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DETERMINANTS OF ELECTRONIC HEALTH RECORD IMPLEMENTATION IN GOVERNMENT-OWNED HOSPITALS ACROSS CALABAR METROPOLIS, CROSS RIVER STATE, NIGERIA.

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ABSTRACT: *The implementation of Electronic Health Records (EHRs) has been promoted globally as a strategy for improving healthcare delivery, yet progress remains uneven in many public health facilities in Nigeria. In Calabar Metropolis, concerns persist regarding the level of EHR integration and the conditions required for effective utilisation. This study, therefore, examined the determinants of Electronic Health Record implementation in government-owned hospitals across Calabar Metropolis, Cross River State, Nigeria. The study was a facility-based cross-sectional study conducted among healthcare professionals across major professional groups. Data were collected using a structured, self-administered questionnaire, and a multistage sampling approach was used to ensure adequate representation across staff categories. Descriptive statistics and multivariate regression analysis were employed to analyse the data. The findings showed that the mean age of respondents was 39.27 ± 0.79 years; 63.06% were female, 32.34% constituted the largest professional group, and 79.94% were full-time staff. A total of 50.3% reported moderate EHR implementation, while 49.7% reported low implementation. Furthermore, respondents aged 30–39 years had significantly lower implementation impact scores compared to those aged less than 25 years (β = -5.227, 95% CI: -9.207 to -1.247, p = 0.010), while those with more than ten years of service reported significantly higher barrier scores (β = 13.281, 95% CI: 4.999 to 21.562, p = 0.002). The study highlights that while EHR systems are operational in Calabar Metropolis, sustainable digital transformation requires strengthening workforce capacity, institutional support structures, and infrastructural reliability. Thus, policymakers and hospital management should prioritize human resource readiness and supportive organizational frameworks alongside technological investment to achieve effective, sustainable EHR integration.*

KEYWORDS: Electronic Health Record Implementation, Government-owned Hospitals, Calabar Metropolis, Cross River State, Nigeria.

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INTRODUCTION

The growing reliance on digital technologies in healthcare has brought renewed attention to how patient information is generated, stored, and used within health systems [1,2]. In many settings, efforts to improve service delivery have increasingly focused on replacing fragmented paper-based records with more integrated electronic systems [3]. Among these, Electronic Health Records (EHRs) have emerged as a key component of health system strengthening, particularly in relation to information management and continuity of care [4,5]. Unlike traditional record-keeping approaches, EHR systems are designed to support real-time documentation and access to patient information across different points of service [6]. In practice, this means that clinical data, laboratory results, and treatment histories can be more readily available to authorised providers, potentially improving coordination of care and reducing delays associated with manual record retrieval [7,8].

However, the presence of an EHR system alone does not guarantee these benefits. The extent to which such systems improve healthcare delivery depends largely on how they are implemented and integrated into routine practice [9]. In many low- and middle-income countries, including Nigeria, the implementation of EHR systems represents a significant shift from long-established paper-based processes [10]. This transition is often complex, requiring not only technological infrastructure but also adjustments in workflow, staff capacity, and institutional support systems [11,12]. As a result, implementation tends to be uneven, with some facilities achieving partial integration while others continue to rely heavily on manual processes despite the availability of digital platforms [13].

Several constraints continue to shape how EHR systems function in practice. Challenges related to infrastructure, such as unstable electricity supply, limited internet connectivity, and inadequate hardware, can disrupt routine use [14]. At the organisational level, insufficient technical support, weak system coordination, and limited planning may further restrict effective utilisation [15]. In addition, differences in professional roles and experience can influence how healthcare workers engage with electronic systems, sometimes leading to variations in system use across departments and facilities [16].

In Nigeria, although there has been increasing emphasis on digital health initiatives, evidence suggests that the implementation of EHR systems within public hospitals remains inconsistent [17,18]. In some cases, systems are introduced but not fully embedded into daily clinical operations, limiting their contribution to service delivery [19]. This gap between system availability and actual use highlights the need to move beyond discussions of adoption and focus more closely on implementation realities within specific institutional contexts [20].

Despite the growing interest in digital health, there is still limited empirical evidence examining how EHR systems are being implemented across public healthcare facilities at the sub-national level [21]. In particular, there is a need to understand the extent of implementation, the structural conditions that support or constrain system use, and the practical challenges encountered by healthcare providers [22]. This study, therefore, examines the implementation of Electronic Health Records in government-owned hospitals in

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Calabar Metropolis, Nigeria. It focuses on the level of system implementation and the key barriers affecting effective integration into healthcare delivery.

MATERIALS AND METHODS

Study setting and data source

This study employed a facility-based, cross-sectional design using quantitative methods to examine the implementation of Electronic Health Records (EHRs) in government-owned hospitals across Calabar Metropolis, Cross River State, Nigeria. The research was conducted in five public healthcare institutions: University of Calabar Teaching Hospital, University of Calabar Medical Centre, Federal Neuropsychiatric Hospital Calabar, General Hospital Calabar, and Nigerian Navy Reference Hospital Calabar. Calabar Metropolis is located in the Southern Senatorial District of Cross River State and comprises Calabar Municipality and Calabar South Local Government Areas. The metropolis has a combined projected population of over 600,000 residents. It serves as an important administrative, commercial, and healthcare hub within the state, attracting patients from surrounding communities and neighbouring regions.

The selected hospitals function as key referral centres providing both preventive and curative healthcare services. In addition to routine clinical care, these institutions are actively involved in patient documentation, record keeping, and health information management. They operate across different levels of care and include specialised departments such as internal medicine, surgery, paediatrics, obstetrics and gynaecology, and laboratory services. Each facility also maintains units relevant to health information management, including medical records departments and information and communication technology (ICT) units.

The hospitals operate under the regulatory oversight of the Federal Ministry of Health and the Cross River State Ministry of Health, with guidance from professional bodies such as the Medical and Dental Council of Nigeria and the Health Records Officers Registration Board of Nigeria. These frameworks ensure adherence to standards relating to patient confidentiality, ethical practice, and proper management of health information.

Study population

The study population comprised healthcare professionals working in the selected hospitals who were involved in the use, management, and documentation of patient health information. This included Health Information Management practitioners, medical doctors, nurses, pharmacists, medical laboratory scientists, and ward clerks/desk officers. These professionals play complementary roles in generating, documenting, processing, and utilising patient information within both paper-based and electronic health record systems.

Sample size determination

A proportionate-to-size sampling technique was adopted to select participants across the different professional groups. The sample size for the study was determined using the Taro Yamane formula for finite populations:

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$$n = \frac{N}{1+N(e^2)} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

where n represents the required sample size, N is the total population (4,106), and e is the margin of error set at 5% (0.05). Substituting these values yielded a sample size of 364 respondents.

$$n = \frac{4{,}106}{1 + 4{,}106(0.05^2)} = \frac{4{,}106}{11.265} \approx 364 \ldots\ldots\ldots\ldots 2$$

Participants were then proportionally allocated across professional categories based on their representation within the study population. The final sample comprised 90 Health Information Management personnel, 80 medical doctors, 100 nurses, 30 pharmacists, 37 medical laboratory scientists, and 27 ward clerks/desk officers.

Sampling technique

A multistage sampling approach was adopted to ensure adequate representation of healthcare personnel across the five hospitals. In the first stage, stratification was done by institution, with the five selected hospitals serving as the primary strata. In the second stage, healthcare workers within each hospital were further stratified according to professional designation, including Health Information Management personnel, doctors, nurses, pharmacists, medical laboratory scientists, and ward clerks. This ensured that all cadres involved in patient record management and information processing were represented.
In the third stage, proportional allocation was applied such that the number of participants selected from each professional group reflected their relative size within the hospital workforce. Finally, eligible participants who met the inclusion criteria were selected within each stratum, ensuring fair representation across all groups.

Method of Data Collection

Data were collected through the administration of a structured questionnaire to eligible healthcare professionals across the selected hospitals. The questionnaire was designed in line with the study objectives and consisted of sections covering socio-demographic characteristics, level of EHR implementation, impact of EHR on healthcare delivery, and facilitators and barriers to implementation.
Completed questionnaires were retrieved on the spot, where possible, to reduce the likelihood of non-response. All returned copies were reviewed for completeness and consistency before being prepared for coding and subsequent analysis. Prior to the main study, the instrument was pretested among healthcare workers in similar facilities outside the study area to ensure clarity, relevance, and appropriateness of the items.

Data Analysis

Data were coded and analysed using the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise respondents' socio-demographic characteristics and describe patterns related to the implementation of Electronic Health Records (EHRs) across

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the study settings. Inferential analyses were conducted to address the study objectives. Associations between key variables were initially explored using appropriate statistical tests. Thereafter, separate multivariable linear regression models were fitted for each major outcome variable to identify determinants of EHR implementation outcomes.

Specifically:

i. One multiple linear regression model was fitted to assess predictors of perceived EHR implementation impact on healthcare delivery.

ii. A second model was fitted to identify factors associated with barriers to EHR use.

iii. A third model was fitted to examine determinants of facilitators of EHR implementation and use.

For each model, the dependent variable was computed as a composite score derived from Likert-scale items related to the construct of interest. Independent variables included respondents' socio-demographic and professional characteristics such as age, sex, professional category, years of service, and level of computer literacy.

The general multiple linear regression model was specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

where Y represents the dependent variable (EHR implementation impact or barrier score), β_0 is the intercept, $\beta_1 \ldots \beta_k$ are regression coefficients, $X_1 \ldots X_k$ represents the independent variables (such as age, professional category, and years of service), and ε is the error term. Regression coefficients (β\betaβ), 95% confidence intervals (CI), and corresponding p-values were reported to determine the strength and statistical significance of associations. Statistical significance was set at $p < 0.05$.

Ethical considerations

Ethical approval for the study was obtained from the relevant ethics committee of Rivers State University and the participating hospitals. Permission to conduct the study was also obtained from the management of the selected institutions. Written informed consent was secured from all participants prior to data collection. Participation was voluntary, and respondents retained the right to withdraw at any stage without consequence. Anonymity and confidentiality were strictly maintained, and no personal identifiers were collected. The study adhered to the principles of beneficence, non-maleficence, autonomy, and respect for participants throughout the research process.

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RESULTS

The data in Table 1 shows the socio-demographic characteristics of the respondents. The mean age of the respondents was 39.27 ± 0.79 years. The largest proportion of respondents (26.65%) was aged 30–39 years. Those aged 50 years and above accounted for 22.46%, while 19.16% were within 40–49 years. Similarly, more than half of the respondents (63.06%) were female, while 36.94% were male. Slightly over half (53.59%) were married, and 46.41% were single. All respondents (100.00%) identified as Christians.
Additionally, Health Information Management professionals formed the largest professional group (32.34%), while pharmacists constituted 6.89% of the respondents. The data further showed that half of the respondents (50.45%) possessed HND/BSc qualifications. Those with postgraduate qualifications made up 29.13%, while 20.42% held ND or technician-level qualifications. A majority of the respondents (79.94%) were full-time staff, while 20.06% were casual workers. Respondents with 5–10 years of service constituted 40.72% of the sample. Those with less than five years of service accounted for 38.62%, while 20.66% had more than ten years of service.

Table 1: Socio-Demographic Characteristics of Respondents

Variable	Frequency (n)	Percentage (%)
Age (years)		
Less than 25	45	13.47
25–29	61	18.26
30–39	89	26.65
40–49	64	19.16
50 and above	75	22.46
Mean Age		**39.27 ± 0 .79**
Gender		
Female	210	63.06
Male	123	36.94
Marital Status		
Married	179	53.59
Single	155	46.41
Religion		
Christian	334	100.00
Professional Category		
Doctors	40	11.98
Health Information Mgt	108	32.34
Medical Lab Scientists	62	18.56
Nurses	101	30.24
Pharmacists	23	6.89
Qualification		
ND/Technician	68	20.42
HND/BSc	168	50.45
Postgraduate	97	29.13

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Staff Status		
Casual	67	20.06
Full Time	267	79.94
Years of Service		
5–10 years	136	40.72
>5 years	129	38.62
>10 years	69	20.66

Table 2 presents the distribution of Electronic Health Record (EHR) implementation across public hospitals in Calabar Metropolis. The data shows that personnel were identified as the major (45.51%) resource available for EHR implementation, while 23.65% reported technical resources as the major resource available. The data also showed that visual training was the most (38.02%) reported mode of training, while seminars constituted 24.25%. The findings further indicate that the most frequently reported challenge during implementation was inadequate funding (31.94%), lack of computer and internet facilities accounted for 25.00%, while 22.22% of respondents identified unstable power supply as a constraint.
A large majority of respondents (90.42%) reported that data transmission was carried out manually, whereas only 9.58% indicated the use of electronic transmission. Similarly, data encryption was the most commonly reported strategy (45.51%) for cybersecurity measures, while cybersecurity systems and password-protected logins each accounted for 9.58%. A majority of the respondents (90.42%) reported organizing workshops as a capacity-building Strategy, whereas 9.58% mentioned conferences.

Table 2. Distribution of Implementation of EHR across Public Hospitals

Variable	Frequency (n)	Percentage (%)
Major Resource available for EHR implementation		
Personnel	152	45.51
Finance	103	30.84
Technical	79	23.65
Mode of healthcare workers' training on the new system		
Visual Training	127	38.02
Workshop	126	37.72
Seminars	81	24.25
Biggest challenges faced during the EHR implementation		
Inadequate funding	92	31.94
Lack of computer & internet facilities	72	25.00
Unstable power supply	64	22.22
Inadequate training	33	11.46
Lack of interoperability standards	27	9.38
Mode of Data Transmission		
Manual Transmission	302	90.42
Electronic Transmission	32	9.58
Cybersecurity Measure		

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Data encryption	152	45.51
Antivirus installation	150	44.91
Cyber security systems and Password-protected logins	32	9.58
Capacity Building Strategy		
Organize workshops	302	90.42
Conferences	32	9.58
Priority Improvement Area		
Interoperability	302	90.42
Post-installation maintenance	32	9.58

Fig 1 shows the level of EHR implementation. Approximately half (50.3%) of the respondents reported moderate implementation of EHR systems, while 49.7% reported low implementation. The overall mean implementation index was 1.50±0.50.

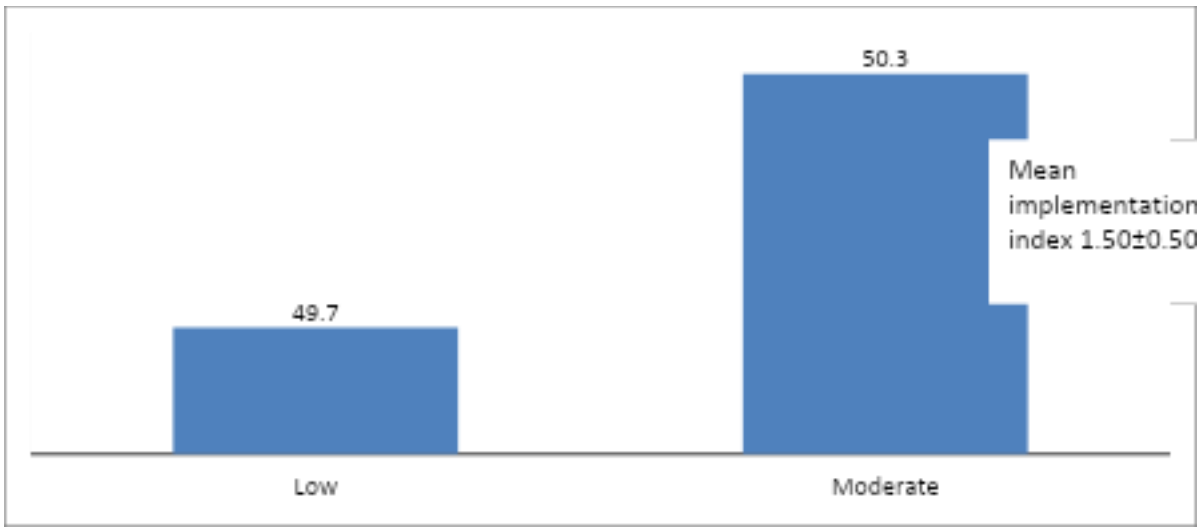

Figure 1: EHR Implementation Level

The data in Table 3 shows that respondents aged less than 25 years reported 46.67% (95% CI: 32.71–61.17) low EHR implementation and 53.33% (95% CI: 38.83–67.29) moderate EHR implementation. Among those aged 25–29 years, 27.87% (95% CI: 18.05–40.39) reported low implementation, while 72.13% (95% CI: 59.61–81.95) reported moderate implementation, representing the highest proportion of moderate implementation across age groups. Respondents aged 30–39 years recorded 70.79% (95% CI: 60.50–79.31) low implementation and 29.21% (95% CI: 20.69–39.50) moderate implementation.

Among female respondents, 50.00% (95% CI: 43.25–56.75) reported low implementation and 50.00% (95% CI: 43.25–56.75) reported moderate implementation. Similarly, married respondents reported 41.90% (95% CI: 34.87–49.28) low EHR implementation and 58.10% (95% CI: 50.72–65.13) moderate implementation. Single respondents reported 58.71% (95% CI: 50.78–66.21) low implementation and 41.29% (95% CI: 33.79–49.22) moderate implementation. Across professional groups, doctors reported 35.00% (95% CI: 21.91–50.83) low EHR implementation and 65.00% (95% CI: 49.17–78.09) moderate implementation. Health Information Management practitioners reported 38.89% (95% CI: 30.15–48.41) low implementation and 61.11% (95% CI: 51.59–69.85) moderate implementation. Among respondents with HND/BSc qualifications, 50.00% (95% CI: 42.47–57.53) reported low EHR

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implementation and 50.00% (95% CI: 42.47–57.53) reported moderate implementation. Those with ND/Technician qualifications recorded 54.41% (95% CI: 42.51–65.83) low implementation and 45.59% (95% CI: 34.17–57.49) moderate implementation. Respondents with postgraduate qualifications showed 45.36% (95% CI: 35.73–55.36) low implementation and 54.64% (95% CI: 44.64–64.27) moderate implementation.

Casual staff reported 23.88% (95% CI: 15.15–35.54) low implementation and 76.12% (95% CI: 64.46–84.85) moderate implementation. Full-time staff reported 56.18% (95% CI: 50.15–62.04) low implementation and 43.82% (95% CI: 37.96–49.85) moderate implementation.

Respondents with 5–10 years of service had 49.26% (95% CI: 40.93–57.64) low implementation and 50.74% (95% CI: 42.36–59.07) moderate implementation. Those with more than 10 years of service reported 66.67% (95% CI: 54.76–76.77) low EHR implementation and 33.33% (95% CI: 23.23–45.24) moderate implementation.

Table 3: Level of EHR Implementation by Background Characteristics

Category	Low % (95% CI)	Moderate % (95% CI)
Age		
<25	46.67 (32.71–61.17)	53.33 (38.83–67.29)
25–29	27.87 (18.05–40.39)	72.13 (59.61–81.95)
30–39	70.79 (60.50–79.31)	29.21 (20.69–39.50)
40–49	43.75 (32.15–56.08)	56.25 (43.92–67.85)
≥50	49.33 (38.20–60.53)	50.67 (39.47–61.80)
Gender		
Female	50.00 (43.25–56.75)	50.00 (43.25–56.75)
Male	48.78 (40.04–57.59)	51.22 (42.41–59.96)
Marital Status		
Married	41.90 (34.87–49.28)	58.10 (50.72–65.13)
Single	58.71 (50.78–66.21)	41.29 (33.79–49.22)
Religion		
Christian	49.70 (44.34–55.07)	50.30 (44.93–55.66)
Profession		
Doctors	35.00 (21.91–50.83)	65.00 (49.17–78.09)
HIM Practitioners	38.89 (30.15–48.41)	61.11 (51.59–69.85)
Lab Scientists	59.68 (47.07–71.12)	40.32 (28.88–52.93)
Nurses	61.39 (51.54–70.38)	38.61 (29.62–48.46)
Pharmacists	47.83 (28.74–67.57)	52.17 (32.43–71.26)
Qualification		
HND/BSc	50.00 (42.47–57.53)	50.00 (42.47–57.53)
ND/Technician	54.41 (42.51–65.83)	45.59 (34.17–57.49)
Postgraduate	45.36 (35.73–55.36)	54.64 (44.64–64.27)
Staff Status		
Casual	23.88 (15.15–35.54)	76.12 (64.46–84.85)
Full Time	56.18 (50.15–62.04)	43.82 (37.96–49.85)
Years of Service		
5–10	49.26 (40.93–57.64)	50.74 (42.36–59.07)
>10	66.67 (54.76–76.77)	33.33 (23.23–45.24)
≤5	41.09 (32.91–49.79)	58.91 (50.21–67.09)

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Table 4 presents the multiple linear regression analysis examining the impact of the EHR implementation in healthcare delivery. Attitude was a statistically significant predictor of implementation impact (β = 0.38, SE = 0.07, t = 5.42, p < 0.001). Knowledge (β = 0.08, SE = 0.05, t = 1.69, p = 0.09) and perception (β = -0.02, SE = 0.07, t = -0.25, p = 0.80) were not statistically significant predictors.

Respondents aged 30–39 years had lower implementation impact scores compared to those aged less than 25 years (β = -5.23, 95% CI: -9.21 to -1.25, p = 0.01). Those aged 40–49 years also recorded lower scores (β = -5.44, 95% CI: -9.88 to -1.00, p = 0.02). There was no statistically significant difference for respondents aged 25–29 years (β = 2.89, p = 0.23) or those aged 50 years and above (β = -2.69, p = 0.20). Also, male respondents had significantly lower implementation impact scores compared to females (β = -4.71, 95% CI: -8.06 to -1.35, p = 0.01). Single respondents had significantly higher implementation impact scores compared to married respondents (β = 3.68, 95% CI: 0.31 to 7.06, p = 0.03).

Moreover, respondents with ND/Technician qualifications had higher implementation impact scores compared to those with HND/BSc (β = 11.92, 95% CI: 7.33 to 16.50, p < 0.001). In contrast, respondents with postgraduate qualifications had lower implementation impact scores (β = -8.60, 95% CI: -11.92 to -5.27, p < 0.001). Full-time staff had significantly higher implementation impact scores compared to casual staff (β = 7.95, 95% CI: 4.42 to 11.49, p < 0.001). Furthermore, respondents with more than ten years of service had higher implementation impact scores compared to those with five years or less (β = 6.54, 95% CI: 2.76 to 10.33, p = 0.001). Those with more than five years of service had lower implementation impact scores (β = -6.25, 95% CI: -10.22 to -2.29, p = 0.00) relative to those with five years or less.

Table 4: Adjusted Multiple Linear Regression of EHR Implementation Impact in Healthcare Delivery

Predictor	**aβ**	**p-value**	**95% CI**
Knowledge (%)	0.08	0.09	-0.01, 0.17
Attitude (%)	0.38	<0.001	0.24, 0.52
Perception (%)	-0.02	0.80	-0.15, 0.11
Age			
<25 (Ref)	1.00		
25–29	2.89	0.23	-1.87, 7.66
30–39	-5.23	0.01	-9.21, -1.25
40–49	-5.44	0.02	-9.88, -1.00
≥50	-2.69	0.20	-6.81, 1.43
Gender			
Female (Ref)	1.00		
Male	-4.71	0.01	-8.06, -1.35
Marital Status			
Married (Ref)	1.00		
Single	3.68	0.03	0.31, 7.06

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Profession			
Doctor (Ref)	1.00		
HIM Practitioners	3.81	0.10	-0.73, 8.36
Medical Laboratory Scientists	-2.69	0.29	-7.69, 2.30
Nurses	1.57	0.56	-3.74, 6.88
Pharmacists	-0.94	0.78	-7.45, 5.57
Educational Qualification			
HND/BSc (Ref)	1.00		
ND/Technician	11.92	<0.001	7.33, 16.50
Postgraduate	-8.60	<0.001	-11.92, -5.27
Staff Status			
Casual (Ref)	1.00		
Full Time	7.95	<0.001	4.42, 11.49
Years of Service			
≤5 (Ref)	1.00		
>10	6.54	0.001	2.76, 10.33
>5–10	-6.25	0.002	-10.22, -2.29
Implementation Level			
Low (Ref)	1.00		
Moderate	5.27	<0.001	2.33, 8.20

The results presented in Table 5 show that the majority of the respondents (95.78%) agreed that EHRs enable quick access to patient records for coordinated and efficient care. A similarly high proportion (89.79%) reported that EHRs improve privacy and security, while 86.75% agreed that EHRs enable safer and more reliable prescribing. In addition, 84.69% believed that EHRs help to provide accurate information, and 80.78% stated that EHRs allow them to spend more time on other aspects of patient care.

However, the majority of respondents (94.19%) reported lack of user involvement as a key barrier, making it the most frequently identified challenge. Poor training and technical support were reported by 84.38% of respondents, while 83.78% indicated that literacy and technological skills posed a challenge. Similarly, 83.18% identified poor system integration and interoperability as a barrier. Furthermore, 85.98% reported lack of trust and belief in the quality of the EHR system as an impediment to effective implementation.

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Table 5: Facilitators and Barriers to EHR Implementation

Variables	Frequency	Percentage (%)
Facilitators		
EHRs allow me to spend more time on other aspects of patient care.		
Yes	269	80.78
No	64	19.22
EHRs improve privacy and security.		
Yes	299	89.79
No	34	10.21
EHRs enable quick access to patient records for coordinated and efficient care.		
Yes	318	95.78
No	14	4.22
EHRs help to provide accurate information.		
Yes	271	84.69
No	48	15.00
Don't know	1	0.31
EHRs enable safer and more reliable prescribing.		
Yes	288	86.75
No	42	12.65
Don't know	2	0.60
Barriers		
Poor training and technical support.		
Yes	281	84.38
No	39	11.71
Don't know	13	3.90
Lack of user involvement.		
Yes	292	94.19
No	18	5.81

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Literacy and skill in technology.		
Yes	279	83.78
No	42	12.61
Don't know	12	3.60
Poor system integration and interoperability.		
Yes	277	83.18
No	31	9.31
Don't know	25	7.51
Lack of trust and belief in EHR system quality.		
Yes	276	85.98
No	33	10.28
Don't know	12	3.74

Table 6 presents the results of multiple linear regression analyses of the Facilitator and Barrier factors to implementation of EHR. After adjusting for age, gender, marital status, profession, qualification, staff status, years of service, and implementation level, knowledge and attitude were significant positive predictors of facilitator scores. Specifically, knowledge was positively associated with facilitator scores (β = 0.427, 95% CI: 0.307 to 0.548, p < 0.001). Similarly, attitude showed a significant positive association (β = 0.356, 95% CI: 0.179 to 0.533, p < 0.001). Perception was not statistically significant in the facilitators model (β = 0.119, 95% CI: -0.048 to 0.286, p = 0.161).

Age differences were observed. Respondents aged 30–39 years had lower facilitator scores compared to those aged less than 25 years (β = -5.211, 95% CI: -10.346 to -0.077, p = 0.047). Other age categories were not statistically significant. Medical Laboratory Scientists had significantly higher facilitator scores (β = 11.406, 95% CI: 4.966 to 17.845, p = 0.001). Pharmacists showed higher scores (β = 7.737), although this did not reach statistical significance (95% CI: -0.662 to 16.135, p = 0.071). Health Information Management Practitioners (β = 2.418, p = 0.418) and Nurses (β = -0.773, p = 0.824) were not statistically different from doctors.

Respondents with ND/Technician qualifications had substantially higher facilitator scores compared to those with HND/BSc (β = 22.727, 95% CI: 16.815 to 28.640, p < 0.001). Postgraduate qualification was not statistically significant (β = 3.867, p = 0.077). Full-time staff had significantly lower facilitator scores compared to casual staff (β = -13.150, 95% CI: -17.714 to -8.586, p < 0.001). Respondents with more than ten years of service (β = 10.331, 95% CI: 5.446 to 15.216, p < 0.001) and those with more than five years of service (β = 7.843, 95% CI: 2.731 to 12.954, p = 0.003) had higher facilitator scores compared to those with five years or less. Respondents in facilities with moderate implementation level had significantly higher facilitator scores than those in low-implementation settings (β = 11.616, 95% CI: 7.824 to 15.408, p < 0.001).

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Table 6: Multiple Linear Regression Predicting EHR Implementation Facilitators and Barriers

Variables	Facilitators		Barriers	
	aβ (95% CI)	p-value	aβ (95% CI)	p-value
Knowledge (%)	0.43 (0.31, 0.55)	<0.001	0.05 (-0.16, 0.25)	0.64
Attitude (%)	0.36 (0.18, 0.53)	<0.001	0.75 (0.45, 1.05)	<0.001
Perception (%)	0.12 (-0.05, 0.29)	0.16	-0.46 (-0.75, -0.18)	0.001
Age				
<25: Ref	1.00		1.00	
25–29	-2.38 (-8.52, 3.77)	0.45	-4.71 (-15.13, 5.71)	0.37
30–39	-5.21 (-10.35, -0.08)	0.05	-11.87 (-20.57, -3.16)	0.01
40–49	2.21 (-3.53, 7.94)	0.45	-7.23 (-16.95, 2.49)	0.14
≥50	1.41 (-3.91, 6.72)	0.60	-2.91 (-11.92, 6.10)	0.53
Gender				
Female: Ref	1.00		1.00	
Male	-2.27 (-6.59, 2.06)	0.30	5.25 (-2.08, 12.59)	0.16
Marital Status				
Married: Ref	1.00		1.00	
Single	-7.68 (-12.03, -3.32)	0.001	2.97 (-4.41, 10.36)	0.43
Profession				
Doctor: Ref	1.00		1.00	
HIM Practitioners	2.42 (-3.44, 8.28)	0.42	3.36 (-6.58, 13.30)	0.51
Medical Lab Scientists	11.41 (4.97, 17.85)	0.001	14.70 (3.78, 25.61)	0.01
Nurses	-0.77 (-7.63, 6.08)	0.82	20.99 (9.37, 32.60)	<0.001
Pharmacists	7.74 (-0.66, 16.14)	0.07	15.96 (1.72, 30.19)	0.03
Qualification				
HND/BSc: Ref	1.00		1.00	
ND/Technician	22.73 (16.82, 28.64)	<0.001	12.78 (2.75, 22.80)	0.01
Postgraduate	3.87 (-0.42, 8.16)	0.08	-2.04 (-9.31, 5.23)	0.58
Staff Status				
Casual: Ref	1.00		1.00	
Full Time	-13.15 (-17.71, -8.59)	<0.001	1.42 (-6.32, 9.15)	0.72
Years of Service				
≤5: Ref	1.00		1.00	
>10	10.33 (5.45, 15.22)	<0.001	13.28 (5.00, 21.56)	0.002
>5	7.84 (2.73, 12.95)	0.003	-13.40 (-22.07, -4.74)	0.003

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Implementation Level				
Low: Ref	1.00		1.00	
Moderate	11.62 (7.82, 15.41)	<0.001	12.77 (6.34, 19.20)	<0.001

DISCUSSION

The result revealed that while EHR systems are operational within the facilities assessed, their implementation into routine clinical and administrative workflows is not yet fully consolidated. This pattern reflects what has been described in many low- and middle-income countries (LMICs) as a transitional or hybrid phase of digitalization, where electronic systems coexist with elements of paper-based documentation [23].

Variation across age groups suggests that generational dynamics play an important role in shaping engagement with EHR systems. Younger healthcare professionals appeared more adaptable to digital workflows, whereas respondents within the middle-aged categories demonstrated comparatively lower implementation levels. This finding may reflect differences in prior exposure to digital technologies, training orientation, and comfort with technology-driven workflows. Younger professionals are more likely to have encountered computer-based learning environments during their education and early professional practice, which may facilitate faster adaptation to EHR systems. In contrast, older or mid-career staff may have developed long-standing reliance on paper-based documentation practices, making behavioural transition more gradual. Similar findings have been reported in several LMIC settings where younger healthcare workers demonstrated greater acceptance and utilisation of health information technologies due to higher digital familiarity and perceived ease of use [24]. However, some studies have reported no significant association between age and EHR adoption, arguing that institutional support and training opportunities may reduce generational disparities [25]. This suggests that the influence of age may be context-dependent and shaped by the extent of organisational preparedness and continuous technical support available within health facilities.

Sex differences in implementation were relatively limited, indicating that access to and engagement with EHR systems may not be strongly differentiated along gender lines within the study setting. This finding supports studies suggesting that institutional and infrastructural conditions are more influential determinants of EHR utilisation than demographic characteristics such as sex [25]. In public-sector healthcare settings where staff are exposed to similar operational structures and training opportunities, gender disparities in digital health adoption may become less pronounced.

Professional background emerged as a major determinant of EHR implementation. Doctors and Health Information Management professionals demonstrated comparatively stronger integration of EHR systems into their daily activities, likely due to the direct relevance of electronic documentation, patient data management, and clinical decision-making to their routine responsibilities. Health Information Management professionals, in particular, are often more formally trained in records management and health informatics processes, which

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may enhance their confidence and competence in navigating electronic systems. Conversely, comparatively lower implementation levels among some professional groups, particularly nurses and laboratory scientists, may reflect workflow incompatibilities, limited role-specific training, and increased workload pressures. In many Nigerian public hospitals, EHR platforms are frequently designed with stronger emphasis on physician documentation and administrative reporting, while nursing and laboratory workflows may remain partially dependent on parallel paper systems. Such fragmented integration can reduce perceived usefulness and contribute to uneven adoption across professional cadres. Similar disparities have been documented in previous studies where unequal system design and insufficient user involvement during implementation limited engagement among non-physician staff [24,26]. However, contrary findings from some high-resource settings suggest that when EHR systems are fully integrated into multidisciplinary workflows and supported with tailored professional training, differences between professional groups become less significant [29]. This highlights the importance of context-specific implementation strategies that accommodate the operational realities of different healthcare cadres.

Staff employment status and years of service also influenced implementation patterns. Respondents with shorter duration of service and those engaged on non-permanent terms appeared more receptive to EHR implementation, whereas longer-serving and full-time staff demonstrated comparatively lower implementation levels. This pattern may reflect organisational change dynamics commonly observed during digital transformation processes. Employees with longer institutional experience may be more accustomed to traditional work routines and may perceive digital systems as disruptive to established practices, particularly in environments where workload demands are already high and technical support is inconsistent. In contrast, newer or temporary staff may demonstrate greater flexibility and willingness to adapt to changing systems in order to align with organisational expectations. Similar observations have been reported in studies examining resistance to health technology adoption in resource-constrained settings, where institutional culture, workload burden, and change fatigue influenced staff responsiveness to innovation [27]. Nevertheless, other studies have found that experienced staff may demonstrate stronger adoption when adequate mentoring, leadership support, and continuous professional training are provided. This indicates that resistance among long-serving staff may not necessarily reflect inability, but rather inadequate institutional support during implementation processes.

CONCLUSION

This study assessed the implementation of Electronic Health Records (EHR) in healthcare delivery systems across Calabar Metropolis, Cross River State, by examining implementation levels and the facilitators and barriers influencing adoption. The findings indicate that EHR implementation within the study setting reflects a system in transition, where digital platforms are operational but the depth of integration varies across institutions and workforce categories. Regression analysis further showed that attitude toward EHR was a significant predictor of implementation impact, while professional category, educational qualification, staff status, years of service, and implementation level significantly influenced facilitators and barriers to EHR adoption. Specifically, respondents with ND/Technician qualifications,

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full-time employment status, and longer years of service demonstrated significantly higher implementation impact scores, whereas some middle-aged groups and male respondents showed comparatively lower implementation levels. Attitude toward EHR also significantly increased facilitator and barrier scores, suggesting that user perception and experience strongly shape implementation outcomes.

Furthermore, the identification of both facilitators and barriers confirms that EHR implementation is multidimensional. Structural readiness, leadership support, infrastructure stability, workforce experience, and user engagement collectively determine whether digital systems translate into meaningful improvements in healthcare delivery. The findings also demonstrate that differences in implementation across professional groups are likely influenced by variations in workflow integration, role-specific training, and institutional support mechanisms. Thus, the study concludes that sustainable EHR implementation in Calabar Metropolis requires a balanced integration of technological investment, workforce capacity strengthening, continuous user training, and supportive institutional frameworks. Digital transformation in healthcare is not achieved solely through system deployment; rather, its success depends fundamentally on the preparedness of healthcare workers, the adaptability of institutional systems, and the enabling environment within which the technology operates.

STRENGTHS AND LIMITATIONS

This study draws on primary data from healthcare professionals directly involved in patient care and health information management across multiple public hospitals, providing practical insight into real-world experiences with Electronic Health Records (EHR) implementation. The relatively large and diverse sample enhanced the robustness of the findings, while the use of both descriptive and inferential analyses enabled a comprehensive assessment of implementation patterns and associated factors.
However, the cross-sectional design limits causal inference between observed variables. The reliance on self-reported data introduces the potential for social desirability and recall bias, particularly regarding knowledge and prior EHR experience. Although statistical adjustments were made, unmeasured institutional factors may have influenced the results. In addition, the absence of qualitative data limited deeper contextual interpretation, and the focus on selected public hospitals may restrict generalisability to other settings.

PRACTICAL IMPLICATIONS

The findings highlight the need for sustained investment in ICT infrastructure, continuous capacity building for healthcare workers, and the establishment of strong institutional support systems to enhance the effective implementation of Electronic Health Records (EHR). Strengthening training programmes, improving system reliability, and ensuring ongoing technical support will help maximise the benefits of EHR use in routine healthcare delivery.
In addition, aligning EHR systems with clinical workflows and fostering positive user engagement across different professional groups are essential for improving utilisation and

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reducing resistance to digital systems. Addressing identified barriers such as infrastructural gaps, limited technical skills, and organisational constraints will further enhance system performance and user acceptance.

Importantly, this study provides context-specific evidence from Calabar Metropolis, contributing to a better understanding of how EHR implementation is shaped by workforce and institutional factors within public healthcare settings. These insights can inform policy, planning, and implementation strategies aimed at strengthening digital health systems in similar resource-constrained environments.

Abbreviations

EHR	EHR Electronic Health Record
HIM	Health Information Management
ICT	Information and Communication Technology

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AUTHOR CONTRIBUTIONS

- EDU, Elemi Éko: Conceptualization, Methodology, Writing – original draft, Writing – review & editing
- Olatunde Raimi: Formal Analysis, Methodology, Visualization, Writing – review & editing
- Adetomi Bademosi: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing
- Anthony Ike Wegbom: Conceptualization, Formal Analysis, Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing
- Kenneth S. Ordu: Conceptualization, Methodology, Supervision, Visualization, Writing – original draft, Writing – review & editing

CONFLICTS OF INTEREST

The authors have declared that no competing interests exist

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