



ISSN:2230-9926

Available online at <http://www.journalijdr.com>

IJDR

International Journal of Development Research

Vol. 16, Issue, 06, pp.70672-70679, June, 2026

<https://doi.org/10.37118/ijdr.30984.06.2026>



REVIEW ARTICLE

OPEN ACCESS

A STUDY ON ASSESSMENT OF DIGITAL STANDARDIZATION AND WORKFLOW INTEGRATION IN A SELECTED HOSPITAL

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ARTICLE INFO

Article History:

Received 29th March, 2026

Received in revised form

19th April, 2026

Accepted 10th May, 2026

Published online 30th June, 2026

Key Words:

Digital Standardization, Digital Maturity, EMR, NABH, Work flow Integration.

ABSTRACT

Background: The healthcare sector is increasingly adopting digital technologies to enhance operational efficiency, accuracy, and quality of patient care. Digital standardization and workflow integration play a crucial role in ensuring seamless communication and coordination among various hospital departments. In alignment with National Accreditation Board for Hospitals and Healthcare Providers (NABH) standards, hospitals are increasingly focusing on strengthening their Information Management Systems (IMS). **Aim:** This study, titled “A Study on Assessment of Digital Standardization and Workflow Integration in a Selected Hospital,” aims to evaluate the extent of digital system implementation and the effectiveness of integrated workflows within a private hospital setting. **Material and Methods:** Primary data was collected through department audit checklists, structured questionnaires, direct system observation, and EMR documentation review, while secondary data was obtained from hospital policies, HIS/EMR reports, laboratory Turnaround Time (TAT) reports, and NABH standards manuals. The study included assessment of 7 major departments, responses from 53 hospital staff members, and review of 100 patient records. Department-wise digital maturity was evaluated using a weighted Digital Maturity Index and percentage analysis. **Results:** The findings revealed an overall digital maturity score of 55.5%, indicating a moderate level of digital standardization within the hospital. Registration achieved the highest compliance score at 80%, followed by IT Security at 75%. OPD/IPD (EMR) and Pharmacy demonstrated scores of 60% and 58.33% respectively, while Laboratory (45%), HR (31.25%), and Infection Control (25%). The EMR documentation review showed that discharge summaries were complete in 100% of records, diagnosis documentation was present in 95% of cases, digital authentication was available in 81% of records, and doctor notes were digitally documented in 78% of records. However, only 41% of records contained proper time-stamped entries, indicating a major gap in audit trail compliance. Staff feedback analysis indicated that 71.7% of respondents considered data entry quick and efficient, while 69.8% confirmed the availability of technical support. Around 60.4% reported easy sharing of patient data across departments. However, only 58.5% felt they received adequate training, 52.8% reported difficulties while using the system, and only 49.1% expressed full confidence in navigating the digital platform. Additionally, 62.3% of staff reported that system downtime significantly affected their workflow and productivity. **Conclusion:** The study concludes that strengthening digital standardization and improving workflow integration are essential for enhancing hospital efficiency, patient safety, and NABH compliance. The findings of this study can assist hospital management in identifying gaps and implementing strategies for improving digital efficiency and overall healthcare delivery.

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Citation: Hemang Chath and Dr. Pradyumansinh Jadeja, 2026. “A Study on Assessment of Digital Standardization and Workflow Integration in a Selected Hospital.” *International Journal of Development Research*, 16 (06), 70672-70679.

INTRODUCTION

The healthcare industry is rapidly transforming due to advancements in digital technology, leading hospitals to adopt systems that improve patient care, operational efficiency, and regulatory compliance. Digital standardization ensures the consistent use of systems such as Hospital Information Systems (HIS), Electronic Medical Records (EMR), Laboratory Information Systems (LIS), and Pharmacy Management Systems across all

departments. This consistency improves the accuracy, reliability, and accessibility of healthcare information while reducing variations in documentation practices. Workflow integration further enhances hospital functioning by enabling seamless coordination between departments through interconnected digital platforms. Integrated digital systems allow patient information entered during registration to be instantly accessed by departments such as outpatient services, inpatient care, laboratory, pharmacy, and billing. This reduces repetitive data entry, minimizes errors, and improves the speed and efficiency of service delivery. In traditional hospital systems, manual documentation and fragmented workflows often result in delays, duplication of work, communication gaps, and reduced patient safety.

To overcome these challenges, hospitals are increasingly adopting digital solutions that support real-time data sharing, automated processes, accurate documentation, and better clinical decision-making. Regulatory bodies like the National Accreditation Board for Hospitals & Healthcare Providers (NABH) emphasize standardized information management, data confidentiality, audit trails, and proper documentation. Digital standardization supports compliance with these standards by ensuring transparency, accountability, and traceability in hospital operations. However, many private hospitals still face issues such as partial digital implementation, inconsistent usage across departments, and lack of staff training, resistance to change, technical limitations, and inadequate system integration. These challenges reduce workflow efficiency and hinder the effective utilization of digital infrastructure. This study focuses on evaluating the level of digital standardization and workflow integration in a private hospital. It aims to assess digital implementation across departments, evaluate compliance with NABH Information Management System Standards, measure department-wise digital maturity, and identify existing gaps and challenges. The study also highlights the importance of improving digital infrastructure, enhancing workflow efficiency, strengthening patient safety, and supporting evidence-based decision-making. Finally, it seeks to provide practical recommendations for improving digital standardization, system integration, and overall hospital performance.

Need and Importance: The increasing dependence on digital systems in healthcare has made digital standardization and workflow integration essential for improving operational efficiency, patient safety, and quality of care. Hospitals are required to maintain accurate documentation, seamless interdepartmental communication, and efficient information management systems to meet NABH accreditation standards and enhance healthcare delivery. Despite the adoption of Hospital Information Systems (HIS) and Electronic Medical Records (EMR), many hospitals continue to face challenges such as incomplete digital integration, inconsistent documentation practices, and lack of interoperability, inadequate staff training, and dependence on manual processes. These gaps can lead to delays, communication errors, reduced workflow efficiency, and compliance risks.

This study is significant because it helps to assess the current level of digital maturity across hospital departments and identifies gaps affecting workflow integration and digital standardization. The findings provide practical insights for hospital management to improve digital infrastructure, strengthen system utilization, enhance patient safety, ensure NABH compliance, and support evidence-based decision-making for future digital transformation initiatives. The study is also needed to address inefficiencies arising from partial or improper implementation of digital systems.

Objectives

- To evaluate the extent of digital implementation across clinical and non-clinical departments within the hospital.
- To assess the compliance of existing digital systems with the Information Management System (IMS) standards prescribed by National Accreditation Board for Hospitals and Healthcare Providers (NABH).
- To determine the level of department-wise digital maturity using a structured and standardized assessment framework.
- To identify gaps, barriers, and challenges related to digital standardization and workflow integration across hospital departments.
- To propose evidence-based recommendations for improving digital standardization, interoperability, workflow integration, and overall hospital performance.

RESEARCH METHODOLOGY

The present study adopts a descriptive and analytical cross-sectional research design. The descriptive approach is used to assess the current level of digital standardization and workflow integration across various hospital departments, while the analytical aspect focuses on identifying gaps, evaluating compliance with standards, and interpreting the effectiveness of digital systems. The cross-sectional nature of the study involves data collection at a single point in time from multiple departments within the hospital.

Sources of Data: Primary data for the study was collected directly from hospital staff using structured questionnaire and system observations using the Department audit checklist, Staff interviews, direct system observations, whereas Secondary data was collected from existing hospital records and official documents, including Hospital policies (IT policy, data backup policy), HIS/EMR reports, Pharmacy stock reports, Laboratory Turnaround Time (TAT) reports and NABH standards manual.

Sample Size: The sample for the study consists of, 7 major departments, including Registration, OPD/IPD, Pharmacy, Laboratory, HR, IT, and Infection Control, 53 hospital staff members for structured interviews and review of 100 patient records.

Sampling Technique

- The study employs the following sampling techniques:
- Purposive Sampling: Used for selecting departments based on their relevance to digital systems and workflow processes.
- Simple Random Sampling: Used for selecting patient records to ensure unbiased evaluation of documentation and system usage.

Tools of Data Collection

- Structured Digital Audit Checklist: Used to assess the level of digital standardization and compliance in each department
- Staff Interview Questionnaire: Used to collect insights from employees regarding system usage, challenges, and workflow integration
- EMR Documentation Review Format: Used to evaluate the quality and completeness of patient records
- Digital Maturity Scoring Model: Used to quantify the level of digital implementation across departments

Tools of Data Analysis

The collected data was analyzed using both quantitative and qualitative techniques, including:

- Percentage Analysis: To measure compliance levels and system usage
- Digital Maturity Index (Weighted Scoring Model): To assess department-wise and overall digital maturity
- Gap Analysis (Current vs. NABH Standards): To identify areas requiring improvement
- SWOT Analysis: To analyze strengths, weaknesses, opportunities, and threats related to digital systems
- Pareto Analysis: To identify major problem areas contributing to inefficiencies

REVIEW OF LITERATURE

- A study conducted by Patricia A. H. Williams *et al.* (2019), titled Improving Digital Hospital Transformation: Development of an Outcomes-Based Infrastructure Maturity Assessment framework, developed an infrastructure maturity assessment framework to support digital hospital transformation. The study identified 164 measurable capabilities across five technology domains and eight maturity levels, demonstrating that effective digital infrastructure improves clinical workflow, patient care, operational efficiency, information accessibility, and overall hospital performance through structured digital transformation strategies.
- A study conducted by Christoph von Schudnat *et al.* (2023), titled The Economic Impact of Standardization and Digitalization in the Operating Room: A Systematic Literature Review, reviewed existing literature on the economic effects of standardization and digitalization in operating rooms. The study found that implementing digital technologies and standardized procedures in operating rooms can improve efficiency, reduce operational costs, optimize workflow management, and enhance overall healthcare performance in hospitals.
- A study conducted by Taşkın Kılıç (2016), titled Digital Hospital; An Example of Best Practice, explained that digital hospitals improve personnel productivity, facilitate hospital operations, enhance process quality, and ensure patient safety through the integration of smart information systems and digital technologies. The study highlighted that hospitals adopting digital systems experienced increased efficiency, reduction in paper-based expenses, minimized human errors, faster decision-making, and improved diagnosis and treatment processes through electronic and automated healthcare systems.
- A study conducted by Justus Vogel *et al.* (2024), titled Assessing the Relationship between Hospital Process Digitalization and Hospital Quality – Evidence from Germany, and examined the relationship between hospital process digitalization and quality of care in German hospitals. The study found that higher levels of digitalization were associated with slight improvements in certain patient outcomes, such as reduced pneumonia mortality rates, while some indicators showed insignificant results. The researchers concluded that hospital digitalization has the potential to improve healthcare quality, efficiency, and clinical documentation, although further longitudinal studies are needed to establish stronger evidence.
- A study by S. A. Pavlopoulos and A. N. Delopoulos (1999), titled Designing and Implementing the Transition to a Fully Digital Hospital, described the development and implementation of a fully digital hospital system in Greece. The study highlighted that the adoption of Picture Archiving and Communication Systems (PACS) and DICOM-based digital infrastructure enabled efficient storage, distribution, and management of medical images and patient data, facilitating smoother hospital workflows, improved information accessibility, and integration of various medical imaging technologies into a centralized digital healthcare system.
- A study conducted by Vicki Burkoski *et al.* (2019), titled Experiences of Nurses working in a Fully Digital Hospital: A Phenomenological study, explored the experiences of nurses working in a fully digital hospital environment. The study revealed that digital hospital systems improved access to patient information, enhanced communication, increased efficiency in nursing documentation, and supported better clinical decision-making. However, the study also noted challenges such as adaptation to new technologies, increased dependency on electronic systems, and the need for continuous training and technical support for nursing staff.
- Mehta *et al.* (2026), in the study titled “Mapping Digital Health Maturity Models and Accreditation-Linked Standards: A Scoping Review to Position the National Accreditation Board for Hospitals & Healthcare Providers (NABH) Digital Health Standards of India,” through a scoping review of 38 sources using PRISMA-ScR guidelines, showed that NABH Digital Health Standards strongly align with global frameworks such as HIMSS EMRAM and WHO-PAHO IS4H. The study identified strengths in governance, patient safety, and information management, while gaps were found in AI governance, cybersecurity, interoperability outcomes, and patient-generated health data integration.
- Parhlad Singh Ahluwalia *et al.* (2024), in the study titled “Digital Transformation in Hospitals: Improving Workflow Integration, Operational Efficiency, and Patient Safety,” showed that digital transformation improves workflow integration, operational efficiency, and patient safety in hospitals. The study also highlighted that resistance to change and inadequate staff training remains major barriers to successful digital implementation.
- Rosian Tossaint-Schoenmakers *et al.* (2021), in the study titled “The Challenge of Integrating eHealth into Health Care: Systematic Literature Review of the Donabedian Model of Structure, Process, and Outcome,” showed that e-Health interventions improve documentation, accessibility, communication, and patient engagement. However, the study reported challenges such as workflow misalignment and insufficient staff training affecting successful integration.
- Radha Ambalavanan *et al.* (2025), in the study titled “Barriers and Facilitators in Digital Health Data Integration: A Systematic Review,” showed that fragmented systems, lack of interoperability, and weak governance frameworks are major barriers to digital health data integration. The study recommended phased implementation, stakeholder engagement, standardized data formats, and strong leadership for successful integration.

RESULTS AND DISCUSSION

Percentage Analysis and Digital Maturity Index: Data was collected using department-specific digital maturity checklists aligned with NABH standards. Parameters related to clinical and administrative digital practices were scored on a 3-point scale: 0 = Not Available, 1 = Partially Implemented/Manual and 2 = Fully Implemented. Department-wise scores were compared with the respective maximum scores and converted into percentages to determine digital maturity levels. Based on predefined criteria, scores were categorized as Low (0–40%), Moderate (41–70%), and High (71–100%) digital maturity. According to the study registration department demonstrated the highest level of digital standardization (80%), followed by IT Security (75%), indicating strong system integration and governance practices. Moderate levels of digital

adoption were observed in OPD/IPD (EMR) (60%) and Pharmacy (58.3%), while Laboratory (45%) and HR (31.25%) exhibited lower levels of digital maturity, reflecting gaps in automation and workflow integration. Infection Control showed the lowest score (25%), highlighting significant deficiencies in digital surveillance and reporting systems.

EMR Documentation Review Analysis: Data for the EMR audit were collected through a retrospective review of 100 randomly selected OPD and IPD patient records. A structured audit checklist was used to assess parameters including digital documentation, time-stamping, diagnosis recording, discharge summary completeness, and digital authentication. Observations were recorded in binary format (Yes/No) and analyzed using Excel.

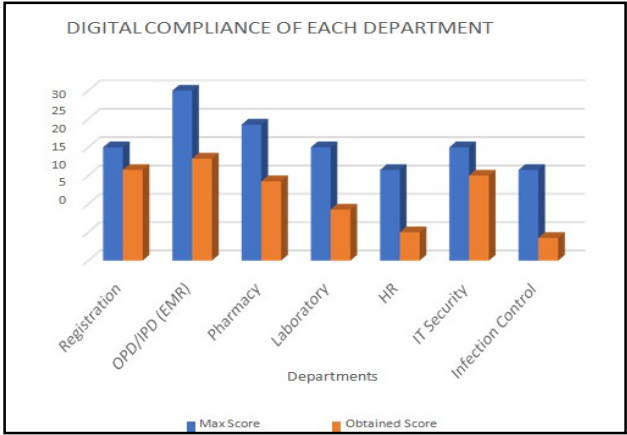


Table 1. Compliance rates

Criteria	Compliant Cases	Percentage
Doctor notes digital	78	78%
Time-stamped entries	41	41%
Diagnosis mentioned	95	95%
Discharge summary complete	100	100%
Digital authentication	81	81%
Total		

Table 1 shows compliance rates of 78% for digital documentation of doctor notes, 41% for time- stamped entries, 95% for diagnosis recording, 100% for completeness of discharge summaries, and 81% for digital authentication.

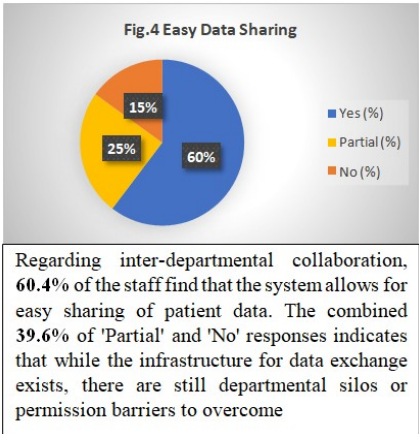
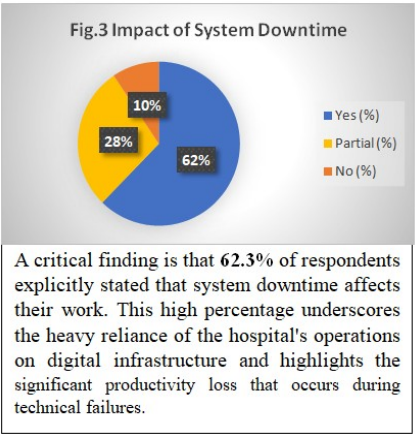
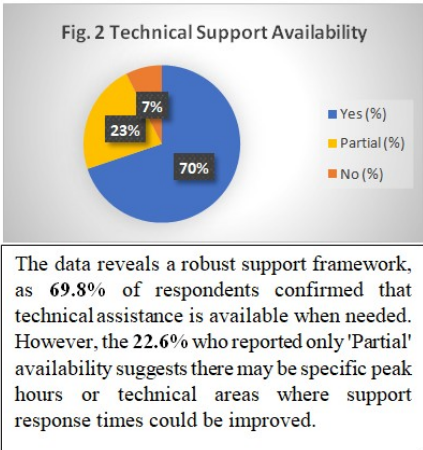
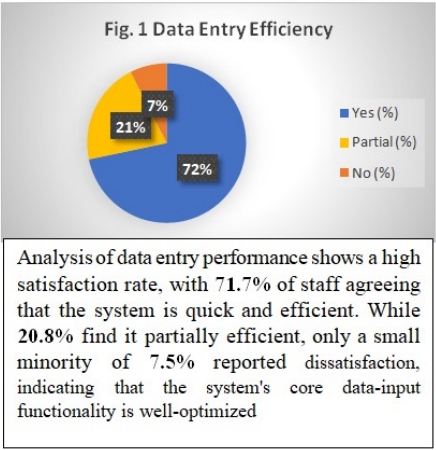
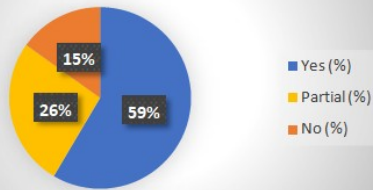
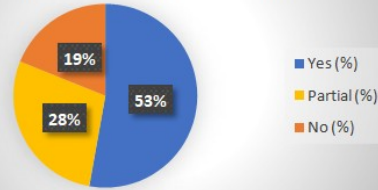


Fig.5 Adequate Training Provided



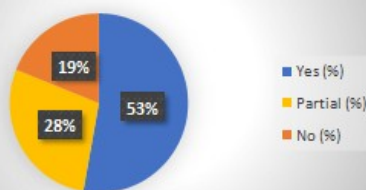
Training outcomes appear moderately positive, with 58.5% of the workforce feeling they received adequate instruction before using the system. The fact that nearly 41.5% felt training was either partial or non-existent suggests a need for more comprehensive on-boarding programs for new or existing staff.

Fig.6 System Reliability (Rare Delays)



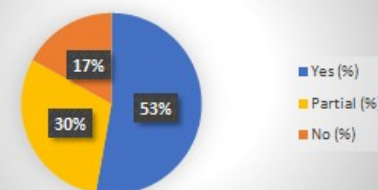
System stability shows a divided response, where 52.8% of users believe the system rarely causes delays. Conversely, the remaining 47.2% encounter issues at least partially, suggesting that intermittent technical glitches or latency issues remain a persistent challenge for nearly half the workforce.

Fig.7 Real-time Record Access



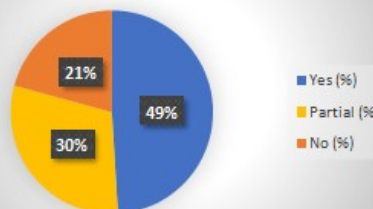
Exactly 52.8% of the participants confirmed they can access reports and records across departments in real time. This metric suggests that while the system supports live data access, a significant portion of the staff (47.2%) still experiences delays or hurdles in retrieving updated information instantly.

Fig.8 Difficulties Faced



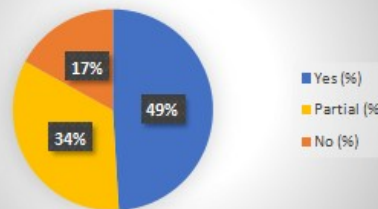
When assessing user friction, over half the respondents (52.8%) admitted to facing difficulties while using the digital system. This indicates that despite high data entry efficiency, the overall user journey involves complexities that require further investigation into the system's interface design.

Fig. 9 Navigation Friendliness



User interface feedback shows that less than half the staff (49.1%) find the system's navigation simple and user-friendly. With 20.8% flatly stating the navigation is not simple, this metric identifies 'Ease of Use' as a primary area for future system upgrades.

Fig.10 User Confidence



The survey indicates a confidence gap, with only 49.1% of staff feeling fully confident in using the digital system for their daily tasks. The 34% reporting 'Partial' confidence highlights a significant group of users who may be prone to errors or require frequent assistance, affecting overall operational speed.

Staff Interview Questionnaire Analysis: Data for the study was collected using a structured quantitative questionnaire administered to 53 staff members selected through a cross-departmental approach. Participants represented nine functional areas, including Doctors/DMOs, Infection Control, OPD/IPD, Pharmacy, Laboratory, IT, Registration, HR, and Imaging Services. The closed-ended questionnaire assessed usability, technical support, training adequacy, and operational efficiency using responses of "Yes," "Partial," or "No." The findings indicate that while the digital system performs well in backend efficiency, challenges remain in user interface and user confidence.

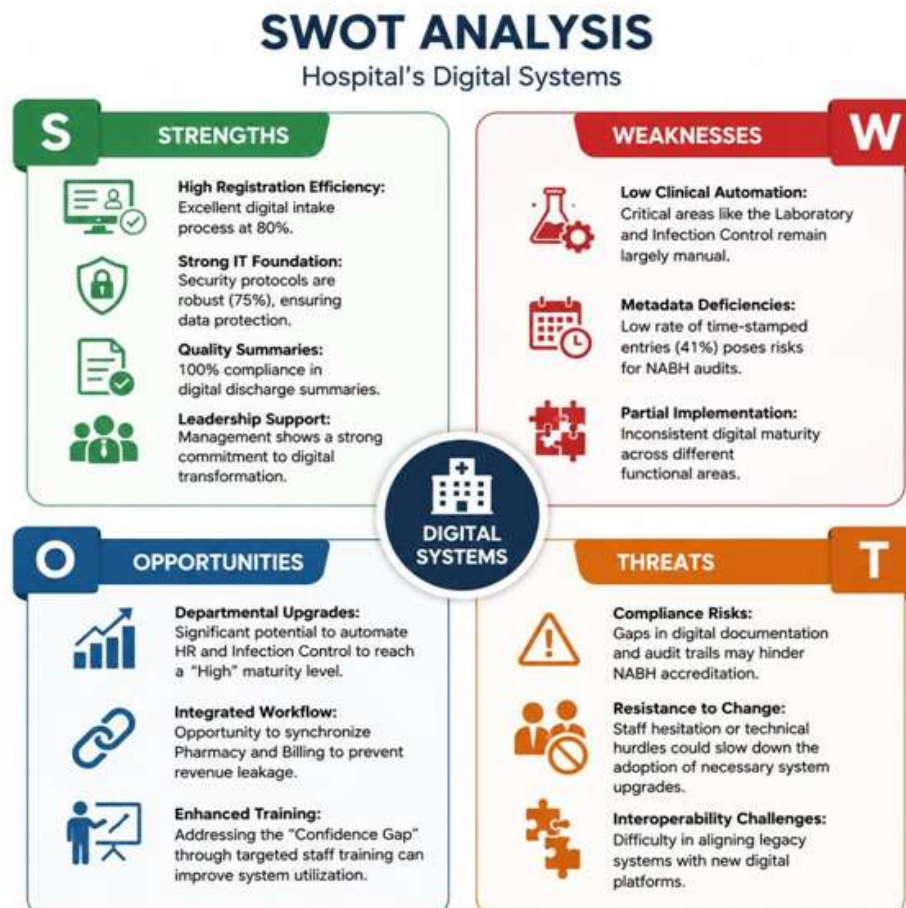
Gap Analysis (Current vs. NABH Standards): The gap analysis identifies discrepancies between the hospital's current digital state and the ideal standards required for National Accreditation Board for Hospitals and Healthcare Providers (NABH) compliance.

This Pareto Chart displays the gap scores (i.e., the difference between maximum possible score and obtained score) for each department at a selected hospital. Departments are arranged from highest gap (worst performer) to lowest gap (best performer) on the left Y-axis, while the red cumulative line tracks the running percentage of total gaps on the right Y-axis — following the classic 80/20 Pareto principle. The first three departments — Infection Control, HR, and Laboratory — collectively account for approximately 61% of the total digital gap, making them the critical priority areas for improvement.

Table 2. Gap Analysis

Area	NABH Standards / Requirements	Current Status	Identified Gap
HIS and Workflow Integration	NABH requires integrated HIS/EMR systems that ensure seamless information flow between clinical, diagnostic, pharmacy, and administrative departments.	Registration and IT departments demonstrated higher digital maturity, while Laboratory, HR, and Infection Control showed lower levels of integration.	Incomplete interoperability between departments leads to fragmented workflow and delays in information exchange.
EMR Documentation and Audit Trail	NABH mandates complete, authenticated, time-stamped, and traceable electronic medical records for continuity of care and accountability.	Discharge summaries showed 100% completeness, diagnosis documentation was high, but only 41% of records contained proper time-stamping.	Inadequate audit trail practices and inconsistent documentation reduce traceability and compliance efficiency.
Infection Control Surveillance	NABH emphasizes digital monitoring, reporting, and surveillance mechanisms for infection prevention and patient safety.	Infection Control demonstrated only 25% digital maturity with significant reliance on manual processes.	Absence of standardized digital surveillance systems limits effective monitoring and reporting.
Laboratory Information Management	NABH requires standardized laboratory information systems to support timely reporting, data accuracy, and workflow efficiency.	Laboratory department demonstrated moderate digital adoption with partial automation and manual dependency in some processes.	Limited automation and incomplete system integration affect turnaround efficiency and data accessibility.
Staff Training and Digital Competency	NABH recommends periodic staff training and competency assessment for effective utilization of digital systems.	Only 58.5% of staff reported receiving adequate training, while many users experienced operational difficulties.	Insufficient training and low user confidence affect optimal utilization of digital systems.
System Accessibility and Technical Support	NABH requires reliable access, system availability, and technical support for uninterrupted healthcare operations.	Technical support availability was reported positively by 69.8% of staff, but system downtime significantly affected workflow.	Frequent system interruptions and usability challenges impact operational continuity and staff productivity.
Area	NABH Standards / Requirements	Current Status	Identified Gap
Data Security and Access Control	NABH requires secure access control, confidentiality, authentication, and protection of patient information.	IT Security demonstrated relatively higher digital maturity and structured access practices.	Need for stronger standardization of security protocols and uniform compliance monitoring across departments.

SWOT Analysis



PARETO Chart

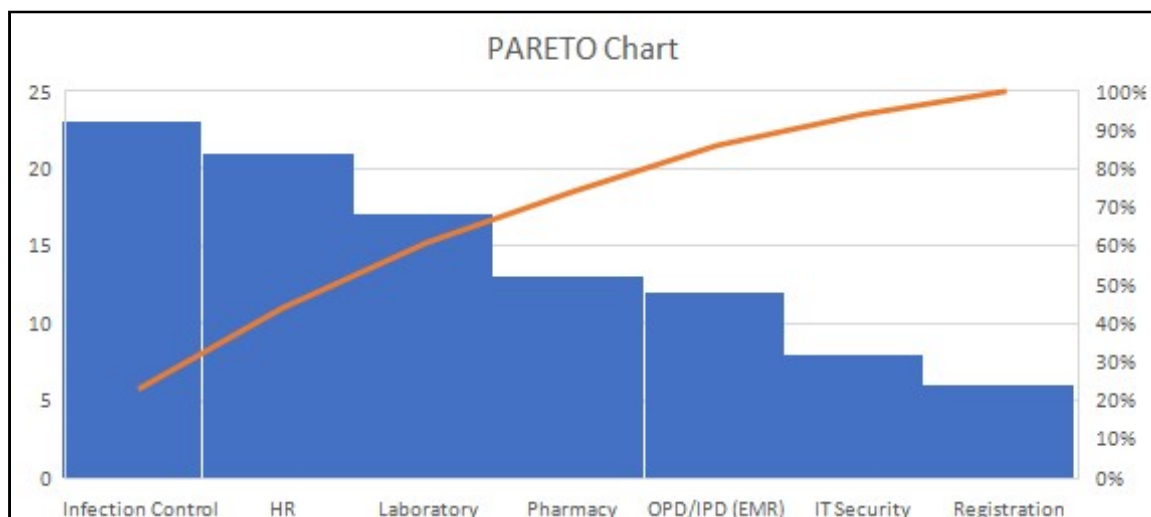


Figure 12

FINDINGS

Major findings of the study are:

- The hospital demonstrated an overall digital maturity score of 55.5%, indicating a moderate level of digital standardization and workflow integration.
- Registration (80%) and IT Security (75%) showed the highest digital maturity, reflecting better implementation of digital systems and governance practices.
- OPD/IPD (EMR) and Pharmacy demonstrated moderate digital adoption, indicating partial workflow integration and system utilization.
- Laboratory, HR, and Infection Control departments showed low digital maturity, highlighting gaps in automation, interoperability, and digital reporting systems.
- EMR review revealed 100% completeness in discharge summaries and 95% compliance in diagnosis documentation.
- Digital authentication was present in 81% of records, while doctor notes were digitally documented in 78% of records.
- Only 41% of records contained proper time-stamped entries, indicating weak audit trail compliance.
- Most staff reported that data entry was efficient and technical support was available within the hospital.
- A significant proportion of staff reported that system downtime affected workflow and productivity.
- Moderate levels of staff training, system usability, and interdepartmental data sharing indicated incomplete workflow integration.
- Many users experienced difficulties in system navigation and lacked full confidence in using digital platforms effectively.
- Pareto analysis identified Infection Control, HR, and Laboratory as the major contributors to digital gaps within the hospital.
- The study findings indicate that although foundational digital infrastructure exists, improvements are needed in interoperability, staff competency, workflow integration, and standardized digital practices to achieve higher digital maturity and NABH compliance.

CONCLUSION

The present study has provided a comprehensive understanding of the hospital's current digital landscape. The overall digital maturity score of 55.5% reflects a hospital that is digitally functional but not yet fully mature, with critical gaps identified in Infection Control, HR, and Laboratory departments that directly impact patient safety, clinical efficiency, and administrative accountability. The EMR documentation review and staff feedback further revealed that inconsistent real-time documentation practices, inadequate training, and low system confidence continue to undermine the effectiveness of existing digital systems. These findings collectively indicate that digital transformation in healthcare requires equal attention to people, processes, and technology — and that technical investment alone cannot drive meaningful change without a parallel focus on staff capacity building and organizational culture. Strengthening digital standardization and workflow integration is therefore not optional but essential for the hospital to achieve operational excellence, ensure NABH compliance, and fulfill its vision.

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