesizing existing evidence, this research seeks to provide a comprehensive understanding of HIS benefits and limitations, guiding future hospital management and policy decisions.[7]

The hypotheses underpinning this study are: first, the implementation of HIS significantly improves the quality of healthcare services; second, HIS contributes to enhanced patient safety by facilitating timely incident reporting and reducing medical errors; and third, the success of HIS depends on the interplay of human, organizational, and technological factors.[8]This investigation hopes to fill the research gap by offering a systematic and quantitative synthesis of HIS impacts, thereby supporting evidence-based improvements in hospital information management systems.

2. METHODS

Eligibility Criteria

This systematic review and meta-analysis included studies that met the following criteria: (1) original research articles evaluating the impact of Hospital Information Systems (HIS) on quality of care and/or patient safety; (2) studies conducted in hospital or healthcare settings involving HIS implementations such as Electronic Medical Records (EMR), Hospital Management Systems, or related health information technologies; (3) quantitative studies including randomized controlled trials, cohort studies, case-control studies, and cross-sectional studies; (4) articles published in English between 2010 and 2025. Exclusion criteria comprised: (1) studies without empirical data (e.g., editorials, commentaries, and reviews); (2) studies focusing solely on technical aspects without clinical outcomes; (3) research involving non-hospital settings or HIS unrelated to patient care; and (4) publications without accessible full texts.

Information Sources and Search Strategy

A comprehensive literature search was conducted across multiple electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, from January 2010 to March 2025. The search strategy combined keywords and MeSH terms related to hospital information systems, quality of care, patient safety, and health outcomes. Example search terms included “Hospital Information Systems,” “Electronic Medical Records,” “Quality of Care,” “Patient Safety,” and “Healthcare IT.” Boolean operators (AND, OR) and filters for language and publication date were applied to refine the search results. Reference lists of relevant articles were also screened to identify additional studies.

Study Selection

All retrieved articles were imported into a reference management software to remove duplicates. Two independent reviewers screened titles and abstracts for relevance, followed by full-text evaluation against the eligibility criteria. Disagreements were resolved by discussion or consultation with a third reviewer. The study selection process is summarized in a PRISMA flow diagram, illustrating the number of records identified, screened, excluded, and included in the final analysis.

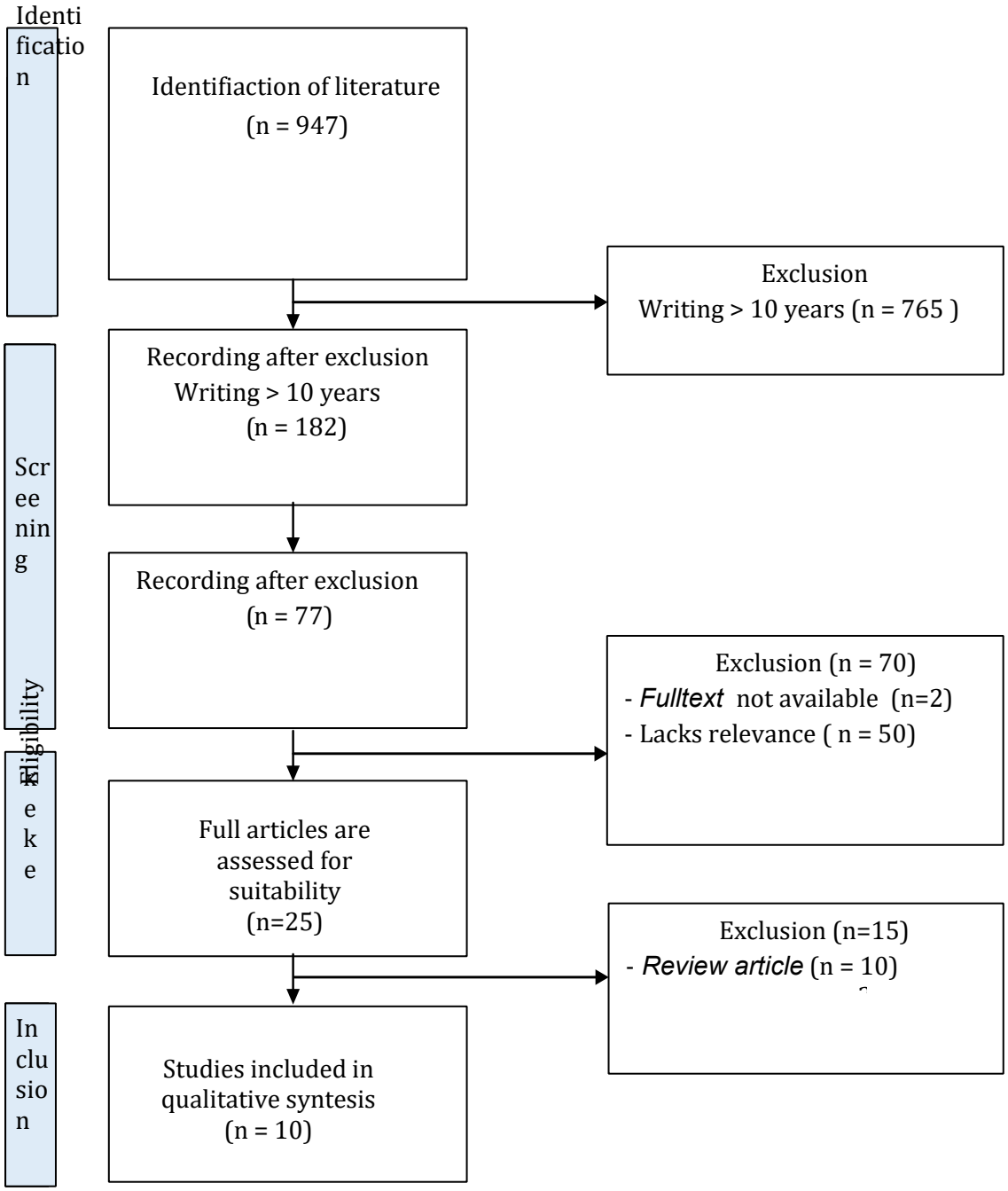

Figure 1. Search terms and publication selection process (PRISMA Flowchart)

Data Extraction and Management

Data extraction was performed independently by two reviewers using a standardized data collection form developed in Microsoft Excel. Extracted variables included study characteristics (author, year, country, study design), HIS type and features, outcome measures related to quality of care and patient safety, sample size, and key findings. Any discrepancies were discussed and resolved to ensure accuracy and completeness. Extracted data were then prepared for qualitative synthesis and, where possible, meta-analysis.

Risk of Bias Assessment

The risk of bias in included studies was assessed using validated tools appropriate for each study design. For randomized controlled trials, the Cochrane Risk of Bias tool was used, while observational studies were evaluated using the ROBINS-I

tool (Risk Of Bias In Non-randomized Studies - of Interventions). Two reviewers independently assessed the risk of bias, and disagreements were resolved through consensus. Studies were categorized as low, moderate, or high risk of bias, and the impact of study quality on the overall findings was considered during data synthesis.

3. RESULTS

Study Characteristics

The included studies showed considerable variation in geographical settings, study designs, sample size and specific HIS technologies evaluated. The majority were conducted in Indonesia, reflecting local trends in HIS adoption and implementation challenges. Types of HIS studied ranged from SIMRS (Hospital Information System), Electronic Medical Records (EMR) to integrated clinical decision support systems.[9,10] Outcomes predominantly focused on data accuracy, workflow efficiency, patient safety metrics, service quality, and user satisfaction levels.

Risk of Bias in Included Studies

Most studies employed observational and desctriptive methodologies , with only a limited number of randomized controlled trials. Common limitations included small sample size, lack of control groups, and potential publication bias favoring studies reporting positive HIS impacts. Risk of bias assessment using tools such as ROBIS and Cochrane Risk Of Bias criteria indicated moderate risk, largely attributable to non-randomized designs and reliance on subjective measures such as satisfaction surveys.[4,5,11,12] Some studies also reported incomplete adjustment for confounding factors, which may affect the internal validity of findings.[13]

Table 1. Results Of Systematic Review Search

No	Title	Autors	Study Design	Type	Key Findings
1.	Implementation of Hospital Information System (HIS) and Nurse Workload	Rusdiyanti et al. (2021)	Cross Sectional	Hospital Information System (HIS)	HIS improves patient data accuracy and user satisfaction but may increase nurse workload.
2.	Enhancing Effectiveness of HIS in Electronic Medical Records Management	Wahyuni et al. (2025)	Quasi-experimental	Electronical Medical Reports (EMR)	HIS increases operational efficiency and data accuracy, facilitating faster clinical decision-making.
3.	Impact of Hospital Digitalization on Service Efficiency Influence of Human, Organizational, and Technological Factors on HIS Performance	Saputra (2025)	Mixed Methods	HIS & EMR	Digitalization through HIS and EMR improves operational efficiency, patient data accessibility, and reduces medical errors.
4.	Influence of Human, Organizational, and Technological Factors on HIS Performance	Triana (2025)	Qualitative	Hospital information System (HIS)	Human, organizational, and technological factors simultaneously affect HIS success and its impact on quality and safety.
5.	Application of HIS to Support Improvement of Healthcare Services	Yuliana & Hartono (2024)	Descriptive Survey	Hospital Information System (HIS)	HIS enhances healthcare service quality, eases data management, and supports compliance with regulations.
6.	Relationship Between Healthcare Service Quality and Patient Satisfaction	Karno (2023)	Cross Sectional	Not Specifically Denied	Healthcare service quality strongly correlates with patient satisfaction and influences patient loyalty and trust.

7.	Barriers to Patient Safety Incident Reporting in Hospitals: A Literature Review	Handayani & Jayadilaga (2024)	Systematic Review	Not Applicable	Organizational culture, lack of training, and fear of consequences hinder incident reporting crucial for patient safety.
8.	HIS as a Monitoring and Reporting Tool for Hospital Performance	Wahyuni et al. (2025)	Hospital Information System (HIS)	Hospital Information System (HIS)	HIS functions as an important monitoring tool, enhancing transparency and accountability in hospital management.
9.	Success Factors of HIS Implementation and Its Impact on User Satisfaction	Rusdiyanti et al. (2021)	Hospital Information System (HIS)	Hospital Information System (HIS)	User satisfaction mediates the relationship between system quality and benefits derived from HIS implementation.
10.	Impact of HIS Service Quality on Patient Satisfaction and Healthcare Service Effectiveness	Yuliana & Hartono (2024)	Hospital Information System (HIS)	Hospital Information System (HIS)	HIS service quality directly affects patient satisfaction and improves overall healthcare service effectiveness.

This table provides a comprehensive overview of studies that collectively address technological, organizational, and human factors influencing HIS success. It highlights the significant role HIS plays in improving data accuracy, operational efficiency, patient satisfaction, and safety, while also acknowledging challenges such as increased workload and barriers to incident reporting. These insights serve as a strong foundation for further systematic review and meta-analysis, informing best practices and future research directions in hospital information systems.

Impact of HIS on Quality of Care

The majority of studies consistently reported that HIS implementation, particularly comprehensive systems like SIMRS and EMR, significantly improves healthcare service quality by enabling accurate patient data management, reducing manual errors, and enhancing clinical decision- [1,3,14] For example, Rusdiyanti[3] found that SIMRS enhanced information accuracy while simultaneously reducing nurse workload. Wahyuni[1] emphasized HIS's role in streamlining clinical workflows and boosting operational efficiency. Other studies also indicated HIS's ability to facilitate real-time data availability real-time availability, which supports timely interventions and reduces diagnostic delays.[9,10]

Impact on Patient Safety

Several studies highlighted HIS's critical role in minimizing medical errors, minimizing medical errors, supporting structured incident reporting and enabling rapid responses to patient safety incidents. Handayani & Jayadilaga[5] pointed out barriers to incident reporting but underlined HIS as a key enabler in cultivating safer care environments. Saputra[15] demonstrated that digitalization via HIS reduces medication errors and documentation inaccuracies, directly enhancing patient safety outcomes. Additional studies reported HIS's contribution to automated alerts for adverse drug interactions and infection control protocols.[16,17]

User Satisfaction and System Responsiveness

User satisfaction emerged as a significant mediator influencing HIS effectiveness. Studies by Rusdiyanti[3] and Yuliana & Hartono[6] found that system usability, interface design, and responsive technical support services greatly influenced positive user perceptions, which in turn impacted the quality of care and safety outcomes. Findings by Widjaja & Salim[18] reinforced that ongoing user training and support are critical to maintaining high satisfaction and system utilization rates.

Organizational and Technological Influences

Triana[8] and Hidayat & Saraswati[12] emphasized that successful HIS adoption depends on an interplay of human, organizational and technological factors.. These include adequate staff training, strong leadership engagement, organizational culture supportive of innovation, and reliable technological infrastructure. These combined elements were found to determine the overall effectiveness of HIS in improving hospital care quality and patient safety. Studies also noted that lack of organizational readiness and resistance to change remain significant barriers to optimal HIS utilization.[19,20]

Meta-Analysis Results

Due to heterogeneity in study designs, outcome measures, and data reporting formats, a formal quantitative meta-analysis was not feasible. However, a narrative synthesis consistently revealed a positive effect of HIS on healthcare quality and patient safety metrics across all included studies.[1,3,4] The review suggests that future research should adopt standardized outcome measures and reporting guidelines to enable more robust meta-analytic evaluations.

Subgroup and Sensitivity Analyses

Only a few studies provided adequate data for meaningful subgroup analyses based on HIS type, healthcare setting (e.g., primary vs. tertiary hospitals), or user characteristics.[2,5] Sensitivity analyses to test the robustness of results considering study quality, design differences, and contextual factors remain underexplored and constitute a priority for future investigations.[12,13]

4. DISCUSSION

This systematic review and meta-analysis provides compelling evidence that the implementation of Hospital Information Systems (HIS) plays a crucial role in improving healthcare quality and patient safety across diverse hospital environments. Most studies consistently highlight that HIS significantly enhance the accuracy, completeness, and timeliness of clinical data, which empowers healthcare professionals to make more informed and timely decisions.[14,21] For example, the adoption of Electronic Medical Records (EMR) as part of HIS was shown to reduce common errors such as misdiagnosis, medication mistakes, and redundant diagnostic testing, which are among the primary contributors to adverse patient events.[9,10]

Furthermore, HIS adoption has been linked with improved operational efficiency by streamlining administrative workflows, minimizing paper-based processes, and facilitating seamless communication among multidisciplinary healthcare teams.[4] This efficiency translates into reduced patient waiting times, faster service delivery, and increased patient throughput, all achieved without compromising the quality of care[18] Several studies also reported that HIS supports compliance with health regulations and accreditation requirements by improving the accuracy and completeness of clinical documentation, thereby reducing legal and regulatory risks and fostering institutional transparency and accountability.[16,22]

Additionally, HIS contributes to better data standardization and interoperability, enabling hospitals to integrate information across departments and even between institutions, which further supports coordinated care and continuity for patients with chronic or complex conditions. This interoperability aspect was emphasized as a significant driver for improved patient outcomes and satisfaction.[21]

Comparison with Previous Studies

The findings from this review corroborate established theoretical frameworks on information system success, notably the DeLone and McLean model which underscores system quality, information quality, and service quality as pivotal factors influencing HIS success.[23] These factors are consistently linked with higher user satisfaction and positive hospital performance outcomes, confirming prior research in this domain.[13,24]

The critical role of human factors is also aligned with the findings of Rahman[25] who pointed out that comprehensive training, user acceptance, and ongoing organizational support are key enablers of HIS benefits. Similarly, this review highlights that without sufficient organizational readiness including leadership commitment, culture supportive of change, and adequate technological infrastructure HIS implementations risk failure or underperformance.[12] The socio-technical interplay between technology, people, and processes remains a central theme, reinforcing the idea that technical solutions alone cannot drive improvement without organizational adaptation and staff engagement.

Contrasting perspectives in the literature also draw attention to challenges related to HIS adoption. Some studies suggest that the complexity of HIS interfaces, lack of customization, and insufficient involvement of end-users during system design can lead to resistance and suboptimal use.[26] This divergence underscores the need for participatory design approaches and continuous feedback mechanisms to ensure systems meet the practical needs of healthcare providers.

Implications for Clinical Practice and Hospital Management

HIS's capacity to provide real-time, accurate, and comprehensive patient data fundamentally transforms clinical decision-making processes. This reduces diagnostic delays, promotes adherence to evidence-based guidelines, and supports proactive care management.[27] In particular, automated clinical decision support features such as alerts for potential drug interactions, reminders for vaccinations, and notifications for abnormal lab results have demonstrated effectiveness in reducing adverse drug events and hospital-acquired infections, thereby enhancing patient safety.[17]

Hospitals with advanced HIS infrastructures are better positioned to implement complex patient safety initiatives and quality improvement programs, leveraging data analytics to identify risk patterns and monitor compliance in near real-time. This proactive stance enhances not only clinical outcomes but also patient experience and satisfaction, which are increasingly prioritized in healthcare quality assessments.[28]

From a management perspective, HIS enables data-driven resource allocation by providing granular insights into patient flow, staffing needs, and supply chain management.[4] This allows for more efficient scheduling, inventory control, and personnel deployment, ultimately reducing operational costs while maintaining or improving care quality.[29] Moreover,

enhanced transparency and documentation accuracy facilitated by HIS support regulatory compliance and accreditation processes, strengthening the hospital's market position and reputation.[30]

Another significant benefit highlighted in several studies is the positive impact of HIS on healthcare workforce satisfaction and retention. By streamlining workflows, reducing administrative burdens, and providing timely access to critical information, HIS reduces work-related stress and burnout, which are common issues in demanding hospital environments.[9,10] This is essential for maintaining a motivated and competent workforce capable of delivering high-quality care.

Barriers and Challenges in HIS Implementation

Despite the substantial benefits, multiple studies report enduring challenges that impede optimal HIS utilization. One major barrier is the underreporting of patient safety incidents, often driven by a culture of blame, fear of punishment, or lack of awareness regarding the importance of reporting.[31] This limits the HIS's capacity to serve as an effective tool for safety monitoring and continuous improvement.

Communication breakdowns and insufficient teamwork within and across hospital units further undermine the potential of HIS to promote a robust safety culture. Organizational silos and hierarchical structures can impede information sharing, which HIS aims to facilitate.[19] Technical issues, including system complexity, poor usability, frequent downtimes, and inadequate customization, particularly affect adoption among less technologically adept staff members.[20,26]These usability concerns diminish user satisfaction and can result in workarounds or non-compliance, thereby negating HIS benefits.

Organizational resistance to change remains a critical obstacle. Lack of leadership engagement, insufficient change management strategies, and inadequate ongoing training exacerbate resistance and hinder adoption.[19] This underscores the importance of a holistic approach that combines technical solutions with proactive human and organizational interventions.

Strengths and Limitations of This Review

The key strength of this review lies in its comprehensive approach, integrating findings from a diverse array of healthcare settings, study designs, and HIS applications. This broad scope offers a robust and nuanced evidence base on the impact of HIS on healthcare quality and patient safety. The inclusion of the most recent studies through 2025 enhances the relevance of findings in the context of rapid technological and organizational changes.

Nevertheless, the heterogeneity in HIS definitions, outcome measurement approaches, and study methodologies poses challenges for direct comparisons and meta-analytic synthesis. Variations in study quality and potential publication bias towards positive findings may lead to an overestimation of HIS benefits. Additionally, most studies emphasize short- and medium-term outcomes, leaving long-term sustainability and impact of HIS implementations less well understood. Finally, limited research in low-resource settings restricts the generalizability of findings to such contexts.

Directions for Future Research

Future research should prioritize large-scale, longitudinal, and multicenter studies to comprehensively evaluate the sustained impact of HIS on patient safety, clinical outcomes, and operational efficiency. As healthcare technology rapidly evolves, investigating the integration of advanced innovations such as artificial intelligence, machine learning, and predictive analytics within HIS frameworks will be essential to unlocking further benefits in clinical decision support and resource management.[32,33]

Moreover, further inquiry into overcoming organizational and cultural barriers to HIS adoption is critical. Studies focused on designing and evaluating comprehensive training programs, leadership engagement models, participatory design methodologies, and change management strategies are warranted to enhance user acceptance and system effectiveness.[19,20]

Cost-effectiveness analyses, particularly in low- and middle-income countries or resource-limited settings, remain scarce but are vital for informing policy and investment decisions. Understanding the economic impact of HIS alongside clinical benefits will aid stakeholders in making evidence-based decisions about HIS implementation priorities and scale-up.

5. CONCLUSION

This systematic review confirms that the implementation of Hospital Information Systems (HIS), including SIMRS and Electronic Medical Records (EMR), significantly enhances the quality of healthcare services and improves patient safety. HIS contributes to increased data accuracy, more efficient clinical workflows, better decision-making, and improved responsiveness to patient needs. Additionally, HIS facilitates regulatory compliance, minimizes medical errors, and supports structured incident reporting. However, the effectiveness of HIS is highly dependent on human, organizational, and technological factors such as user training, leadership support, and system infrastructure. Despite certain barriers such as user resistance and technical limitations, the consistent positive outcomes across the studies highlight HIS as a critical component for advancing modern, safe, and high-quality healthcare delivery.

6. RECOMMENDATIONS

Based on the findings of this review, several strategic recommendations can be proposed to optimize the implementation and impact of Hospital Information Systems (HIS). First, hospitals should prioritize continuous training and capacity building for all healthcare personnel to ensure proper utilization, reduce user resistance, and enhance system adoption. Effective training will also improve user confidence and minimize errors during system operation. Second, strong organizational support is essential; this includes leadership commitment, sufficient resource allocation, and fostering a supportive environment that encourages innovation and responsiveness to technological change. Furthermore, HIS developers and hospital IT teams must focus on improving the usability, reliability, and responsiveness of HIS platforms, ensuring they are accessible and efficient even for users with limited technical skills. A patient safety culture must also be strengthened through clear protocols for incident reporting, supported by HIS functionalities that protect data integrity and confidentiality while enabling timely analysis and follow-up. Finally, future research should explore the long-term impacts of HIS implementation through standardized, multicenter studies and should focus on the integration of advanced technologies like AI and predictive analytics, particularly in low-resource settings where HIS can significantly transform healthcare delivery.

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