Role of health informatics in hospital quality improvement: A scoping review of Indian healthcare facilities

Musa Hussaini Dibal*[1], Bukar Mustapha[2], Umar Abba Aja[1], Tijjani Ahmed[1]

[1]Department of Basic Medical Sciences, Faculty of Health and Medical Sciences, Integral University, Lucknow, India

[2]Department of Community Medicine, Faculty of Health and medical Sciences, Integral University, Lucknow, India

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ABSTRACT

Hospital quality measurement in India is constrained by incomplete data collection and fragmented health information systems. Health informatics, the application of digital technologies to healthcare data management and decision-making has the potential to strengthen hospital quality; however, evidence of its impact across Indian healthcare settings remains dispersed. This scoping review maps available evidence on the role of health informatics in improving hospital quality in India. A study was conducted following the Joanna Briggs Institute (JBI) methodology. PubMed, Scopus, and Google Scholar were used to source out relevant studies published between January 2010 to December 2025 that evaluated health informatics interventions in Indian hospital settings. A total of 24 relevant studies where sourced across the database of which twenty key empirical studies were selected for detailed characterization of settings. Findings were synthesized narratively across four hospital quality domains; patient safety, operational efficiency, clinical outcomes and data quality. Across the reviewed literatures, the health informatics adoption was consistently associated with improvements in operational efficiency. There are reductions in record keeping time of up to 50% and improved administrative processes. The hospitals that are accredited by the National Accreditation Board for Hospitals and Healthcare Providers (NABH) show's greater gains, including improved infection control compliance, higher patient satisfaction, and better staff job satisfaction. The public Health Management Information System (HMIS) platforms enable data capturing accurately, enhance routine monitoring and performance. However, challenges still exist which include, physician or clinician resistance, incomplete data capturing, and limited consistent improvements in clinical safety outcomes. Strategic implementation of health informatics integrated within governance frameworks and supported by workforce capacity building is essential for translating digital adoption into sustained hospital quality improvement efforts in India.

Keywords: health informatics, hospital quality improvement, India, HMIS, NABH, data quality.

INTRODUCTION

Hospital quality is a multidimensional construct encompassing patient safety, clinical effectiveness, patient-centeredness, and operational efficiency (World Health Organization, 2018).

In India, the quality assurance frameworks issued by the National Accreditation Board for Hospitals and Healthcare Providers (NABH) have emphasized standardized data capture, improvement of infection control surveillance, medication safety, and outcome monitoring (Nidhi et al., 2018).

The commonly used hospital quality indicators to assess quality improvement include: Central Line Associated Bloodstream Infection (CLABSI) rates, standardized mortality ratios (SMR), medication error rates, readmission rates, and patient satisfaction scores. Even though policies are putting more emphasis on using data to improve quality, the routine health data in Indian public-sector facilities is still not complete or timely (Gera et al., 2015). Research has indicated that data completeness fluctuates between 40% and 70%, exhibiting significant disparities within states and service areas, which constrains routine monitoring, benchmarking, and remedial

measures (Faujdar et al., 2019). These challenges directly limit the effective use of data for ongoing hospital quality improvement. Health informatics defined as the application of information and communication technologies to support healthcare data management, workflows, and quality improvement processes (National Health Authority, 2021). Digital systems such as Electronic Health Records (EHRs), Hospital Information Systems (HIS), and Health Management Information Systems (HMIS) facilitate structured data capture, longitudinal patient tracking, and real-time analytics (Chaudhry et al., 2006).

Internationally data has shown that informatics interventions lower drug mistakes (Bates et al., 2003) it also increases surveillance of infection, and make it easier to follow therapeutic recommendations using clinical decision support systems (Chaudhry et al., 2006). New evidence from India shows that adopting informatics can have similar benefits, such as better documentation efficiency, better coordination of treatment, and better administrative supervision. However, the size of the effect might be very different in different places (Jha et al., 2017; Gudivada et al., 2017).

The India's healthcare system is markedly characterized by heterogenicity in its structural, with variation in their infrastructures, financing, and digital usage across states (Rao et al., 2011). Highly digitized tertiary hospitals in urban areas coexist with secondary and district hospitals that often lack even basic digital infrastructure, reflecting significant disparities in digital capacity across India (Meghani et al., 2022).

Public-sector facilities providing service mostly to rural and marginalized populations in India encounter ongoing financial and human resource limitations. In contrast to the commercial hospitals that implement informatics selectively, guided by organizational priorities and market incentives (Jha et al., 2017). Moreover, state-driven health administration has led to fragmented and poorly interoperable HMIS platforms, which makes it hard to compare facilities, keep an eye on the whole country, and keep care going (HISP India, 2011; Meghani., 2022).

Even while regulatory and professional frameworks are becoming more reliant on reliable electronic data, the execution of NABH requirements for electronic incident reporting is still not consistent across all healthcare settings (NABH, 2020). The Indian Society of Critical Care Medicine's suggestions for ICU-specific quality improvement indicators are still being implemented unevenly across hospital settings.

Individual hospital case studies, surveys, and implementation assessments offer significant insights into the application of health informatics within Indian healthcare yet, the total evidence base is still fragmented across various locations, facility types, and quality domains (Faujdar et al., 2019). The variety of health informatics interventions used in Indian hospitals and their documented effects on hospital quality improvement matrix's have not yet been methodically mapped (HISP, India 2011).

Addressing this evidence gap is critical for guiding hospital leadership, informing health policy, and strengthening national digital health initiatives, including the Ayushman Bharat Digital Mission (National Health Authority, 2021). This scoping review therefore aims to synthesize available evidence on the role of health informatics in improving hospital quality across Indian health-care facilities.

METHODOLOGY

Study design

This study was conducted as a scoping review following the Joanna Briggs Institute (JBI) methodology for scoping reviews. A scoping method was selected due to the heterogeneity and complexity of study designs in the Indian literature.

The review aimed to map the available evidence, identify areas of hospital quality improvement influenced by informatics, and summarize implementation experiences. The review was reported in accordance with the PRISMA-ScR guidelines.

LITERATURE SEARCH STRATEGY

A literature search was conducted across PubMed (MEDLINE), Scopus, and Google Scholar. Searches terms related to health informatics, hospital quality, and India. The core search strategy was, "health informatics", "hospital quality" "electronic health record", “HMIS”, and "digital health" combined with “quality improvement", "patient safety", "data”, efficiency, "Indian hospital".

Grey literature searches included government reports, institutional evaluations, and organizational publications. Reference lists of included studies were hand-searched. The search was limited to English language publications from January 2010 to December 2025.

Eligibility criteria

Studies included include: (1) studies conducted in hospital settings within India; (2) implementation or evaluation of a health informatics or digital health intervention; (3) reporting hospital quality improvement indicators, data quality metrics, efficiency outcomes, or implementation experiences; and (4) peer-reviewed articles or grey literature with empirical data.

Exclusion criteria included studies conducted outside India, publications unrelated to hospital systems, non-healthcare digital interventions, and articles without accessible full text.

Study selection

Study selection was conducted in two stages: title and abstract screening followed by full-text review. Screening was performed by the author against predefined eligibility criteria. Data from included studies were charted using a standardized extraction form capturing publication details, study design, setting, type of informatics intervention, quality improvement assessed, key findings, and reported barriers and facilitators.

Consistent with JBI guidance for scoping reviews, formal risk-of-bias assessment was not undertaken.

Data synthesis

Data were synthesized descriptively and narratively. Findings were organized thematically across hospital quality domains patient safety, efficiency, clinical outcomes, and data quality and by type of informatics intervention. Quantitative pooling was not attempted due to substantial heterogeneity in study designs and outcome measures.

RESULTS

The literature search identified 24 studies out of which twenty studies where selected for detailed characterization of health informatics contributions to hospital quality improvement which include; health informatics in Indian hospital settings, qualitative studies, cross-sectional surveys, mixed-methods evaluations, systematic reviews, and large-scale program assessments conducted across public and private facilities.

Adoption of digital health systems varied substantially by healthcare setting. Electronic Health Record (EHR) use was higher in urban and tertiary hospitals, with adoption levels approaching 70%, whereas inter-organizational data exchange remained limited to fewer than 10% of facilities.

Although internal access to basic patient demographic information was common, access to comprehensive clinical data such as vital signs, allergy status, and longitudinal clinical histories was frequently incomplete (Faujdar et al., 2019). Across studies, implementation of health informatics systems was associated with improved administrative efficiency, faster record-keeping, and better documentation practices.

Healthcare workers in several studies reported improved job satisfaction following the adoption of the system. However, persistent data quality challenges were observed, particularly in public-sector facilities, where incomplete data entry and inconsistencies between paper and electronic records were common.

Table 1: Summary of selected health informatics interventions and their contributions to hospital quality improvement in Indian healthcare facilities.

Domain	Studies	Evidence Type	System/Intervention	Outcomes
Accreditation & Quality Systems	Nidhi et al. (2018); Singh et al. (2017); Kanyal et al. (2025); Swathi et al. (2024)	Cross-sectional; Observational; Systematic Review; Regression	National Accreditation Board for Hospitals & Healthcare Providers (NABH) systems	Improved documentation, patient safety, infection control, and service quality
HMIS	Gera et al. (2015); Prakash et al. (2021); Meghani et al. (2022); Krishnan et al. (2010)	Audit; Implementation; Landscape; Evaluation	HMIS platforms, dashboards	Improved planning and service delivery; early systems showed poor data quality
EHR/EMR	Powell et al. (2017); Pradeepa et al. (2011)	Survey; Descriptive review	EHR/EMR systems	Improved data sharing and guideline adherence; barriers include cost and resistance
Clinical Practices (Need for Decision Support)	Yadav, A., & Rashed, M. R. (2019)	Observational; Cross-sectional	Prescription audits	High prescribing errors and antibiotic misuse
HIS & Workflow	Ross et al. (2016);	Descriptive; Case study	HIS, DIS	Reduced waiting time and improved admissions workflow
ICU Informatics & Quality Indicators	Gudivada et al. (2017); Ray et al. (2009)	Database review; Guidelines	ICU databases, dashboards	Enabled monitoring of quality indicators
Governance & Interoperability	Faujdar et al. (2019); Itumalla (2012); Gnanadhas et al. (2025)	Qualitative; Conceptual; Grounded theory	Public HIS systems	Identified fragmentation, poor interoperability, and training gaps

Abbreviations: DIS (Department Information System); EHR (Electronic Health Record); EMR (Electronic Medical Record); HIS (Hospital Information System); HMIS (Health Management Information System); ICU (Intensive Care Unit); NABH (National Accreditation Board for Hospitals & Healthcare Providers).

Resistance to health information technology (HIT) adoption was identified as a key challenge with participants noting that some individuals do not readily adopt digital systems due to their perceived complexity and concerns about their impact on work processes (Gnanadhas et al., 2025). Additionally, all hospital administrators in the study (100%) reported using digital technologies in their daily operations, this reflects their routine reliance on health information technology within their roles. The study further found that 63% of respondents prioritized

policies and procedures as a key competency area for managing and implementing HIT (Gnanadhas et al., 2025).).

Large-scale public-sector implementations, such as state-level Health Management Information System (HMIS) platforms, were associated with improved data completeness, standardized reporting timelines, and greater use of routine data for performance monitoring and corrective action (Meghani et al., 2022).

Overall evidence indicates that while health informatics adoption in Indian hospitals is associated with improvements in efficiency, documentation, and selected aspect of hospital quality, the extent of benefit varies widely and is strongly influenced by organizational factors.

Figure 1: Timeline of key included studies

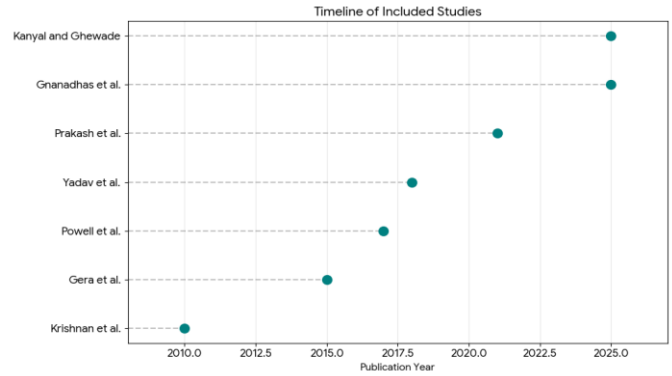
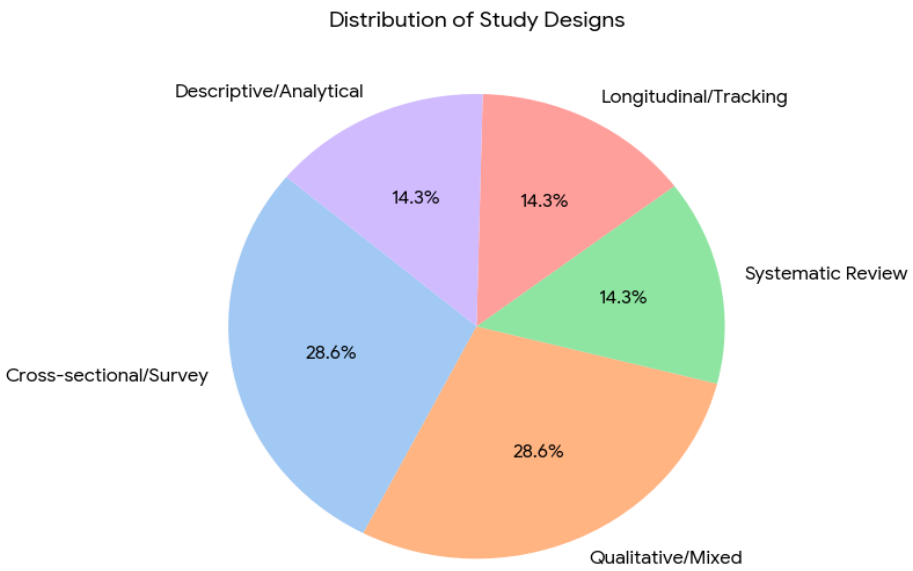


Figure 2: Distribution of included study designs



DISCUSSION

From administrative digitization to hospital quality improvement

The evidence synthesized in this scoping review indicates a clear evolution of health informatics in Indian hospitals from systems initially designed to support administrative functions to platforms increasingly embedded in clinical quality management and patient safety activities (Jha et al., 2017). Early hospital information systems, particularly in private-sector facilities, emphasized operational efficiency and cost recovery, with limited integration into clinical workflows or outcome monitoring (Itumalla, 2012; Ross & Venkatesh, 2016).

Over the time informatics platforms have expanded to support well-structured clinical data capturing, longitudinal patient tracking, and routine quality improvement processes across diverse healthcare settings

(Chaudhry et al., 2006; World Health Organization, 2016). Evidence from the rural and resource low settings show's that high-impact quality improvements do not necessarily require comprehensive enterprise-wide EHRs.

Accreditation frameworks have been very important in speeding up the change from administrative digitization to clinical quality management in hospital setting. NABH standards include electronic incident reporting, prescription audits, and organized monitoring of safety indicators as part of routine quality improvement practice (Nidhi et al. 2018).

Studies has shown that accreditation leads to measurable improvements, such as better infection control. This suggests that informatics systems work best if they are part of formal governance and accountability structures rather than being used as stand-alone technologies for hospital quality improvement (Gudivada et al., 2017; Kanyal & Ghewade, 2025).

The introduction of standardized dashboards and outcome-oriented indicators has enhanced health administrators to move beyond the aggregate service counts toward data-driven performance management and corrective action at the facility and system level (Prakash et al., 2021; Meghani et al., 2022). Together, these findings suggest that health informatics in India has progressed from a narrow administrative role toward a central function in clinical quality improvement within hospital settings.

Effects on the operational efficiency and patient satisfaction.

Research reviewed suggested that Indian hospitals that use health informatics' often have better operational efficiency and perceived quality of service (Ross & Venkatesh, 2016). Particularly if it comes to operations that require a lot of paperwork in routine hospital workflow, like admissions, discharge planning, and documentation (Itumalla, 2012; Ross & Venkatesh, 2016).

The digital systems have decrease repetition of work, improve patient flow, and enhance transparency across departments, contributing to measurable reductions in waiting times and greater coordination of care among clinical and administrative team in both corporate and tertiary care settings (Itumalla, 2012; Jha et al., 2017).

Patient satisfaction outcomes have appear closely linked to these efficiency gains in hospital environment. Studies applying SERVQUAL frameworks report improvements in dimensions such as responsiveness, assurance, and reliability following health IT implementation. This has reflected patients' perceptions of improved communication and organizational competence within healthcare facilities (Itumalla, 2012).

Based on evidence from tertiary hospitals in India that which demonstrate a substantial proportion of healthcare workers perceive improvements in hospital processes, patient satisfaction, and job satisfaction after implementation following NABH implementation, this highlights the synergistic relationship between informatics adoption and accreditation-driven quality culture in practice (Nidhi et al., 2018). A recent systematic review corroborates these findings (Kanyal & Ghewade, 2025).

By combining multiple paper-based reporting formats into a merged digital platform, UP-HMIS at the public sector improved data completeness and enabled real-time performance ranking across districts (Meghani et al., 2022). These operational efficiencies demonstrate that informatics can function as a critical enabler of managerial oversight and accountability, particularly when supported by administrative incentives and leadership engagement (Prakash et al., 2021).

Improvement of clinical safety and outcome indicators.

The clinical safety outcomes represent one of the most significant yet unequally realized benefits of health informatics adoption in Indian hospitals settings. ICU-specific implementations illustrate the potential of informatics to support continuous surveillance of healthcare associated infections and mortality indicators as part of clinical quality improvement (Gudivada et al., 2017).

However, observed infection rates exceeding international benchmarks highlight that digital surveillance alone does not guarantee outcome improvement without also strengthening of infection control practices and staffing

(Gudivada et al., 2017). Medication safety remains a critical concern in Indian hospitals, with high rates of prescribing errors reported, largely driven by manual prescribing, transcription errors, and fragmented documentation (Yadav & Rashed, 2019; Govil et al., 2025)

Specialized disease management systems further illustrate the clinical potential of informatics. Diabetes-specific EMRs enable longitudinal monitoring of complications and support clinical decision-making, facilitating early identification of high-risk patients and adherence to evidence-based care pathways (Pradeepa et al., 2011). The Indian Society of Critical Care Medicine (ISCCM) has established standardized ICU quality indicators, including infection rates, mortality metrics, and process indicators, which require systematic data collection and monitoring through health information systems for effective implementation (Ray et al., 2009).

Public health program monitoring and data usage.

The health informatics platforms have significantly strengthened public health program monitoring and decision-making. HMIS dashboards enable district and state administrators to conduct systematic analyses, prioritize corrective actions, and monitor progress across key maternal and child health quality improvement priorities (Prakash et al., 2021; Meghani et al., 2022).

Computerized systems in rural settings reduce record-keeping time and improve work planning efficiency, allowing frontline workers to redirect effort toward service delivery (Krishnan et al., 2010). Improvements in reporting timeliness and completeness following HMIS consolidation further support the role of informatics as an enabler of governance and accountability within large public health systems (Meghani et al., 2022).

Even with these advances, a recurrent gap still exists between data generation and effective data use (Meghani et al., 2022). Evaluations of HMIS and MCTS systems consistently report incomplete data capture and discrepancies between paper registers and digital platforms, limiting the effectiveness of quality improvement efforts (Gera et al., 2015). High accuracy observed on limited datasets highlights a paradox wherein precision is achieved at the expense of completeness, undermining the utility of informatics for real-time service planning and quality improvement.

Challenges in implementation and barriers to quality improvement.

Implementation challenges still remain a constraint on the quality enhancement potential of health informatics in India. Data completeness and accuracy issues persist across public-sector systems, reflecting the well-documented "garbage in, garbage out" phenomenon (Faujdar et al., 2019; Gera et al., 2015). Barriers include data that are unclearly processed, insufficient standardization, insufficient training of frontline health workers, unreliable electricity and internet connectivity, and absence of dedicated data entry personnel, particularly in rural and underserved areas (Gera et al., 2015; Meghani et al., 2022).

Human factors such as physician resistance to health information technology adoption is reported in over half of surveyed hospitals, driven by increased documentation burden, workflow disruption, and limited informatics training (Gnanadhas et al., 2025). Interoperability constraints further limit system effectiveness; surveys indicate near-universal internal data access but minimal inter-organizational exchange, restricting continuity of care and benchmarking (Jha et al., 2017).

Recent reviews have identified additional systemic barriers, including high implementation costs, shortage of trained personnel’s, data privacy concerns, ethical and legal accountability gaps, and language barriers (Claggett et al., 2024). Policy responses such as NABH standards and the Ayushman Bharat Digital Mission offer promising ways by linking informatics adoption to regulatory requirements. Evidence from UP-HMIS demonstrates that supportive supervision, leadership engagement, and structured data validation can greatly improve data quality and utilization, reinforcing the importance of governance alongside technology (Meghani et al., 2022).

Limitations of the study

This scoping review has several limitations. First, the relatively small number of identified studies examining informatics impact on quality improvement in Indian hospitals limits the breadth of evidence synthesis. The inclusion of only English language publications may exclude relevant studies published in regional languages.

Publication bias likely favors positive findings from urban, accredited, and well-resourced facilities. The heterogeneity of study designs, outcome measures, and interventions prevented meta-synthesis or quantitative pooling, reducing analytical precision.

CONCLUSION

This scoping review brings together evidence on the role of health informatics in improving hospital quality in Indian healthcare facilities, showing both benefits and ongoing challenges. Adoption of digital health systems is generally linked with better operational efficiency, improved documentation and some gains in key quality improvement outcome especially in hospitals that have strong governance and accreditation like NABH. However, the clinical outcome improvements are still irregular which shows that technology alone is not enough without proper training, changes in workflow and a strong quality environment. Overall, health informatics can be an important tool for hospital quality improvement in India when it is designed well, supported by leadership and fitted to local resource realities.

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