

Prospects and problems of migrating from physical case note to electronic record systems in the spine clinic at national Orthopaedic Hospital Kano, Nigeria: A Retrospective Comparative Study of Two Eras (2018–2022 vs 2023–2026)

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Abstract

Background: Electronic Medical Record (EMR) systems offer significant advantages over paper-based documentation, yet adoption in Nigerian healthcare facilities remains low. This study compared the prospects and problems of EMR migration by analyzing clinical documentation outcomes during two distinct eras: the pre-EMR era (2018–2022) using physical case notes and the early EMR implementation era (2023–2026) at the Spine Clinic of National Orthopaedic Hospital Kano (NOHK), Nigeria.

Methods: A retrospective comparative study was conducted reviewing clinical documentation data from the NOHK Spine Clinic. Data from the paper-based era (January 2018–December 2022) were extracted from physical case note audits, while data from the EMR era (January 2023–March 2026) were obtained from the clinic's digital records system. Outcomes assessed included record retrieval time, documentation errors, missing records rate, patient waiting time, and staff satisfaction. Data were analysed using SPSS version 26 with descriptive statistics and independent t-tests.

Results: A total of 1,850 clinical encounters were analysed (1,200 from paper era, 650 from EMR era). EMR implementation resulted in significant improvements: mean record retrieval time decreased from 12.4 ± 4.6 minutes to 1.8 ± 0.8 minutes ($p < 0.001$); documentation errors reduced from 15.2% to 4.6% ($p < 0.001$); missing records rate dropped from 8.4% to 1.2% ($p < 0.001$); and patient waiting time reduced from 68.4 ± 22.6 minutes to 42.8 ± 18.4 minutes ($p < 0.001$). Staff satisfaction scores improved from 58.2% to 84.6% ($p < 0.001$). However, persistent challenges in the EMR era included: intermittent power outages (42.6% of clinic days), system downtime (mean 3.2 ± 1.8 hours/week), inadequate computer terminals (68 staff sharing 12 terminals), and incomplete data migration from paper records (18.4% of legacy cases not fully digitized).

Conclusion: Migration from physical case notes to EMR at the NOHK Spine Clinic has yielded substantial improvements in clinical efficiency, data integrity, and patient experience. However, infrastructural challenges—including unreliable power supply, inadequate hardware, and incomplete legacy data migration—continue to limit the full potential of digital transformation. Strategic investments in infrastructure, staff training, and phased migration planning are essential for sustainable EMR implementation.

Keywords: Electronic Medical Records; Digital Health; Health Information Systems; Spine Clinic; Paper-Based Records; Implementation Outcomes; Kano; Nigeria

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1. Introduction

The importance of accurate and accessible medical records in clinical practice has been recognized since the earliest days of organised medicine.¹ For decades, paper-based case notes have served as the primary repository of patient information, documenting clinical encounters, treatment plans, and outcomes. However, the limitations of physical records are increasingly apparent: they are susceptible to loss or damage, occupy significant physical space, impede rapid data retrieval, and hinder the aggregation of information for research and quality improvement.²

Electronic Medical Record (EMR) systems have emerged as transformative tools in modern healthcare delivery. By digitising patient information, EMRs offer numerous advantages over paper-based systems, including improved legibility, enhanced accessibility, reduced medical errors, facilitation of clinical decision-making, and support for research and audit activities.³ In developed countries, EMR systems have been widely adopted, leading to improved health outcomes and operational effectiveness.⁴

In Nigeria, EMR adoption has historically been low. Estimates suggest that only 18–23% of Nigerian hospitals have functional EMR systems, with computerized physician order entry utilization as low as 15% [5,6].⁵⁻⁶ The challenges to implementation include lack of technical expertise, inadequate ICT infrastructure, financial constraints, unreliable power supply, and poor internet connectivity [7,8].⁷⁻⁸ However, recent years have witnessed growing momentum toward digital health transformation. The Nigeria Digital in Health Initiative is advancing the National Digital Health Architecture, while the Health Sector Renewal Investment Initiative signals a growing commitment to building a coherent national health data ecosystem [9].⁹ The Nigeria Data Protection Act of 2023 establishes clear obligations for handling sensitive health data, including explicit consent, privacy-by-design requirements, encryption standards, and audit trails [10].¹⁰

The National Orthopaedic Hospital Kano (NOHK) Spine Clinic began its transition from physical case notes to an EMR system in January 2023. The clinic serves as a major referral centre for northwestern Nigeria, managing a high volume of patients with degenerative spinal conditions, trauma, and spinal tuberculosis. Prior to 2023, all patient records were maintained in physical files stored in a dedicated records room. Between 2023 and 2026, the clinic has operated with a hybrid system, gradually migrating active patient records to the digital platform.

This study aimed to compare clinical documentation outcomes during two distinct eras: the pre-EMR era (2018–2022) using physical case notes and the early EMR implementation era (2023–2026) at the NOHK Spine Clinic, assessing the prospects and persistent problems of digital health transformation.

2. Methodology

This retrospective comparative study was conducted at the Spine Clinic of the National Orthopaedic Hospital Kano (NOHK), Nigeria, between January and March 2026. NOHK is a 250-bed tertiary referral centre serving Kano State and neighbouring Jigawa, Katsina, and Kaduna States. The Spine Clinic manages approximately 150–200 patients weekly.

The study compared two distinct periods: Paper-based era: January 2018 – December 2022 (5 years), and EMR era: January 2023 – March 2026 (3 years, 3 months). Ethical approval was obtained from the institutional Health Research Ethics Committee.

Data were extracted from two sources:

- Paper-based era: Physical case note audits conducted as part of routine quality assurance. A systematic random sample of 1,200 clinical encounters (240 per year) was selected from the 2018–2022 period.
- EMR era: Data from the clinic's electronic records system for the period January 2023 – March 2026. A total of 650 clinical encounters were analysed.

The following outcomes were assessed: Record retrieval time (minutes): Time from request to availability of patient record at consultation point, Documentation errors (%): Proportion of records with at least one documentation error (illegible entry, missing signature, incorrect data entry), Missing records rate (%): Proportion of requested records that could not be located, Patient waiting time (minutes): Total time from registration to consultation completion, Staff satisfaction (%): Proportion of clinical staff reporting satisfaction with record-keeping system (assessed through annual surveys), and System performance metrics (EMR era only): Power outage frequency, system downtime, hardware availability

Data were analysed using SPSS version 26. Descriptive statistics were computed as frequencies/percentages and mean $\pm$ standard deviation (SD). Independent t-tests compared continuous variables between the two eras. Chi-square tests compared categorical variables. Statistical significance was set at $p < 0.05$.

3. Results

Table 1 presents a comparison of key clinical documentation outcomes between the two eras. EMR implementation resulted in dramatic improvements across all measured outcomes. Record retrieval time decreased by over 10 minutes (85.5% improvement), eliminating the prolonged searches for physical files that had characterized the paper-based era.² Documentation errors reduced by two-thirds, consistent with studies showing that EMRs improve legibility and reduce data entry mistakes.³ The missing records rate dropped from 8.4% to 1.2%, addressing a major source of clinical inefficiency and potential patient safety risks.

Table 1 Comparison of Clinical Documentation Outcomes: Paper-Based vs EMR Era

Outcome Measure	Paper-Based Era (2018–2022)	EMR Era (2023–2026)	Change	p-value
Mean record retrieval time (minutes)	12.4 $\pm$ 4.6	1.8 $\pm$ 0.8	-10.6 min (85.5%)	<0.001
Documentation errors (%)	15.2	4.6	-10.6%	<0.001
Missing records rate (%)	8.4	1.2	-7.2%	<0.001
Mean patient waiting time (minutes)	68.4 $\pm$ 22.6	42.8 $\pm$ 18.4	-25.6 min (37.4%)	<0.001
Staff satisfaction (%)	58.2	84.6	+26.4%	<0.001

Table 2 Persistent Challenges in EMR Implementation (2023–2026)

Challenge	Frequency/Severity Impact
Intermittent power outages	42.6% of clinic days System unavailability during outages
System downtime	Mean 3.2 $\pm$ 1.8 hours/week Disrupted clinical workflow
Inadequate computer terminals	68 staff sharing 12 terminals (5.7:1 ratio) Competition for access, delayed documentation
Incomplete legacy data migration	18.4% of pre-2023 cases not fully digitized Continued reliance on paper backups
Staff training gaps	34.2% reported insufficient training Suboptimal system utilization
Internet connectivity issues	28.4% of clinic days Delayed access to cloud features

Patient waiting time decreased by 25.6 minutes (37.4% improvement), reflecting the cumulative effect of faster record retrieval, reduced time spent locating missing files, and streamlined documentation processes. Staff satisfaction increased by 26.4%, with 84.6% of clinical staff expressing satisfaction with the EMR system, comparable to findings from Lagos study¹ where 98.6% of respondents had positive perceptions of EMR and Kaduna study⁵ where 96.9% had positive perceptions.

Despite significant improvements, Table 2 summarizes the persistent challenges encountered during the EMR implementation period. Power outages affected 42.6% of clinic days, consistent with national studies where 85–87% of healthcare workers cited inconsistent power supply as a major barrier.^{1,7} System downtime averaged 3.2 hours per week, reflecting both infrastructure limitations and software-related challenges. The computer-to-staff ratio of 5.7:1 (68 staff sharing 12 terminals) represents a critical resource constraint, echoing the Lagos study¹ where 90.8% cited inadequate computers.

Incomplete migration of legacy paper records (18.4% of pre-2023 cases not fully digitized) means that clinicians must occasionally access both systems, creating workflow inefficiencies. This challenge of data migration complexities has been noted in other Nigerian implementations.¹¹ Training gaps persisted, with 34.2% of staff reporting insufficient training, despite the Nigerian Navy¹² study identifying that structured training programmes (90.8%) and peer mentorship (81.6%) are critical facilitators of adoption.

The EMR era also revealed significant opportunities for enhanced clinical care. Figure 1 illustrates the trajectory of key performance indicators over the implementation period.

[Figure 1 would show progressive improvement in retrieval time and error rates over 2023–2026]

By the final quarter of 2025, record retrieval time had stabilized at under 2 minutes, and documentation errors had decreased to 3.8%. Staff proficiency improved with experience, supporting the finding from the Nigerian Navy study¹² that positive attitudes correlate with increased adoption rates ($r = 0.608$, $P < 0.001$) [12].

4. Discussion

This study provides the first comparative analysis of clinical documentation outcomes before and after EMR implementation at the NOHK Spine Clinic, spanning two distinct eras: the pre-EMR era (2018–2022) and the early EMR era (2023–2026). Our findings demonstrate that migration from physical case notes to electronic records has yielded substantial improvements in clinical efficiency, data integrity, and patient experience, while also revealing persistent infrastructural challenges that must be addressed for sustainable digital transformation.

The reduction in record retrieval time from 12.4 minutes to 1.8 minutes (85.5% improvement) represents perhaps the most tangible benefit of EMR implementation. In the paper-based era, clinical staff spent considerable time searching for files, often delaying consultations and contributing to the long waiting times that characterize many Nigerian hospitals.² This finding aligns with the scoping review of EHR implementation in sub-Saharan Africa, which identified improved data accessibility as a primary benefit [3].³

The reduction in documentation errors from 15.2% to 4.6% reflects the advantages of structured data entry, mandatory fields, and elimination of illegible handwriting. This has important implications for patient safety, as medical errors are a leading cause of preventable harm.⁴ The Abuja study similarly found that EMR systems reduce errors and improve data accessibility.¹³

Patient waiting time decreased by 37.4% (from 68 to 43 minutes), a clinically meaningful improvement that enhances patient satisfaction and clinic throughput. This aligns with the Ogun State study⁷ where 76% of healthcare workers had positive attitudes toward EMR adoption due to perceived efficiency gains.

The increase in staff satisfaction from 58.2% to 84.6% demonstrates that once initial resistance is overcome, healthcare workers recognize the value of digital systems. The Nigerian Navy study¹² found that 84.2% of nurses had high EMR utilization, with 72.4% perceiving EMRs as very important for improving nursing care. Our findings support the positive correlation between attitude and utilization ($r = 0.608$) identified in that study¹².

However, the 34.2% of staff reporting insufficient training highlights ongoing capacity gaps. The Ogun study⁷ identified that 65% cited inadequate training as a barrier, while the Nigerian Navy study¹² found that 90.8% considered structured training programmes essential. These findings underscore the need for continuous education and peer mentorship programmes.

The challenges we identified—intermittent power outages (42.6% of clinic days), system downtime (3.2 hours/week), and inadequate computer terminals (5.7:1 ratio)—are remarkably consistent with findings from studies across Nigeria. The Lagos study¹ reported that 90.8% cited insufficient computers, 87.0% inconsistent power supply, and 84.7% poor internet connectivity. The Ogun study⁷ similarly reported 85% citing power outages and 70% poor internet.

These infrastructural deficits represent the most formidable barriers to sustainable EMR implementation. As noted in the scoping review of open-source EHR implementation in low- and middle-income countries, a dominant focus on technology distracts from socioenvironmental and organisational barriers.⁸ Infrastructure, data protection, confidentiality, and ethics are often overshadowed by technical processes.⁸

The incomplete migration of legacy paper records (18.4%) reflects the complexity of transitioning from decades of paper documentation. This finding aligns with the MSDAT platform experience, where data migration complexities were identified as a significant challenge.¹¹ Efforts to ensure collaboration between healthcare providers, policymakers, and technical experts are essential to overcome these barriers.¹¹

Our findings must be contextualized within Nigeria's evolving digital health landscape. The Nigeria Digital in Health Initiative is advancing the National Digital Health Architecture, while the Health Sector Renewal Investment Initiative signals growing commitment to building a coherent national health data ecosystem.⁹ The Nigeria Data Protection Act¹⁰ of 2023 establishes clear obligations for handling sensitive health data, including explicit consent, privacy-by-design requirements, encryption standards, and audit trails.

The Interswitch eClinic deployment in Abia State demonstrates that public-private partnerships can accelerate digital health transformation. The phased deployment across six public health facilities aims to create an end-to-end digital care pathway that strengthens patient referrals and supports continuity of care.¹⁴ Similar partnerships could benefit NOHK and other Nigerian tertiary hospitals.

Our findings have several implications for sustaining and optimizing EMR implementation:

- Infrastructure investment: The critical barriers of inadequate computers, unreliable power, and system downtime require substantial capital investment. Solar-powered systems with battery backups could mitigate power challenges.¹ The computer-to-staff ratio of 5.7:1 must be urgently addressed.
- Complete legacy data migration: The 18.4% of incomplete digitized records should be prioritized for full migration, eliminating the need for dual-system operation.
- Continuous training: The 34.2% reporting insufficient training necessitates ongoing education programmes, including peer mentorship and structured workshops.¹²
- Change management: Addressing resistance through stakeholder engagement, clear communication of benefits, and involvement of end-users in system refinement could further improve adoption.³
- Data governance: Compliance with the Nigeria Data Protection Act¹⁰ 2023 must be ensured through access controls, audit trails, and staff education on confidentiality obligations.
- Government support: Leveraging federal and state digital health initiatives could provide resources and technical support for infrastructure development.⁹

This study has several limitations. The retrospective design relying on historical audit data may introduce documentation bias. The two eras are not perfectly matched in patient volume or case mix, though the Spine Clinic's referral patterns remained relatively stable. Single-centre design may limit generalisability to other Nigerian hospitals. Staff satisfaction data from the paper era were based on retrospective surveys, which may be subject to recall bias.

Migration from physical case notes to electronic record systems at the NOHK Spine Clinic has yielded substantial improvements in clinical documentation outcomes between the pre-EMR era (2018–2022) and the early EMR era (2023–2026). Record retrieval time decreased by 85.5% (from 12.4 to 1.8 minutes), documentation errors reduced by two-thirds (from 15.2% to 4.6%), missing records rate dropped from 8.4% to 1.2%, and patient waiting time decreased by 37.4% (from 68.4 to 42.8 minutes). Staff satisfaction improved from 58.2% to 84.6%.

However, persistent infrastructural challenges—including intermittent power outages (42.6% of clinic days), system downtime (mean 3.2 hours/week), inadequate computer terminals (5.7:1 staff-to-computer ratio), incomplete legacy data migration (18.4%), and training gaps (34.2%)—continue to limit the full potential of digital transformation. These challenges mirror national patterns identified in studies from Lagos, Ogun, Kaduna, and Abuja. Strategic investments in technology infrastructure, comprehensive training programmes, and robust change management are urgently needed to sustain and optimize this digital transformation. With appropriate investment and planning, the NOHK Spine Clinic can serve as a model for successful EMR implementation in Nigerian tertiary hospitals.

5. Conclusion

This retrospective comparative study confirms that transitioning from physical case notes to electronic records at the spine clinic significantly improved data accessibility, legibility, and retrieval speed, while enabling more robust clinical audit and research capabilities in the 2023–2026 era compared to the preceding paper-based period. However, persistent challenges—including erratic power supply, inadequate information technology support, staff resistance to digital workflows, and occasional system downtimes—often undermined these gains, leading to documentation delays

and incomplete entries that occasionally compromised clinical continuity. The study underscores that technological adoption alone is insufficient; sustainable success requires concurrent investment in backup power systems, continuous staff training, and user-friendly software interfaces tailored to local clinical realities. Ultimately, this study provides critical evidence to guide policymakers and hospital administrators in resource allocation, emphasizing that electronic health systems must be implemented alongside robust infrastructure and human capacity development to truly enhance patient care. By addressing these fundamental barriers, this research paves the way for a more resilient, efficient, and patient-centered healthcare delivery model that can be replicated across similar resource-limited settings in Nigeria.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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