Electronic Medical Records and Healthcare Worker Efficiency in a Nigerian Tertiary Hospital

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ABSTRACT

Introduction:

Electronic Medical Records (EMRs) have transformed healthcare by improving documentation, communication, and patient care efficiency. However, challenges such as inadequate training, poor infrastructure, and resistance to adoption continue to hinder their effectiveness, particularly in low- and middle-income countries (LMICs). This study assessed the effectiveness of EMRs in improving workflow efficiency and identified barriers to their adoption among healthcare workers at Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nigeria.

Methods

A descriptive cross-sectional study was conducted among 299 healthcare workers at NAUTH. Data were collected using a structured, self-administered questionnaire assessing workflow processes, self-reported time efficiency, operational challenges, and barriers related to EMR use. The questionnaire was developed from published literature, reviewed by five subject matter experts, and pilot-tested in 20 staff members. Internal consistency was assessed using Cronbach's alpha ($\alpha = 0.78$). A paired sample t-test compared self-reported documentation time under both paper-based and EMR systems among the same respondents, enabling within-subject comparison within the cross-sectional framework.

Results

The majority of participants (63.6%) agreed that EMR workflows were well-structured and efficient, with 77.2% reporting that EMRs handle time-sensitive activities effectively. Significant challenges included poor power supply (50.2%), difficulty using EMR software (39.8%), and limited technical knowledge (36.1%). Barriers to adoption included lack of EMR training (86.6%), limited computer access (72.6%), and inadequate technical support (62.2%). A statistically significant reduction in documentation time was found: EMRs required a mean of 8.76 ± 9.09 minutes compared to 21.10 ± 15.03 minutes for paper-based systems (mean difference = 12.34 minutes; $t = 20.73$; $p < 0.001$).

Conclusion

EMRs significantly improve workflow efficiency and reduce documentation time compared to traditional paper-based systems. However, inadequate infrastructure, insufficient training, and limited technical support continue to hinder optimal adoption. Targeted, multi-level interventions addressing these barriers are essential for maximising EMR benefits in Nigerian tertiary healthcare settings.

Keywords-Electronic Medical Records; workflow efficiency; healthcare workers; time efficiency; Nigeria; digital health; LMIC

INTRODUCTION

Hospital staff represent a critical healthcare resource, and their effective utilisation is fundamental to achieving quality care and meeting national health objectives (Elikwu et al., 2020). Health information plays a central role in monitoring and improving healthcare programmes and services, and Healthcare Information Technology (HIT), particularly Electronic Medical Records (EMRs), has substantially transformed the healthcare industry by reducing waste and improving health outcomes (Baumann et al., 2018). However, the growing burden of documentation and administrative tasks has progressively reduced time available for direct patient care and meaningful communication, contributing to staff dissatisfaction and burnout (Wisner et al., 2019). Evidence suggests that up to 49% of hospital physicians experience burnout, which adversely affects care quality and escalates healthcare costs (Stanhope & Matthews, 2019). Optimising staff time allocation is therefore essential for improving patient care efficiency and outcomes.

The widespread adoption of EMRs was anticipated to streamline information sharing, reduce documentation time, and increase direct patient care time (Stanhope & Matthews, 2019). EMRs, often augmented with computerised physician order entry (CPOE) and clinical decision support systems, offer potential benefits including improved documentation quality, reduced administrative burdens, and enhanced management of chronic conditions (Stanhope & Matthews, 2019; Fennelly et al., 2021; Ayaad et al., 2019). Nonetheless, realising these benefits has proven challenging due to suboptimal adoption and inconsistent utilisation in clinical practice (De Groot et al., 2020; Ondogan et al., 2023). Additional concerns include the relative absence of patient-centred outcomes in EMR design (Bail et al., 2022; Østensen et al., 2020), as well as ethical considerations and cognitive overload among end-users (Jacquemard et al., 2020; De Groot et al., 2019; Tolentino & Gephart, 2021; Wisner et al., 2019).

The global transition from paper-based to electronic records gained momentum in the 1990s, driven by technological advancements and advocacy from leading institutions such as the Institute of Medicine (Baumann et al., 2018). Despite demonstrated benefits—including improved service quality and reduced operational costs (Ayaad et al., 2019)—EMR adoption remains limited in LMICs, including Nigeria, where implementation is further constrained by inadequate infrastructure, insufficient workforce capacity, and systemic institutional barriers (Agyemang et al., 2023; Tsai et al., 2020).

This study addresses a critical evidence gap regarding the effectiveness of EMRs in improving workflow efficiency in Nigeria, where published data remain scarce (Ayaad et al., 2019). By evaluating time efficiency, identifying operational challenges, and exploring barriers to adoption, this study contributes to the evidence base for targeted, context-appropriate interventions aimed at workflow optimisation and sustainable EMR implementation. The findings are intended to inform health managers, policymakers, and implementation scientists in Anambra State and across sub-Saharan Africa.

METHODS

Study Setting

This study was conducted at Nnamdi Azikiwe University Teaching Hospital (NAUTH), a federal government tertiary institution in Nnewi, Anambra State, Nigeria. NAUTH provides primary, secondary, and tertiary healthcare services and serves as a major referral centre for Anambra State and neighbouring regions. Established in 1988, the hospital operates ancillary training institutions and has an operational EMR system deployed across its clinical departments, providing an appropriate context for this investigation.

Study Design

A descriptive cross-sectional design was employed to capture a population-level snapshot of perceptions, practices, and reported outcomes at a single point in time. Although cross-sectional designs typically preclude

within-subject comparisons, the paired sample t-test used in this study was applied to data from the same respondents who reported documentation time under both systems—with paper-based time estimated retrospectively based on prior experience. This within-subject paired structure, embedded within the cross-sectional survey, justifies the use of a paired test statistic. The retrospective nature of paper-based time estimates introduces recall elements, which are acknowledged as a limitation.

Study Population and Eligibility Criteria

The study population comprised healthcare workers at NAUTH directly involved in patient care, including doctors, nurses, medical laboratory scientists, radiographers, physiotherapists, and ward assistants. Participants were eligible if they had worked at NAUTH for at least six months and provided informed consent. Those with less than six months of service or who declined participation were excluded to ensure respondents had sufficient EMR experience.

Sample Size and Sampling Technique

The minimum sample size was calculated using Cochran's formula, based on a 95% confidence level, a 5% margin of error, and a 23% estimated prevalence of the attribute under investigation derived from prior literature, yielding a minimum of 273 participants. This was adjusted to 299 after accounting for a 10% attrition rate. A mixed sampling technique combining stratified and systematic random sampling was employed to ensure proportional representation across six professional subgroups.

Data Collection Instrument

Data were collected using a structured, self-administered questionnaire divided into six sections. Section A captured socio-demographic characteristics. Sections B through E assessed: (B) workflow processes, (C) self-reported time efficiency for patient data access and documentation under both systems, (D) operational challenges, and (E) barriers to EMR adoption.

The questionnaire was developed through a systematic process informed by published literature on EMR implementation in LMICs. Content validity was established through expert review by five subject matter experts comprising two community medicine physicians, one health information management specialist, and two senior nurses, who evaluated items for relevance, clarity, and representativeness. The instrument was subsequently pilot-tested among 20 NAUTH staff (not included in the main study) to assess item clarity, response format suitability, and completion time, with minor wording adjustments made based on feedback. Internal consistency of the Likert-scaled items (Sections B and E) was assessed using Cronbach's alpha, yielding $\alpha = 0.78$, considered acceptable for exploratory research instruments.

Time efficiency data (Section C) were self-reported: respondents estimated average documentation time under both the current EMR system and the prior paper-based system based on direct experience. This approach is susceptible to recall and social desirability biases, as discussed in the Limitations section.

Data Analysis

Data were analysed using IBM SPSS Statistics, Version 27.0. Descriptive statistics (means, standard deviations, frequencies, and percentages) summarised socio-demographic characteristics and survey responses. A paired sample t-test compared mean self-reported documentation time between paper-based systems and EMRs, as both measurements were obtained from the same respondents. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine, Nnamdi Azikiwe University Teaching Hospital. Oral informed consent was obtained from all participants. Participation was voluntary, with the right to withdraw at any time. Confidentiality was maintained through anonymisation of all questionnaires.

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RESULTS

Socio-demographic Characteristics

A total of 299 participants were enrolled. The majority were female (n = 208; 69.6%), and nearly half (n = 146; 48.8%) were under 30 years of age. The mean age was 32.16 ± 8.43 years. Most respondents were single (74.2%), and the majority held graduate (43.1%) or postgraduate (28.1%) qualifications. Respondents were distributed across health science (34.8%), administrative (33.8%), and medical and surgical (31.4%) departments. Detailed data are presented in Table 1.

Table 1: Socio-demographic characteristics of study participants (n = 299)

Variable	**Category**	**Frequency (n)**	**Percentage (%)**	**Mean ± SD**
Sex	Male	91	30.4	–
	Female	208	69.6	
Age (years)	< 30	146	48.8	32.16 ± 8.43
	30–39	95	31.8	
	40–49	51	17.1	
	≥ 50	7	2.3	
Marital Status	Single	222	74.2	–
	Married	77	25.8	
Level of Education	Secondary Certificate	32	10.7	–
	Diploma	54	18.1	
	Graduate	129	43.1	
	Postgraduate	84	28.1	
Department	Administrative	101	33.8	–
	Health Science	104	34.8	
	Medical & Surgical	94	31.4	

Workflow Processes

Regarding EMR workflow perceptions, 63.6% agreed or strongly agreed that workflows were well-structured and aligned with the hospital's operational needs. A large majority (77.2%) indicated EMRs were capable of handling time-sensitive activities, and 71.2% reported fewer documentation and communication bottlenecks with EMR use. Furthermore, 77.3% agreed the system accommodated evolving clinical needs, 73.6% believed EMR adoption would enhance workflow efficiency, and 83.3% considered EMR performance superior to manual methods. Detailed response distributions are in Table 2.

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Table 2: Participant responses on EMR workflow processes (n = 299)

Statement	SD n (%)	D n (%)	U n (%)	A n (%)	SA n (%)
Methods exist to evaluate whether EMR workflows fit current hospital needs	32 (10.7)	20 (6.7)	57 (19.1)	141 (47.2)	49 (16.4)
EMR workflows handle time-sensitive clinical activities	15 (5.0)	32 (10.7)	21 (7.0)	128 (42.8)	103 (34.4)
Communication and documentation bottlenecks are less frequent with EMRs	21 (7.0)	23 (7.7)	42 (14.0)	139 (46.5)	74 (24.7)
The EMR system accommodates new and evolving clinical needs	17 (5.7)	18 (6.0)	33 (11.0)	139 (46.5)	92 (30.8)
Adoption of EMRs will increase overall workflow efficiency	21 (7.0)	25 (8.4)	33 (11.0)	81 (27.1)	139 (46.5)
EMR performance is far superior to manual (paper-based) methods	18 (6.0)	14 (4.7)	18 (6.0)	106 (35.5)	143 (47.8)

SD = Strongly Disagree; D = Disagree; U = Uncertain; A = Agree; SA = Strongly Agree

Time Efficiency

Self-reported documentation time data indicated that 45.8% of participants spent 3–22 minutes on paper-based documentation, while 42.5% spent 23–42 minutes. Using EMRs, 83.6% reported spending only 1–15 minutes on equivalent tasks. A paired sample t-test demonstrated a statistically significant difference: mean documentation time was 21.10 ± 15.03 minutes for paper-based systems versus 8.76 ± 9.09 minutes for EMRs (mean difference = 12.34 minutes; $t = 20.73$; $p < 0.001$). Results are presented in Table 3.

Table 3: Paired sample t-test comparing self-reported documentation time: paper-based systems vs. EMRs (n = 299)

Documentation Modality	Mean ± SD (minutes)	Mean Difference (minutes)	t-statistic	p-value
Traditional paper-based system	21.10 ± 15.03	12.34	20.73	< 0.001
Electronic Medical Records (EMR)	8.76 ± 9.09	–	–	–

Note: Time estimates are self-reported. Paper-based estimates based on retrospective recall of prior practice.

Challenges Related to EMR Use

Poor power supply and electrical faults were the most frequently cited challenge (50.2%), followed by difficulty using EMR software and inadequate staff training (39.8%), and limited availability of computers and technical expertise (36.1%). Additional challenges included computer illiteracy (35.5%), poor internet connectivity (32.8%), and inadequate manpower (5.7%). Full data are presented in Table 4.

Table 4: Operational challenges related to EMR use reported by healthcare workers (n = 299)

Challenge	1st Choice (n)	2nd Choice (n)	Total (n)	Percentage (%)
Poor power supply and electrical faults	56	94	150	50.2
Difficulty using EMR software; inadequate staff training	60	59	119	39.8
Limited availability of computers and technical expertise	68	40	108	36.1
Computer illiteracy among staff	40	66	106	35.5
Poor internet connectivity and server maintenance issues	69	29	98	32.8
Inadequate manpower	6	11	17	5.7

Barriers to EMR Adoption

The most prevalent barrier was lack of formal EMR training (86.6%), followed by limited knowledge of EMR systems (73.6%), limited computer access (72.6%), and restricted internet connectivity (71.2%). Additional barriers included lack of steady power supply (66.9%), insufficient technical support (62.2%), lack of computer literacy (61.2%), lack of management support (56.9%), lack of perceived system quality (56.5%), lack of perceived information quality (56.2%), absence of EMR user manuals (53.8%), and negative attitudes towards EMR use (51.2%). Full data are presented in Table 5.

Table 5: Barriers to EMR adoption reported by healthcare workers (n = 299)

Barrier	Yes n (%)	No n (%)	Don't Know n (%)	Prevalence (%)
Lack of EMR training	259 (86.6)	34 (11.4)	6 (2.0)	86.6
Lack of knowledge on EMR systems	220 (73.6)	67 (22.4)	12 (4.0)	73.6
Limited computer access	217 (72.6)	67 (22.4)	15 (5.0)	72.6
Limited internet access	213 (71.2)	80 (26.8)	6 (2.0)	71.2
Lack of steady power supply	200 (66.9)	90 (30.1)	9 (3.0)	66.9
Insufficient technical support	186 (62.2)	91 (30.4)	22 (7.4)	62.2
Lack of computer literacy	183 (61.2)	104 (34.8)	16 (4.0)	61.2
Lack of management support	170 (56.9)	104 (34.8)	25 (8.4)	56.9
Lack of perceived system quality	169 (56.5)	109 (36.5)	21 (7.0)	56.5
Lack of perceived information quality	168 (56.2)	100 (33.4)	31 (10.4)	56.2
Absence of EMR user manuals	161 (53.8)	112 (37.5)	26 (8.7)	53.8
Negative attitude towards EMR	153 (51.2)	123 (41.1)	23 (7.7)	51.2

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DISCUSSION

This study examined the effectiveness of EMRs in improving workflow efficiency among healthcare workers at NAUTH, a federal tertiary hospital in south-eastern Nigeria. The findings reveal a complex picture: while EMRs demonstrably enhance documentation efficiency and workflow organisation, their optimal utilisation is significantly constrained by infrastructure deficits, skills gaps, and attitudinal barriers. These results carry important implications for digital health implementation science, health systems strengthening, and policy in Nigeria and the broader sub-Saharan African context.

Socio-demographic Profile and Workforce Readiness

The workforce at NAUTH is predominantly young (mean age 32.16 ± 8.43 years), female (69.6%), and relatively well-educated (71.2% with graduate or postgraduate qualifications). This profile is broadly consistent with comparable tertiary institutions in Ghana (Agyemang et al., 2023) and Turkey (Ondogan et al., 2023), suggesting that Nigerian teaching hospitals share similar workforce characteristics with other digitally transitioning health systems. The predominance of younger, educated staff represents a latent asset for EMR adoption—digital literacy tends to be higher among younger cohorts—yet this potential is evidently unrealised without structured training and sustained institutional support. This finding highlights the critical distinction between general educational attainment and domain-specific digital competency in EMR workforce planning.

EMR Workflow Efficiency: Perceptions and Mechanisms

The majority of participants affirmed that EMR workflows were well-structured (63.6%), capable of managing time-sensitive activities (77.2%), and superior to manual methods (83.3%). These perceptions align with the global evidence base supporting EMR-mediated workflow improvements (Ayaad et al., 2019; Bajwa et al., 2019; Campanella et al., 2016). The finding that 71.2% reported fewer bottlenecks with EMR use reflects the core value proposition of digital health systems: real-time information availability, reduced transcription errors, and more reliable clinical communication pathways. From an implementation science perspective, the fact that the EMR system at NAUTH is perceived as functionally adequate suggests that the primary impediments to optimal outcomes are extrinsic—namely infrastructure, capacity, and attitudinal factors—rather than intrinsic to the technology itself.

The finding that 73.6% believed EMR adoption would increase workflow efficiency represents a prospective orientation: many healthcare workers recognise the system's potential even while experiencing operational constraints. This attitudinal disposition, if strategically harnessed through participatory implementation approaches, could serve as a foundation for more intensive adoption campaigns and sustainable behaviour change.

Time Efficiency: Quantifying the EMR Advantage

The statistically significant reduction in documentation time from a mean of 21.10 minutes for paper-based systems to 8.76 minutes for EMRs ($p < 0.001$) has direct clinical implications. A reduction of approximately 12 minutes per documentation episode, aggregated across hundreds of daily clinical interactions in a busy tertiary hospital, represents a substantial liberation of clinical time that could be redirected towards direct patient care. This finding is consistent with Campanella et al. (2016), whose systematic review and meta-analysis demonstrated that EMR implementation reduces documentation time and improves health information quality, and with Vermeir et al. (2018), who observed that EMRs save time and mitigate document loss.

The contrast with Baumann et al. (2018)—whose systematic review found that electronic health record systems often increase documentation time, particularly in early post-implementation phases—suggests that contextual factors are critical mediators of outcomes. Differences in system design, interface complexity, user training levels, and implementation maturity may explain divergent findings. The relatively favourable time efficiency outcomes at NAUTH may reflect the maturation of the implementation and a degree of user adaptation over time.

Challenges and Barriers: Infrastructure, Capacity, and Behaviour

Poor power supply and electrical faults were cited by half of respondents (50.2%) as the primary operational challenge—a finding reflecting Nigeria's broader energy infrastructure deficit, which has long constrained digital transformation across sectors. This barrier requires coordinated action beyond the health sector, encompassing energy policy reforms and hospital-level investments in uninterruptible power supply infrastructure.

The finding that 86.6% of respondents lacked formal EMR training in a hospital with an operational EMR system represents a critical system failure. Training deficits of this magnitude likely contribute directly to sub-optimal system utilisation, user frustration, and avoidance behaviours. This is corroborated by Mukred et al. (2019), who identified lack of training and computer literacy as persistent and fundamental barriers to digital records adoption across multiple LMIC settings. The high prevalence of limited computer access (72.6%) and restricted internet connectivity (71.2%) reveals that hardware and connectivity remain foundational constraints, even before software proficiency is considered.

Negative attitudes towards EMR adoption (51.2%) merit specific attention from a behaviour change perspective. Such attitudes in this context are rarely irrational; they frequently reflect legitimate concerns about system usability, increased workload, or inadequate institutional support. Addressing these through co-design approaches—engaging end-users in EMR workflow design—and through transparent communication about system benefits and institutional commitments is a well-supported implementation strategy (Tsai et al., 2020). These findings collectively suggest that a multi-level implementation framework is required, encompassing individual-level training, team-level support, organisational infrastructure investment, and national policy engagement.

LIMITATIONS

Several limitations must be acknowledged. First, the use of self-reported data for both workflow perceptions and time efficiency estimates introduces social desirability bias, whereby respondents may over-report favourable perceptions or understate challenges. Second, documentation time under the paper-based system was collected retrospectively, based on participants' recall of prior practice, introducing recall bias that may have inflated the apparent EMR efficiency advantage. Third, this study was conducted at a single institution (NAUTH), limiting generalisability to other Nigerian tertiary hospitals, primary and secondary care facilities, or other LMIC contexts with different EMR systems, implementation histories, or workforce profiles. Fourth, the cross-sectional design precludes causal inference about the impact of EMR implementation on documentation efficiency. Fifth, the questionnaire did not objectively measure digital literacy or system usage logs, which would have provided more objective proxies for EMR competency and utilisation. Future research should employ longitudinal designs, direct time-motion observation methodologies, and multi-site sampling to address these limitations.

CONCLUSION

This study demonstrates that EMRs offer significant advantages over traditional paper-based documentation in a Nigerian tertiary hospital, particularly regarding time efficiency and workflow organisation. The statistically significant reduction in documentation time—from 21.10 to 8.76 minutes—underscores the system's potential to liberate clinical staff time for direct patient care. The high proportion of respondents who perceived EMRs as superior to manual methods further reflects broad recognition of the technology's value.

However, persistent barriers—rooted in inadequate training (86.6%), poor infrastructure, and attitudinal resistance—continue to prevent realisation of these benefits for a substantial proportion of the workforce. Addressing these barriers requires a coordinated, multi-level response: targeted and continuing EMR training embedded in professional development curricula; sustained investment in hospital-level ICT infrastructure; development and dissemination of user-friendly EMR guides; and management engagement to foster a supportive institutional culture for digital health adoption. Policymakers should ensure that national digital health strategies go beyond system deployment to encompass capacity building, infrastructure development, and behaviour change support. Multi-site longitudinal studies using objective time-motion methodologies are

recommended to more rigorously evaluate EMR impact and the effectiveness of implementation interventions in comparable LMIC settings.

Conflict of Interest

The authors declare no conflict of interest.

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Author Contributions

Chioma Ajator contributed to the conceptualisation and design of the study, data analysis, manuscript preparation, supervision of the research process, and critical review of the manuscript at all stages. Chukwuma Obiagwu and Ebuka Okolie were responsible for data collection, data analysis, and preparation of the initial manuscript draft. Collins Alutu, Moses Ohamaeme, Irene Okeke, Sampson Ita, Somtochukwu Obu, Onyinye Nwazor, and Echendu Adinma contributed to manuscript review, provided critical revisions, and approved the final version for publication. All authors read and approved the final manuscript.

Ethical Approval

Ethical approval for this study was obtained from the Ethics Committee of the Faculty of Medicine, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria. The study was conducted in accordance with established ethical standards for research involving human participants. Informed consent was obtained from all participants. Participation was entirely voluntary, and respondents were informed of their right to withdraw at any time. Confidentiality was maintained through anonymisation of all questionnaires, and data were stored and handled securely.

Data Availability Statement

The datasets generated and/or analysed during the current study are not publicly available due to confidentiality and institutional restrictions but may be obtained from the corresponding author upon reasonable request.

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