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Factors influencing User Acceptance of Electronic Health Records Systems in Low Resource Settings: The Case of Ghana

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Background and Purpose: Electronic Health Records (EHR) Systems play a vital role in improving healthcare globally, particularly in low resource settings. Their adoption however remains challenging in developing countries although they have been shown empirically to be superior to traditional paper records. The Lightwave Health Information Management System, an EHR, was deployed in the Tamale Teaching Hospital in December, 2020. Unfortunately, no evaluation has ever been done to ascertain staff attitudes and perceptions of the system. We investigated user acceptance and factors influencing user acceptance among healthcare workers in the Tamale Teaching Hospital, in Ghana.
Methods: A quantitative cross-sectional design was used to study 373 randomly selected health care workers. A Z-test for proportion was used to examine differences in staff attitudes pre- and post-implementation of the system. Further, logistic regression analysis was used to identify factors influencing acceptance of the system.
Results: The study revealed a high acceptance rate (97%) with the application. We observed significant improvement in the overall positive attitude pre-implementation (65%) compared with post-implementation (77%) towards electronic health records system (z=-3.07; p-value=0.007; 95% C.I.-.19 - -.04). Predictors of user acceptance were workers with at least 20 years' experience in computer use (OR=6.307, p=0.032), and being a medical doctor (OR=7.443, p=0.048). The study identified complex software interface, lack of dedicated power supply, poor internet connectivity, and inadequate training as key challenges to the acceptance of the system.
Conclusions: To avoid dissatisfaction among workers, management should organize training sessions to improve computer skills, and make sufficient budgetary allocation for planned maintenance, stable power supply, and reliable internet connectivity.

Keywords: Electronic health records, electronic medical records, eHealth, Ghana, User acceptance, Attitude

1 Introduction

The deployment of Electronic health records (EHR) systems across healthcare institutions in developing countries has grown rapidly, impacting on health outcomes including access to medical information and evidence based treatment decision making [1][2][3]. An electronic health record (EHR) is described as a digital record of health-related information on an individual that complies with nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one health care organization [4]. Rolling out EHRs offers several benefits such as enhancing the security of patient records and promoting efficient patient care [2][5]. These systems minimize patient waiting times and maintain continuity of care by ensuring that patient information is easily available across sister healthcare institutions [2]. Despite these benefits, implementation of EHRs across

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health facilities face multiple challenges. These challenges can be classified into technical factors (security and privacy concerns), infrastructural factors (unstable internet and unreliable power supply), organizational factors (high software and hardware costs), and human factors (inadequate compliance with data security and privacy practices) [6]. These factors affect worker morale leading to dissatisfaction and low acceptance towards electronic health records systems among health professionals. A major barrier to implementing these systems successfully lies in getting users to embrace and effectively utilize the new system [7]. User acceptance signifies the degree to which the system meets the expectations of users about the tasks it is supposed to facilitate [7]. However, user expectations of electronic health records have been affected by perceptions including fear of job losses and disruptions to workflow [8][9].

The Tamale Teaching Hospital (TTH) serving as the major referral centre for Northern Ghana had challenges with paper-based records in the past due to factors including limited storage space and increasing rate of missing records resulting in patient delay and sometimes absence of previous patient records to facilitate continuity of care [7]. The first health information system used by the hospital was an Electronic Medical Records (EMR) system known as the Hospital Administration and Management Services [8][10]. An Electronic Medical Record (EMR) refers to a digital record system used by healthcare professionals to document, manage, and monitor patient care within a single healthcare facility. Unlike an Electronic Health Record (EHR) system, which enables the secure exchange of patient information across multiple healthcare organizations, an EMR system is owned and maintained by a single institution and is limited to that facility. Thus, interoperability is the key feature that distinguishes EHRs from EMR systems [11]. Lack of interoperability and low user acceptance were the main challenges to the use of this new system in the Tamale Teaching Hospital [8][10]. To mitigate these barriers and in response to the World Health Organization's (WHO) advocacy for the adoption of EHR systems to enhance healthcare delivery, the government of Ghana through its Ministry of Health released an electronic health strategic framework in 2010 known as the eHealth strategic framework [12]. Four primary strategic concepts were presented in the framework: First, to simplify the rules governing the administration of health information and data. The second goal was to increase sector capacity so that eHealth solutions may be used more widely in the healthcare industry. Third, to use eHealth to close equity gaps and widen access within the healthcare industry. Lastly to finally transition to electronic reporting and record-keeping systems [12][13]. Subsequently, in 2017, Ghana's Ministry of Health deployed an EHR system known as the Lightwave Health Information Management System (LHIMS) [8][14]. This EHR system, developed by Lightwave Healthcare Solutions, is an interoperable system that provides integrated patient management, real-time disease surveillance, and timely data to support clinical and administrative decision-making. It also enables secure sharing of information, improves billing and National Health Insurance Scheme (NHIS) claims processing, reduces paper-based costs, and enhances efficiency, patient safety, quality of care, and overall health service delivery [15][16][17]. Following the launch in 2017, the LHIMS has fully been adopted by all Teaching Hospitals and regional hospitals in Ghana and is currently being rolled out in other health facilities nationwide [8][18]. The Tamale Teaching Hospital adopted the LHIMS in December 2020 [10].

From an earlier study in two hospitals including the Tamale Teaching Hospital to assess health workers' preparedness for the LHIMS implementation, workers expressed fears about the possible impact of the system on workflow and were therefore reluctant to accept the new technology [6]. Unfortunately, no evaluation has ever been conducted to ascertain staff attitudes and perceptions of the system since its implementation in 2020 [8]. The objectives of the study were to assess user attitudes and the factors affecting acceptance of the electronic health records system pre- and post-implementation. The perceptions of healthcare workers regarding this new system are essential for future implementations and sustainability [19]. The findings would act as a guide to improve acceptance for other hospitals in the ongoing implementation of the LHIMS throughout the country.

2 Materials and methods

2.1 Study setting

The study was conducted in the Tamale Teaching Hospital, a tertiary health facility situated in the Northern Region of Ghana, positioned at latitude 9° 24' 0" north and longitude 0° 50' 0" west [8][20][21][22]. For a period of thirty-four (34) years, the hospital previously functioned as a Regional Referral Hospital but was

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upgraded to the status of a Teaching Hospital in 2008 to provide advanced services and support to neighboring health facilities [8][21]. The hospital provides generalized and specialized services including internal medicine, surgery, obstetrics and gynaecology, pediatrics and child welfare, accident and emergency [8][10]. It was the first hospital in the northern part of Ghana to adopt and implement the Light wave health information system in December 2020 [8][10]. The study was conducted in the hospital because there has not been any evaluation of the Light wave Health Information System to determine its impact on workers.

2.2 Study design

This study applied a hospital-based quantitative cross-sectional design because it allows for the assessment of multiple health related variables simultaneously [23]. Such studies are particularly useful in exploring attitudes, perceptions and behaviours and identifying associations between key factors and outcomes within a defined timeframe [8][23]. The design was well-suited to the objective of examining healthcare workers' acceptance of the LHIMS within a limited timeframe, a necessary consideration in busy healthcare environments [23]. Cross-sectional methods are frequently used in health research to analyze technology adoption and user acceptance within a specified period [8][23].

2.3 Inclusion and exclusion Criteria

The population of interest was healthcare workers specifically, doctors, nurses, laboratory technologists, pharmacists, IT personnel, radiologist, and physiotherapists who use the software in their daily activities and have been working for at least a year in the facility. The study assumed that extended exposure to the new system would allow individuals to provide an objective assessment of the system. Excluded from the study were administrative personnel, staff on annual leave, temporary staff specifically national service personnel, and clinical students.

2.4 Sample size and sampling technique

A sample of 373 participants after adjusting for a 10% non-response rate, was computed using the Yamane's formula, n = N / (1+ N (e)2), from a total population of workers of 2217 [10], a level of precision of 5%, and a confidence level of 95% [24][25]. Participants were selected from each health professional grade using a stratified sampling approach. Each health professional group was considered a stratum, therefore, sample sizes for each cadre were calculated using the proportionate sampling approach. From the calculations, 46 medical doctors, 290 nurses and midwives, 24 laboratory scientists, 8 records officers, 3 radiologists, one IT officer, and one physiotherapist were selected. Subsequently, lists of the healthcare workers in each professional group were compiled from the hospital administration, using their staff identity and contact number. Participants were then selected based on the specific sample sizes, using both systematic and the simple random sampling methods. The systematic approach was used to select Nurses, doctors and laboratory scientists who had large number of workers. The selection for records, radiology, IT and the physiotherapists were done randomly due to the smaller number of workers in these units.

2.5 Data collection tool and procedure

A pretested, self-administered structured questionnaire was used for data collection [26]. The questionnaire was extracted from a validated instrument of the Davis' Technology Acceptance Model [27]. Section A encompassed questions relating to the socio-demographic characteristics of the respondents, section B included questions pertaining to attitudes before and after implementation of the system, while section C contained a series of questions addressing the challenges with the new system [8]. All items in Sections B and C were examined using a 5-point Likert scale [8]. Section D contained binary questions with "Yes" or "No" responses to determine whether users accept the system. The questionnaire was designed electronically using google forms to ensure the principal investigator had real time access to correct errors as data collection was ongoing. After obtaining permission from the institution and respondents, they were

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provided with a link to the questionnaire hosted on Google Forms - this approach was adopted because all respondents were computer literates [8]. We collected data from 13th November 2023 to 13 January 2024.

2.6 Variables

The outcome variable was user acceptance, measured using a binary (yes or no) question to eliminate the possibility of a neutral answer, as is typical in most Likert scales [7][28]. Studies have shown that the inclusion of a "neutral or no opinion" response category as seen in most Likert scales can significantly increase the number of respondents selecting it, thereby masking genuine opinions that respondents may hold [28]. The predictors included age, sex, profession/health cadre, years of experience as a healthcare worker, years of experience with EHRs, duration of computer usage, history of formal computer training, frequency of EHRs use [8]. Additional variables, including respondents' attitudes toward the use of EHRs, were assessed using a 5-point Likert scale [8].

2.7 Data processing and analysis

Responses obtained through Google Forms were exported and organized in a Microsoft Excel worksheet. Data was cleaned and analyzed using IBM's Statistical Product and Service Solutions (SPSS) version 26 [8]. The data were summarized using descriptive statistics such as median, standard deviation, frequencies, and percentages. The Z-test for proportion was applied to test user attitude prior to and following implementation of the system, and the multiple logistic regressions to determine significant associations between the outcome variable and the predictors of EHR acceptance [8]. All tests were two-sided with a p-value less than 0.05 interpreted as significant.

2.8 Ethical Considerations

Ethical approval for the study was obtained from the Committee on Human Research, Publications and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology (Approval No. CHRPE/AP/1004/23). Authorities of the Tamale Teaching Hospital granted approval for the study. Participant informed consent was obtained by agreement and signing the consent form. The study was conducted according to the tenets of the Helsinki declaration.

3 Results

3.1 Socio-Demographic Characteristics of Respondents

Overall, 373 health professionals, 47% female and 53% male participated in the study [8]. The mean age of the workers was 32 years (± 4 years). The majority of workers were nurses and midwives (78%), followed by medical doctors (12%) and other categories of staff (10%). More than half of the workers (54%) had less than five years of professional experience in healthcare. Most (63%) had used the LHIMS for 3 years while 78% indicated regular use of LHIMS in their work. About 65% of workers indicated computer usage experience spanning 10 to 19 years, 59% had formal computer training, while 41% learned to use computers on the job (Table 1).

Table 1. Background characteristics of respondents.

Variable	Frequency n=373	Percentage %=100
Age Group		
Less than 30	125	33.5
30 to 39	220	59.0
40 and above	28	7.5
Mean age (years)	31.88 (SD ± 4)	
Gender		
Male	199	53.4
Female	174	46.6
Profession/Health Cadre		

 J Health Inform Afr. 2026;13(1):182-192. DOI: 10.12856/JHIA-2026-v13-i1-617

Nurse/Midwife	290	77.7
Medical Doctor	46	12.3
Laboratory Staff	24	6.4
Records Staff	8	2.2
Radiology	3	0.8
ICT Staff	1	0.3
Physiotherapist	1	0.3
Level of Education		
Certificate	15	4.0
Diploma	96	25.7
Bachelor's Degree	197	52.8
MBchB	46	12.3
Master's Degree	19	5.2
Years In Healthcare Practice (years)		
Less than 5	202	54.2
5 to 9	96	25.7
10 and above	75	20.1
Years of Using LHIMS		
1 year	37	9.9
2 years	102	27.4
3 years	234	62.7
Years of Computer Use in Life		
Less than 10	69	18.5
10 to 19	243	65.1
20 and above	61	16.4
History of Formal Computer Training		
Yes	220	59.0
No	153	41.0
Frequency of LHIMS Usage		
Never	0	0
Rarely	5	1.3
Often	76	20.4
Every time	292	78.3

Source: Adapted from author's thesis available from udsspace.uds.edu.gh [8]
* LHIMS-Light wave health information management system

3.2 Level of User Acceptance

In general, 97% of the workers expressed acceptance of the LHIMS, suggesting majority were satisfied with the application (Figure 1) [8].

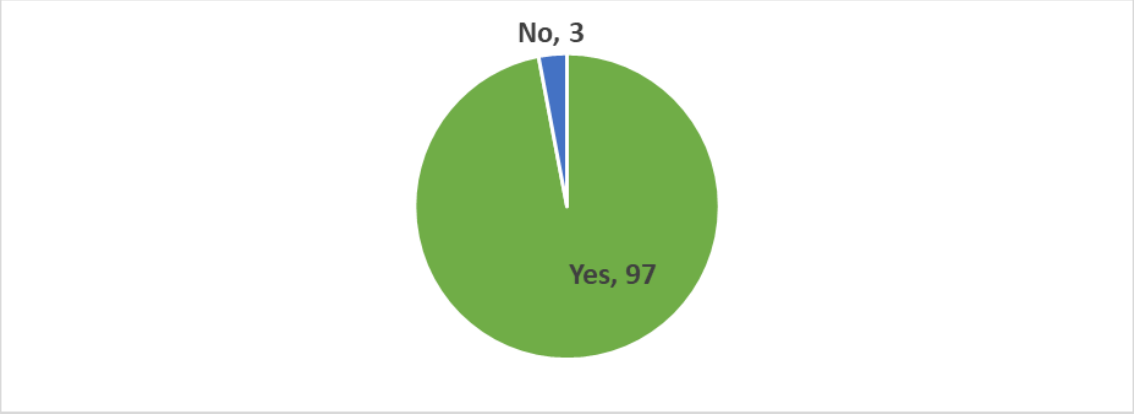

Fig. 1. Level of User Acceptance

3.3 Attitude before and after implementation of the LHIMS EHR

Attitudes of healthcare workers were examined to determine if there were any significant differences in their attitudes pre- and post-implementation of the LHIMS [8]. The study employed a Z-Test for

Proportions to test the null hypothesis that no significant difference existed in the attitudes of healthcare workers prior to and following the implementation of the LHIMS [8]. This analysis was limited to staff who indicated agreement with each attitude-related item in Table 2 pre- and post-implementation of the system [8]. Significant differences were observed across the following factors: favorable attitude for LHIMS (p=0.001), LHIMS being a good idea (p=0.001), expecting LHIMS use in the future (p=0.008), satisfaction with LHIMS (p=0.007), all staff encouraged to use LHIMS (p=0.002), and overall positive attitude towards LHIMS (p=0.002) [8].

Table 2. Z-Tests for Proportions of attitudes before and after the implementation of LHIMS

Factor (Agree)	Pre-implementation %	Post-implementation %	z-value	P-value	95% C.I.
Favorable attitude for LHIMS	171 (45.8)	245 (65.7)	-4.04	0.001	-.29- -.10
LHIMS use is a good idea	226 (60.6)	288 (77.2)	-4.07	0.001	-.25 - -.09
Expect to use LHIMS in the future	256 (68.6)	293 (78.5)	-2.63	0.008	-.18 - -.03
Expect LHIMS use to be satisfying	207 (55.5)	253 (67.8)	-2.71	0.007	-.21- -.03
Believed LHIMS would ensure better care	257 (68.9)	283 (75.9)	-1.82	0.069	-.15 - .01
Never satisfied with paper-based patient records	149 (39.9)	176 (47.2)	-1.32	0.186	-.18 – 0.03
Believed all staff should learn to use LHIMS	252 (67.6)	305 (81.5)	-3.78	0.002	-.21 - -.07
Overall my attitude about LHIMS is positive	244 (65.5)	289 (77.5)	-3.07	0.002	-.19 - -.04

Source: Adapted from author's thesis available from udsspace.uds.edu.gh [8]
LHIMS-Lightwave health information management system

3.4 Challenges with the LHIMS in Tamale Teaching Hospital

The study evaluated perceptions of respondents regarding the challenges encountered using the Lightwave health information system at the hospital. The major challenges reported were frequent power interruptions and absence of a reliable backup power system (79%), inadequate essential logistics particularly computers and laptops (75%), equipment malfunctioning (74%), and poor internet or network connectivity (70%). Other difficulties included inadequate training or support (63%), technical issues including difficulties using the LHIMS interface (57%), lengthy data entry procedures (55%), and concerns over data security and privacy (53%) [8].

3.5 Predictors of User acceptance of the LHIMS

To assess the independent predictors of the User Acceptance of the LHIMS, the logistic regression model was used. We found significant associations between workers with at least 20 years of computer use (OR = 6.307, 95 % CI, 1.17-33.89, p = 0.032), being a medical doctor (OR = 7.443, 95% CI, 1.019-54.378, p = 0.048) and user acceptance. However, age, frequency of LHIMS utilization, and formal training in information and communication technology were not found to be statistically significant predictors of user acceptance (Table 3) [8].

Table 3. Multivariable logistic regression of factors influencing user acceptance

Variable	OR	95% CI	P-value
Age Group (years)			
Less than 30	Ref		
30 to 39	2.072	0.243-17.683	0.506

40 and above	2.470	0.439-13.909	0.305
Profession			
Allied Staff	Ref		
Nurse/Midwife	4.116	0.097-174.864	0.459
Medical Doctor	**7.443**	**1.019-54.378**	**0.048**
Laboratory Staff	3.134	0.338-29.054	0.315
Years of Computer Use			
Less than 10	Ref		
10 to 19	2.913	0.419-20.263	0.280
20 and above	**6.307**	**1.174-33.897**	**0.032**
Frequency of LHIMS Usage			
Every time	Ref		
Often	15.118	0.443-516.142	0.132
Rarely	14.740	0.439-495.180	0.133
History of Formal Training			
No	Ref		
Yes	0.361	0.084-1.544	0.170

Source: Adapted from author's thesis available from udsspace.uds.edu.gh [8] *Ref- Reference Category, OR-Odds Ratio, C.I- Confidence Interval

4 Discussion

The study assessed user attitude and acceptance of an EHR system in the Tamale Teaching Hospital [8]. The findings indicated a high level of user acceptance of the LHIMS, and a positive user attitude towards the system after implementation despite the operational challenges. Workers with 20 years' computer experience, and medical doctors were significantly associated with user acceptance.

Contrary to the pre-implementation findings by Abdulai et al., in 2020 [6], when the health workers were reluctant to accept the Light wave Health Information System, a high level of user acceptance (97%) suggest that most healthcare workers have come to appreciate the system's usefulness in facilitating their duties and have expressed approval of the system. The overwhelming acceptance of the LHIMS suggest that workers found the system beneficial and were highly motivated to adopt it. This reflects a strong foundation for its successful integration and improvement of healthcare delivery. Staff approval of the system is likely to lead to sustained use which ultimately could contribute to improved healthcare outcomes. We found that the high acceptance rate of the system was influenced by a generally positive staff attitude after implementation. The findings indicate a marked improvement in overall attitudes toward the LHIMS, with 77% of respondents expressing positive views compared to 65% before its introduction (Table 2). Majority of workers see the system as a good initiative and satisfying compared to the manual system. This improvement reflects the system's beneficial impact on staff performance and their growing confidence in its long-term usefulness. Our findings are consistent with other studies conducted in the Philippines, United Kingdom and Netherlands where 97%, 96% and 99% of healthcare workers respectively, reported acceptance of EHRs [8][25][29]. The acceptance rate observed in this study exceeds those reported in other African contexts, including Ghana (59%) [25], Ethiopia (72.2%) and Nigeria (78.1%) [30]. Lower acceptance rates in these countries has been linked to high installation costs, insufficient institutional commitment and recurrent system-related issues [25]. Although the user acceptance rate observed in this study was higher than those reported in Ethiopia and Nigeria, this comparison should be interpreted with caution because of methodological differences. The Ethiopian and Nigerian studies measured their outcome (acceptance) using composite Likert-scale items that were subsequently dichotomized, whereas the present study employed a direct binary (Yes/No) outcome measure of acceptance, which may have influenced the observed differences.

Findings from our study suggest that health workers with longer years of experience using computers were more receptive to the LHIMS application. Length of computer use refers to the duration of experience with computer applications, which has been found to predict successful implementation of electronic health information systems [8][31]. Health professionals with longer computer experience are likely to adapt more

readily to new digital applications because of their familiarity with computer use. It is therefore plausible that the high proportion of workers (65%) with 10–19 years of computer experience contributed to the successful implementation and acceptance of the LHIMS. Additionally, previous studies have suggested that greater computer familiarity may reduce concerns about technology-related job losses, although this was not directly assessed in the present study [8]. Our finding aligns with results from other studies, which reported that the duration of computer use significantly influences user acceptance among nurses [7][32], and that health workers with computer expertise were more likely to express readiness for electronic health records use [6]. On the contrary health workers without adequate exposure to computer technology struggle to use electronic records systems [33]. We suggest to the management of the hospital to focus on regular computer training and on-the-job practices to equip workers with needed skills to adapt quickly to the new system, rather than dependence on staff with long duration of computer use.

In our study, medical doctors demonstrated a higher level of acceptance of the LHIMS compared to all other professional categories. This is encouraging, given that physicians have historically been reluctant to integrate electronic record systems into their workflows [34]. Physicians have raised concerns about electronic record systems, including issues such as the time-consuming nature of data entry, fears that they are complex to use, and that computers are disruptive to workflow [34]. Despite these challenges, the finding suggests that physicians in the Tamale teaching hospital recognize the benefits of the application [8]. This suggests that acceptance by the doctors at the teaching hospital has a positive impact on the workflow since they provide the critical information for patient care.

The major barriers associated with using the LHIMS system at the Tamale Teaching Hospital were infrastructural and usability-related issues [8]. Usability concerns such as the complex user interface and inadequate training and support affected staff ability to freely navigate the LHIMS resulting in complaints of lengthy data entry processes. Complex interfaces that lack integration with clinical workflow affect patient care process. Some studies have reported the difficulties clinicians experience with poorly designed software interfaces which often disrupt workflow due to prolonged screen navigation [35]. There is the need to make system procedures more friendly to health workers since information technology is not their core competency. Additionally, this highlights the need for continuous user training, technical support and collaboration with developers to improve system usability. Furthermore, constraints including frequent power interruptions and lack of a backup power supply, inadequate computers, equipment malfunction and poor internet connectivity are major infrastructural challenges which are characteristic of Low- and Middle-Income Countries such as Ghana [6][8]. Mensah, et al., 2024 [36] similarly reported that unstable power supply had negative effects on LHIMS in some major hospitals in Ghana. This suggests the need for institutional investment in reliable power supply, ICT infrastructure, and equipment maintenance. A planned budgetary allocation for administrative overheads by the hospital management would ensure sustainability of the LHIMS EHR. Addressing these distinct challenges is essential to optimize LHIMS performance and promote sustained user acceptance.

The findings of this study support the applicability of the Technology Acceptance Model (TAM) in explaining LHIMS acceptance among healthcare workers. Challenges related to interface complexity and lengthy data entry processes may negatively influence Perceived Ease of Use, while the perceived benefits of LHIMS, including improved access to patient information, documentation, and clinical decision-making, enhance Perceived Usefulness. The high acceptance observed among users, particularly clinicians, may therefore reflect the value they derive from the system in supporting healthcare delivery. Strengthening system usability, user training, and functional improvements will be essential to further enhance acceptance and a sustained use of LHIMS.

4.1 Conclusion

Our study revealed a successful acceptance and integration of the Light wave Health Information System among healthcare workers at the Tamale Teaching Hospital [8]. The favorable attitudes expressed by staff following its implementation indicate a growing professional readiness to transition from manual to digital records systems. Despite usability and infrastructural challenges, the LHIMS demonstrates considerable potential to significantly improve healthcare efficiency and patient outcomes in similar contexts. Management of the Tamale Teaching Hospital should therefore organize comprehensive training programmes that would enhance the computer skills of workers, and make sufficient budgetary allocation for planned maintenance, procurement of ICT infrastructure, and a sustainable internet supply. This study

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shows that acceptability and usage of EHRs has improved across low resourced settings in recent years. A wider implementation is recommended across similar sub regions.

4.2 Limitations and Future Research

This research was limited to a single tertiary healthcare institution, which may restrict the generalizability of the findings to primary and secondary health centers that differ in context and staff composition [8]. Also, the retrospective assessment of pre-implementation attitudes conducted several years after LHIMS implementation may have introduced recall bias, as participants' current experiences with the system could have influenced their recollection of initial perceptions.

Additionally, the cross-sectional design provides a snapshot of user acceptance and satisfaction at a single point in time and does not allow assessment of changes over time or causal relationships.

The study also did not evaluate the long-term impact of LHIMS on patient outcomes, quality of care, or healthcare quality and outcomes. Future research should therefore adopt longitudinal and multi-institutional approaches to examine the broader clinical impact and operational effects of EHR implementation.

4.3 What is already known on this topic

Health workers of the Tamale teaching hospital faced anxiety prior to the introduction of the electronic records application [6].

4.4 What this study adds

Workers have favorable attitude towards the LHIMS application post implementation. Experience with computer use contributed significantly to acceptance of the EHR system. Medical doctors at the hospital are more accommodating to the use of the LHIMS

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Credit authorship contribution statement

- Elijah Bawa Mishio: Conceptualization, Methodology, Formal analysis, Writing – original draft.
- Julius Waamsasiko Adong: Writing – review & editing, Supervision.
- David Nana Adjei: Analysis, Review & editing.

Statement on conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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