JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

DOI: https://doi.org/10.61919/veh9e452

Original Article

Impact of Healthcare Technology on Nursing Workflow Efficiency: A Cross-Sectional Study

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"Cite this Article" Received: 09 January 2026; **Accepted**: 17 March 2026; **Published**: 30 March 2026

Author Contributions: Concept: SR, IB; Design: SR, IB, SA; Data Collection: SR, SA, AG, MM; Analysis: SR, IB; Drafting: SR, IB, SA, AG, MM. **Ethical Approval**: Institute of Ophthalmology and Allied Vision Sciences, Multan, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: NA

ABSTRACT

Background: Digital healthcare technologies may improve nursing documentation, information access, and communication, although poor usability, technical interruptions, and inadequate implementation support can disrupt clinical workflow. Objective: To assess perceived nursing workflow efficiency associated with healthcare technology use and identify demographic, technological, and organisational factors independently associated with workflow efficiency. Methods: This cross-sectional study included 185 registered nurses working in medical and surgical wards of two governmental hospitals in Multan, Pakistan. Participants completed a structured questionnaire assessing workflow efficiency, technology usability, training adequacy, technical-support availability, and perceived technology-related outcomes. Data were analysed descriptively and using multiple linear regression. Results: The mean workflow-efficiency score was 3.59 ± 0.75, and 130 nurses (70.3%) reported high or very high efficiency. The most frequently reported improvements were reduced documentation time (63.8%), improved access to patient information (63.2%), and enhanced teamwork and communication (59.5%). Technical interruptions (50.8%), navigation difficulties (44.3%), and inadequate training (39.5%) were common barriers. Workflow efficiency was positively associated with technology user-friendliness ($\beta = 0.261$; $p < 0.001$), training adequacy ($\beta = 0.243$; $p = 0.023$), and technical-support availability ($\beta = 0.184$; $p = 0.006$), and inversely associated with age ($\beta = -0.223$; $p = 0.035$). Conclusion: Nurses generally perceived healthcare technology as beneficial to workflow, but its effective integration was associated with system usability, adequate training, and accessible technical support. Keywords: nursing workflow; electronic health records; healthcare technology; workflow efficiency; system usability; cross-sectional study.

INTRODUCTION

Digital technologies have become increasingly integrated into healthcare delivery, changing how clinical information is documented, accessed, communicated, and used in decision-making. Electronic health records (EHRs), artificial intelligence-assisted clinical decision-support systems, and other digital applications can facilitate timely access to patient information, automate routine processes, and support clinical decisions (1,2). EHRs, in particular, have transformed conventional documentation by enabling the electronic storage, retrieval, and exchange of patient information across healthcare teams (3,4). These developments are especially relevant to nurses because documentation, information retrieval, medication administration, communication, and care coordination constitute substantial components of their daily workload (5).

Although healthcare technologies may improve clinical workflow, their effects depend on how effectively they are integrated into routine nursing practice. EHR systems can reduce duplication,

improve medication reconciliation, and strengthen the continuity of clinical information; however, poorly designed systems may increase documentation burden, cognitive workload, and technology-related frustration (6,7). Mobile nursing stations and portable documentation systems may enable point-of-care data entry and reduce unnecessary movement between patient-care areas and fixed computer terminals (8). Similarly, artificial intelligence-assisted systems may support early warning, patient monitoring, risk identification, and clinical decision-making, although concerns remain regarding system reliability, alert fatigue, interoperability, and the preservation of professional clinical judgement (9,10). Consequently, the availability of technology alone does not guarantee workflow efficiency.

Technology acceptance frameworks provide a useful basis for understanding differences in nurses' responses to digital systems. The Technology Acceptance Model proposes that perceived usefulness and perceived ease of use influence technology acceptance and subsequent use (11), while the Unified Theory of Acceptance and Use of Technology extends this framework by incorporating social influence and facilitating organisational conditions (12). From a socio-technical perspective, workflow outcomes arise through interactions among technology design, clinical tasks, users, organisational culture, and support systems rather than through technology in isolation (13). Accordingly, user-friendliness, adequate training, and accessible technical support are likely to determine whether digital systems improve or obstruct nursing workflow (14,15). Individual characteristics, including age, previous technological exposure, professional experience, and educational preparation, may also influence adaptation to digital clinical environments (16).

Evidence regarding healthcare technology and nursing workflow has predominantly originated from technologically advanced healthcare systems. Hospitals in developing healthcare contexts may experience additional implementation challenges related to infrastructure, system stability, workforce preparation, device availability, and technical support (17). Moreover, many previous studies have evaluated individual technologies rather than nurses' experiences within clinical environments where EHRs, mobile nursing stations, and AI-assisted systems are used together. Limited evidence is therefore available regarding the combined association of technology usability, training, technical support, and demographic characteristics with nursing workflow efficiency in governmental hospitals in Pakistan.

This study aimed to assess the association between healthcare technology use and perceived nursing workflow efficiency among registered nurses working in two governmental hospitals in Multan, Pakistan. It further sought to identify whether perceived technology user-friendliness, training adequacy, technical support, and selected demographic and professional characteristics independently predicted nursing workflow efficiency.

MATERIALS AND METHODS

A quantitative cross-sectional study was conducted among registered nurses working in the medical and surgical wards of two governmental hospitals in Multan, Pakistan. The participating hospitals had progressively transitioned from paper-based clinical documentation to digital systems comprising EHRs, mobile nursing stations, and AI-assisted clinical decision-support tools between January 2024 and March 2025. Data were collected from May to July 2025. The cross-sectional design was selected to examine nurses' perceptions of workflow efficiency and its relationship with technological, organisational, and demographic factors at a defined point following implementation of the digital systems.

The target population comprised registered nurses directly involved in bedside patient care who had experienced the transition from paper-based to electronic documentation. Nurses were eligible when they held a valid nursing registration, worked in a medical or surgical ward, had at least six months of experience using an EHR system, and provided informed consent. Nurses who were on extended leave, were not directly involved in bedside care, or had not fully transitioned to electronic documentation were excluded. Participants were recruited through convenience sampling because eligibility depended on direct experience of the technology transition. The planned recruitment target was 200 nurses after

allowing for an anticipated 20% non-response. To maximise recruitment, 220 questionnaires were distributed.

Data were collected using a structured, self-administered questionnaire developed from the study objectives and relevant nursing-informatics literature. The questionnaire contained four components. The first component recorded age, gender, nursing experience, experience using EHR technology, educational qualification, and ward type. The second component comprised 20 items assessing perceived workflow efficiency across documentation time, access to clinical information, communication, teamwork, care coordination, medication-related processes, and overall workflow. Each item was rated on a five-point scale ranging from 1, indicating very low efficiency, to 5, indicating very high efficiency. An overall workflow-efficiency score was calculated as the mean of the completed items, with higher values representing greater perceived efficiency. The third component assessed perceived technology usability using the 10-item System Usability Scale (SUS) developed by Brooke (18). In accordance with the conventional SUS scoring procedure, responses to alternating positively and negatively worded items were recoded and transformed to produce a total score ranging from 0 to 100, with higher scores indicating greater perceived usability and user-friendliness. The fourth component included 12 items assessing the perceived adequacy of technology-related training and the availability and responsiveness of technical support. Composite scores were calculated separately for training adequacy and technical support, with higher scores indicating more favourable perceptions.

The questionnaire underwent expert assessment before data collection. The review panel comprised three nursing-informatics experts, two clinical nurse managers, and one biostatistician who evaluated the relevance, clarity, and comprehensiveness of the items. The resulting Content Validity Index was 0.89, indicating satisfactory content validity (19). Face validity and operational feasibility were evaluated through pilot testing with 15 nurses who met the eligibility criteria but were not included in the final analysis. Feedback from the pilot participants was used to clarify ambiguous wording and improve the questionnaire's organisation. The estimated completion time was 20–25 minutes. Internal consistency was satisfactory for the workflow-efficiency scale (Cronbach's $\alpha = 0.89$), technology-usability scale ($\alpha = 0.87$), training-adequacy scale ($\alpha = 0.84$), and technical-support scale ($\alpha = 0.86$), exceeding the conventionally accepted threshold of 0.70 (20).

Following administrative permission from the participating hospitals, potentially eligible nurses were approached during scheduled shift breaks. Each nurse received an information sheet explaining the purpose, procedures, voluntary nature, and confidentiality provisions of the study. Written informed consent was obtained before questionnaire administration. Participants completed the questionnaire independently and returned it in a sealed envelope to reduce social-desirability and supervisory influence. Completed questionnaires were collected weekly by a trained research assistant. A reminder was provided when a questionnaire had not been returned within two weeks. Of the 220 questionnaires distributed, 195 were returned, corresponding to a response rate of 88.6%. Ten questionnaires were excluded because they contained incomplete information required for the primary analysis. Complete-case analysis was therefore conducted using responses from 185 nurses. Questionnaires were checked for completeness and consistency before data entry, and the entered data were reviewed to identify coding or transcription errors.

The primary outcome was the continuous mean workflow-efficiency score. For descriptive presentation, scores were also grouped as very low efficiency (1.00–1.99), low efficiency (2.00–2.99), moderate efficiency (3.00–3.99), high efficiency (4.00–4.99), or very high efficiency (5.00). The principal explanatory variables were perceived technology user-friendliness, training adequacy, and technical-support availability. Demographic and professional covariates included age, gender, nursing experience, technology experience, educational level, and ward type. Nurses' reported technology-related improvements, workflow barriers, and perceived clinical consequences were summarised as categorical variables. Data were analysed using IBM SPSS Statistics version 26.0. Continuous variables were

summarised using means and standard deviations, while categorical variables were presented as frequencies and percentages. Spearman's rank correlation was used to examine bivariate relationships involving ordinal or non-normally distributed variables. Associations between categorized workflow efficiency and technology-experience groups were evaluated using the chi-square test, while differences in mean workflow-efficiency scores between diploma-prepared and degree-prepared nurses were assessed using the independent-samples t-test.

Multiple linear regression was used to identify independent predictors of the continuous workflow-efficiency score. The model included age, gender, nursing experience, technology experience, educational level, technology user-friendliness, training adequacy, and technical-support availability. These covariates were entered simultaneously to estimate the independent association of each factor while controlling for the remaining variables. Regression findings were reported using coefficients, standard errors, 95% confidence intervals, test statistics, and p-values, with standardized coefficients used to compare the relative contribution of the predictors. Regression assumptions were assessed before interpreting the model. The normality of residuals was evaluated using the Shapiro–Wilk test, homoscedasticity using the Breusch–Pagan test, multicollinearity using variance inflation factors, and potentially influential observations using Cook's distance. The reported diagnostic criteria were satisfied, with non-significant residual and homoscedasticity tests, variance inflation factors below 3.0, and Cook's distances below 1.0. All statistical tests were two-sided, and statistical significance was established at $p < 0.05$. Ethical approval was obtained from the relevant institutional review board and the ethics committees of the participating hospitals before recruitment began. Participation was voluntary, and written informed consent was obtained from all nurses. No directly identifying information was recorded on the questionnaires. Completed questionnaires and electronic data were handled confidentially and were accessible only to the research team.

RESULTS

A total of 220 questionnaires were distributed, of which 195 were returned, yielding a response rate of 88.6%. Ten questionnaires were excluded because of incomplete information, leaving 185 participants in the complete-case analysis.

Table 1. Demographic and Professional Characteristics of Participants (n = 185)

Characteristic	Category or summary	Value
Age, years	Mean ± SD	34.2 ± 6.8
	Range	24–52
Age group	24–30 years	51 (27.6)
	31–40 years	89 (48.1)
	41–52 years	45 (24.3)
Gender	Male	38 (20.5)
	Female	147 (79.5)
Nursing experience, years	Mean ± SD	8.4 ± 4.1
	Range	1–22
Nursing experience	1–5 years	62 (33.5)
	6–10 years	78 (42.2)
	>10 years	45 (24.3)
Technology experience, years	Mean ± SD	3.2 ± 1.5
Technology experience	1–2 years	72 (38.9)
	3–4 years	68 (36.8)
	>4 years	45 (24.3)
Educational level	Diploma in nursing	44 (23.8)
	Bachelor of Science in Nursing	122 (65.9)
	MSN/PhD	19 (10.3)
Ward type	Medical	100 (54.1)
	Surgical	85 (45.9)

The participants had a mean age of 34.2 ± 6.8 years and a mean nursing experience of 8.4 ± 4.1 years. Most participants were female (79.5%), and nearly half were aged 31–40 years (48.1%). Approximately

two-thirds held a Bachelor of Science in Nursing degree (65.9%). Participants had used healthcare technology for a mean of 3.2 ± 1.5 years, with 38.9% reporting one to two years of experience. Medical-ward nurses accounted for 54.1% of the sample.

Table 2. Perceived Overall Nursing Workflow Efficiency (n = 185)

Workflow-efficiency measure	n (%) or mean ± SD	95% CI
Overall workflow-efficiency score	3.59 ± 0.75	3.48–3.70
Very low efficiency, 1.00–1.99	7 (3.8)	1.8–7.6
Low efficiency, 2.00–2.99	10 (5.4)	3.0–9.7
Moderate efficiency, 3.00–3.99	38 (20.5)	15.3–26.9
High efficiency, 4.00–4.99	76 (41.1)	34.2–48.3
Very high efficiency, 5.00	54 (29.2)	23.1–36.1
High or very high efficiency	130 (70.3)	63.3–76.4

The mean workflow-efficiency score was 3.59 ± 0.75 on the five-point scale. Overall, 130 nurses, representing 70.3% of the sample, rated their workflow efficiency as high or very high. Moderate efficiency was reported by 20.5%, whereas 9.2% rated their efficiency as low or very low. The distribution was therefore concentrated toward the higher efficiency categories.

Table 3. Perceived Technology-Related Improvements in Nursing Workflow (n = 185)

Improvement	n (%)	95% CI
Reduced documentation time	118 (63.8)	56.6–70.4
Improved access to patient information	117 (63.2)	56.1–69.9
Enhanced teamwork and communication	110 (59.5)	52.3–66.3
Improved medication-administration processes	103 (55.7)	48.5–62.6
Enhanced patient-safety monitoring	98 (53.0)	45.8–60.0
Better care coordination	85 (45.9)	38.9–53.1
More efficient shift handover	76 (41.1)	34.2–48.3
Reduced medication errors	72 (38.9)	32.2–46.1

The most frequently reported improvements were reduced documentation time, identified by 63.8% of participants, and improved access to patient information, reported by 63.2%. More than half of the nurses also perceived improvements in teamwork and communication (59.5%), medication-administration processes (55.7%), and patient-safety monitoring (53.0%). Improvements in shift handover and medication-error reduction were reported less frequently, by 41.1% and 38.9% of participants, respectively.

Table 4. Reported Barriers to Efficient Technology Use (n = 185)

Barrier	n (%)	95% CI
Workflow interruptions caused by technical problems	94 (50.8)	43.7–57.9
Navigation difficulties	82 (44.3)	37.4–51.5
Inadequate training	73 (39.5)	32.7–46.6
Insufficient technical support	65 (35.1)	28.6–42.3
Increased documentation time	58 (31.4)	25.1–38.4
System instability	52 (28.1)	22.1–35.0
Lack of interoperability	48 (25.9)	20.2–32.7

Table 5. Nurses' Perceived Clinical and Occupational Consequences of Technology Use (n = 185)

Perceived consequence	n (%)	95% CI
Improved patient outcomes	134 (72.4)	65.6–78.4
Reduced medical errors	125 (67.6)	60.5–73.9
Enhanced job satisfaction	118 (63.8)	56.6–70.4
Improved documentation quality	112 (60.5)	53.4–67.3
Reduced nurse burnout	94 (50.8)	43.7–57.9

Despite generally favourable efficiency ratings, technology-related barriers were common. Approximately half of the participants reported workflow interruptions caused by technical problems (50.8%), while 44.3% experienced navigation difficulties. Inadequate training and insufficient technical support were reported by 39.5% and 35.1% of nurses, respectively. Approximately one-third reported

increased rather than reduced documentation time, demonstrating variation in nurses' experiences with the implemented systems. The findings represent nurses' perceptions and were not based on independently verified clinical, administrative, or occupational records. Participants could report more than one consequence. CI: confidence interval.

Most nurses perceived that technology use was associated with improved patient outcomes (72.4%) and fewer medical errors (67.6%). Enhanced job satisfaction and improved documentation quality were reported by 63.8% and 60.5%, respectively. Reduced burnout was reported by approximately half of the participants. These findings reflect nurses' perceptions of technology-related consequences rather than objectively measured changes in clinical outcomes, error rates, job satisfaction, or burnout.

Table 6. Multiple Linear Regression Analysis of Factors Associated With Workflow Efficiency (n = 185)

Predictor	Standardized β	SE	t	p-value	95% CI for β
Technology user-friendliness	0.261	0.052	5.02	<0.001	0.158 to 0.364
Training adequacy	0.243	0.106	2.29	0.023	0.034 to 0.452
Technical-support availability	0.184	0.066	2.79	0.006	0.054 to 0.314
Age	−0.223	0.105	−2.12	0.035	−0.430 to −0.016
Nursing experience	0.087	0.089	0.98	0.328	−0.089 to 0.263
Technology experience	0.098	0.053	1.85	0.066	−0.007 to 0.203
Educational level	0.076	0.061	1.25	0.213	−0.044 to 0.196
Gender	0.042	0.073	0.58	0.563	−0.102 to 0.186

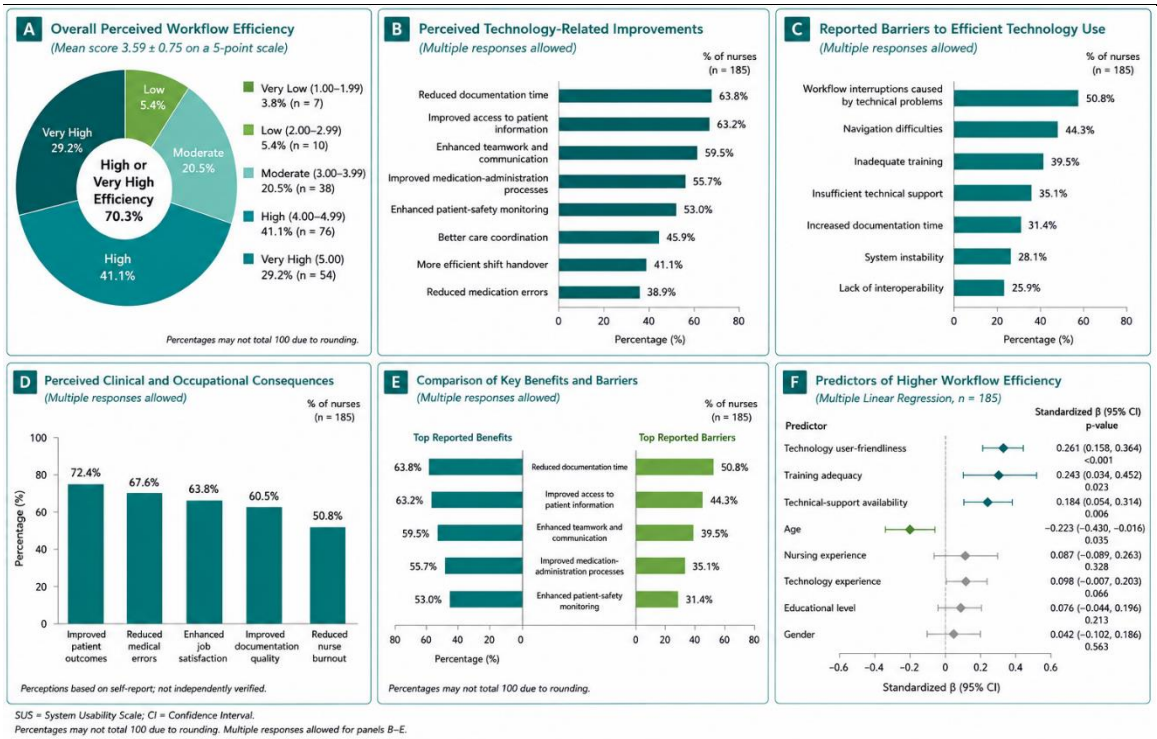

Figure 1 summarizes nurses' perceptions of healthcare technology use and workflow efficiency across two governmental hospitals in Multan (n = 185). Overall, 70.3% of participants reported high or very high workflow efficiency, with a mean score of 3.59 ± 0.75. The most frequently perceived benefits were reduced documentation time (63.8%), improved access to patient information (63.2%), enhanced teamwork and communication (59.5%), improved medication-administration processes (55.7%), and enhanced patient-safety monitoring (53.0%). The leading barriers were workflow interruptions caused by technical problems (50.8%), navigation difficulties (44.3%), inadequate training (39.5%), insufficient technical support (35.1%), and increased documentation time (31.4%). Nurses also perceived improved patient outcomes (72.4%), reduced medical errors (67.6%), enhanced job satisfaction (63.8%), improved documentation quality (60.5%), and reduced burnout (50.8%). In the adjusted regression analysis, technology user-friendliness, training adequacy, and technical-support availability were positively associated with workflow efficiency, whereas age showed an inverse association; nursing experience, technology experience, educational level, and gender were not statistically significant predictors.

In the adjusted regression analysis, technology user-friendliness showed the strongest positive association with workflow efficiency (β = 0.261, 95% CI: 0.158–0.364; p < 0.001). Training adequacy (β =

0.243, 95% CI: 0.034–0.452; p = 0.023) and technical-support availability (β = 0.184, 95% CI: 0.054–0.314; p = 0.006) were also independently associated with higher workflow-efficiency scores.

Age was inversely associated with workflow efficiency after adjustment for the other model variables (β = −0.223, 95% CI: −0.430 to −0.016; p = 0.035). Technology experience showed a positive but statistically inconclusive association (β = 0.098, 95% CI: −0.007–0.203; p = 0.066). Nursing experience, educational level, and gender were not independently associated with workflow efficiency at the prespecified significance threshold.

Taken together, the findings indicate that nurses generally perceived healthcare technology as beneficial to workflow, particularly for documentation and access to information. Nevertheless, technical interruptions, navigation problems, inadequate training, and limited technical support remained common. The adjusted analysis suggests that modifiable implementation factors—especially system user-friendliness, training adequacy, and technical-support availability—were more consistently associated with perceived workflow efficiency than most demographic and professional characteristics.

DISCUSSION

This study found that registered nurses working in two governmental hospitals generally perceived healthcare technology as beneficial to their workflow. The mean workflow-efficiency score was 3.59 out of 5, and 70.3% of participants rated their efficiency as high or very high. The most frequently perceived benefits were reduced documentation time, improved access to patient information, enhanced teamwork and communication, and improved medication-administration processes. Nevertheless, technology-related problems remained common: approximately half of the participants reported workflow interruptions caused by technical problems, and more than two-fifths reported navigation difficulties. In the adjusted analysis, technology user-friendliness, training adequacy, and technical-support availability were positively associated with workflow efficiency, whereas age showed an inverse association. These findings indicate that the perceived value of digital technology depends not only on its availability but also on its usability and the organisational conditions supporting its implementation.

The high proportion of nurses reporting improved workflow is consistent with evidence that electronic systems can facilitate faster retrieval of clinical information, reduce reliance on paper records, and support information exchange among healthcare professionals (3,4). Previous multi-site and time-motion studies have similarly reported improvements in information accessibility and selected documentation processes following EHR implementation (21,22). Mobile documentation may further improve efficiency by allowing nurses to enter and retrieve information closer to the point of care rather than repeatedly moving between patient areas and fixed workstations (8,23). In the present study, reduced documentation time and improved access to patient information were reported by 63.8% and 63.2% of participants, respectively. These findings support the proposed usefulness of digital systems but represent nurses' perceptions rather than objectively recorded time savings.

The results also demonstrate that nurses' experiences were not uniformly favourable. Although 63.8% reported reduced documentation time, 31.4% identified increased documentation time as a barrier. This apparent contrast may reflect differences in system configuration, user proficiency, ward demands, connectivity, or the extent to which electronic processes were integrated with existing clinical routines. EHRs may accelerate information retrieval while simultaneously increasing the number of screens, fields, alerts, or authentication steps required to complete documentation. Previous research has linked poorly designed interfaces with navigation difficulties, increased cognitive workload, workflow fragmentation, and documentation burden (6,7,24–26). Consequently, overall efficiency scores may conceal substantial variation across users, tasks, shifts, and clinical settings.

Technical interruptions were the most commonly reported barrier, affecting 50.8% of the participants. System downtime, unstable connectivity, slow response times, device unavailability, and software errors

can interrupt clinical tasks and require nurses to repeat or postpone documentation. These disruptions may be particularly consequential during medication administration, patient deterioration, shift handover, and other time-sensitive activities. The finding supports a socio-technical interpretation in which technology performance cannot be separated from infrastructure, clinical processes, and organisational support (13). Healthcare institutions should therefore evaluate technology implementation as a continuing workflow-redesign process rather than a one-time installation exercise.

Technology user-friendliness demonstrated the strongest positive association with workflow efficiency. This finding is consistent with the Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology, both of which identify perceived ease of use, perceived usefulness, and facilitating conditions as important determinants of technology adoption (11,12). Systems that use intuitive navigation, consistent terminology, clinically logical screen sequences, and minimal duplicate entry are more likely to be incorporated efficiently into nursing practice. Conversely, systems requiring complex navigation or excessive data entry may reduce productivity even when they offer technically advanced functions.

Training adequacy was also independently associated with workflow efficiency. Effective implementation requires more than a brief orientation before system deployment. Nurses need opportunities to practise common and high-risk scenarios, receive feedback, develop troubleshooting skills, and update their competencies when software or workflows change. Previous studies have found that structured, practical, and simulation-based training can improve nurses' confidence and documentation performance (14,27,28). Training should also be adapted to clinical roles and prior technology experience rather than delivered as a uniform programme to all users.

The positive association between technical-support availability and workflow efficiency further emphasises the organisational component of technology adoption. Accessible support may reduce the duration of interruptions, prevent unsafe workarounds, and increase users' confidence that technical problems will be resolved promptly. Previous studies have similarly linked responsive technical support with more favourable technology adoption and fewer workflow disruptions (15,29). Support systems should include clearly defined reporting procedures, rapid assistance during clinical shifts, escalation pathways for recurrent problems, and feedback mechanisms through which nurses can contribute to system improvement.

Age showed an inverse association with perceived workflow efficiency after adjustment for the other included variables. Similar age-related differences in technology acceptance have been reported in nursing populations (16). However, this finding should not be interpreted as evidence that older nurses are inherently less capable of using healthcare technology. Age may act as a proxy for differences in prior digital exposure, confidence, training opportunities, or familiarity with specific interface conventions. Research indicates that technology experience and appropriately designed training can reduce or eliminate age-related differences in adoption (30). Institutions should therefore provide inclusive and needs-based support rather than relying on age-based assumptions.

Participants also perceived broader clinical and occupational benefits, including improved patient outcomes, reduced medical errors, enhanced job satisfaction, improved documentation quality, and reduced burnout. These findings are compatible with the proposed ability of digital systems to improve information completeness, medication safety, communication, and clinical monitoring (1,3,4). However, these variables were assessed through nurses' self-reports and were not verified using patient records, incident reports, validated burnout instruments, or administrative data. The results should therefore be interpreted as perceived consequences rather than demonstrated changes in clinical outcomes or workforce well-being.

The coexistence of substantial perceived benefits and frequent barriers reinforces the importance of a socio-technical approach to digital health implementation. Technology effectiveness is shaped by

interactions among software design, infrastructure, clinical tasks, staffing, organisational culture, training, and support (13,31). In resource-constrained healthcare settings, limitations in connectivity, equipment maintenance, and informatics support may further affect implementation (17). Hospitals adopting digital systems should involve nurses in system selection, usability assessment, workflow mapping, pilot testing, and post-implementation evaluation. Their direct participation may help identify unnecessary documentation steps and system features that do not correspond with bedside practice.

This study has several strengths. It examined multiple implementation-related factors within a clinical environment that had transitioned from paper-based to electronic documentation, included nurses from both medical and surgical wards, and used internally consistent measures of workflow efficiency, usability, training adequacy, and technical support. The multivariable analysis also allowed the associations of modifiable organisational factors to be examined while accounting for selected demographic and professional characteristics.

Several limitations should be considered. The cross-sectional design does not establish whether healthcare technology or the identified predictors caused changes in workflow efficiency. Convenience sampling may have introduced selection bias, and nurses with stronger opinions or greater interest in technology may have been more likely to participate. The study was restricted to medical and surgical wards in two governmental hospitals in Multan; consequently, the findings may not apply to private hospitals, primary-care facilities, specialised units, or other geographical regions. The outcomes were self-reported and may have been influenced by recall bias, social-desirability bias, and common-method variance. Objective indicators such as documentation time, electronic audit logs, walking distance, medication-error records, patient outcomes, and validated burnout scores were not assessed. In addition, EHRs, mobile nursing stations, and AI-assisted systems were considered collectively, preventing technology-specific effects from being distinguished. Longitudinal, mixed-methods, and time-motion studies are needed to evaluate how workflow changes over time and to determine whether perceived improvements correspond with objectively measured clinical and organisational outcomes.

CONCLUSION

Registered nurses in two governmental hospitals generally perceived healthcare technology as supporting workflow efficiency, particularly by improving access to patient information, documentation processes, and professional communication. However, technical interruptions, navigation difficulties, inadequate training, and insufficient technical support remained common. Greater technology user-friendliness, training adequacy, and technical-support availability were independently associated with higher perceived workflow efficiency, while age showed an inverse association. These findings indicate that the successful integration of healthcare technology into nursing practice depends on usable systems and sustained organisational support rather than technology acquisition alone.

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