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RESEARCH PAPER

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Examining the Influence of e-Health Literacy on Healthcare Workers' Acceptance of Electronic Medical Records: An Insight Into System Transition

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ABSTRACT

Following the aftermath of COVID-19, needs of digitalized medical data system has increased worldwide. As stated by Indonesia's Ministry of Health, electronic medical records (EMRs) usage are being mandated initially by December 2023. However, in some healthcare facilities, this transition are being halted by inadequate digital literacy. This research aimed to understand the impact of e-Health Literacy of healthcare personnel on technology acceptance and their intention to use EMRs. The cross-sectional study was conducted in March 2024 following six months of EMR implementation in Dr. Soetarto Army Hospital, using a valid and reliable questionnaire consisting of 51 items originating from the Unified Theory of Acceptance and Use of Technology (UTAUT) and e-Health Literacy Questionnaire (eHLQ) that was modified into 46 items. The data was collected from 114 healthcare personnel who act as both caregiver and medical data documenter (total sampling). The result was then analyzed using Smart-PLS. There is an increased intention of EMR usage when e-health literacy moderated user's technology acceptance ($p=0.006$), while by itself, technology acceptance doesn't have a meaningful impact towards intention to use EMR ($p=0.391$). Increased e-Health Literacy has also proven to be correlated with increased intention of EMR use ($p<0.001$). Increasing user's e-health literacy is essential to become a pivotal factor in increasing EMR adoption in healthcare personnel workflow. This study suggests integrating targeted e-health literacy programs into professional development to improve EMR usage and healthcare efficiency, with future studies exploring long-term.

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1. INTRODUCTION

The Since the global pandemy of COVID-19, the world are having accelerated growth in medical technology, especially in digitalized medical information. This technology itself help both medical professional to gain health and medical information without physical contact and even accessible wherever and whenever. Moreover, usage of paper based medical records often prone to cause misinformation and miscommunication between healthcare provider. This was caused by various things such as different handwriting and availability of only one copy in each patient that might cause difficulties when there is multiple data inputter in a single time, ensuring continuity and efficiency of care given which in turn increase the quality of healthcare service. increase the quality of care. The use of EMR might also help reducing the burnout and burden of healthcare workers with the benefits toward their workflow. Because of this, every nation has pushed transition toward this technology in healthcare workflow to help increase workload efficiency [1],[4].

In Indonesia, The Indonesia Ministry of Health has enforced the usage of Electronic Medical Records (EMR) in Indonesia healthcare facilities. As stated by the Indonesia Ministry of Health in December 2022 and then December 2023, the usage of electronic medical records is now being mandated by the end of 2024, with sanctions being enforced should the institution fail to fulfill it as targeted [4],[5].

Understanding what exactly is an EMR is necessary if such technology is going to be adapted in daily practice. According to Seymour et al., an EMR is a record of a patient's medical information created, used, and stored electronically [7]. Loveth states that EMR could display records of clinical patient encounters and support other care-related activities directly or indirectly via an interface, including evidence-based decision support, quality management, and outcomes reporting [1]. Uslu and Stausberg found that as time goes by, there are increasing findings of the benefits of EMR usage in

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healthcare workflow, meaning that more healthcare practitioners become aware of the advantages of using such technology [8].

Even though Indonesia's Ministry of Health mandated this transition, the process of this transition is often found to be challenging, mostly caused from user's knowledge of the system. Senishaw et al. stated that users' willingness to use EMR is related to good knowledge, because those with good knowledge can exploit the advantage of using the technology in their workflow, which is similar as stated by Woldemariam and Jimma that how the system is adopted depends on the influence between the user and the system [9], [10]. Hailegebreal et al. also states that users with good computer knowledge tend to be ready for EMR transition compared to those with lower knowledge [11]. Shiferaw et al. divides this knowledge into five aspects of digital competency, which consists of problem-solving, safety, communication, content-creation, and information processing, according to European commision's digital competency framework [12]. Furthermore, Borges do Nacimento et al. also states that while low literacy, the difficulty of understanding the technology used, and even technophobia contribute to user-related challenges to EMR implementation, providing personnel with adequate training tailored to each personnel need and providing high quality and real-time technical support will mitigate these challenges which reduce these conflicts in daily workflow [13]. McMillan et al. also stated that poor navigation and learning of the system used contributes toward increasing work-related stress and burnout [14].

As stated before, adapting a newer technology such as EMR requires the user to understand and gain knowledge so that the system will work smoothly. Some tools aim to assess users' knowledge regarding health technology and how they interact with it in daily practice. Some of these tools are The Unified Theory of Acceptance and Use of Technology (UTAUT), created by Venkatesh and the e-Health Literacy Questionnaire (eHLQ), created by Kayser et al. [14],[15]. The Unified Theory of Acceptance and Use of Technology, or UTAUT, was created by Venkatesh. Alomari and Soh state that UTAUT was created to assess user technology acceptance by integrating the Technology Acceptance Model (TAM) with seven other theories: Theory of Reasoned Action (TRA), Unified Theory of Planned Behavior and Acceptance, Theory of Motivation, Theory of Planned Behavior, Theory of Computer Use, Theory of Diffuse Innovation, and Theory of Social Cognition [17]. Liu et al. And Jones et al. describes four dimensions of UTAUT, consisting of Performance Expectancy (PE), which refers to the "degree to which an individual believes that using the system will help them attain gains in performance," Effort Expectancy (Effort Expectancy), refers to "degree of ease associated with the use of the system," Social Influence (SI) refers to "the degree to which that important others believe they should, and Facilitating Condition (FC) refers to "the degree to which an individual believes that organizational and technical infrastructure exists to support the use of the system." All of these dimensions will contribute to the user's behavioral intention to use technology, which is divided into 4 statements [17],[18].

E-Health Literacy Questionnaire (eHLQ) was created by Kayser as an assessment tool to understand and evaluate an individual interaction with digital health technology [20]. This questionnaire is based on the concept of e-health literacy, which was first defined by Norman as the "ability to find, understand, and process health information and apply gained knowledge to solve health problems [21]." Norgaard then divided it into seven dimensions of e-health Literacy: eHL1, "ability to process information," eHL2 "Engagement in one's own health," eHL3 "Ability to engage with digital services actively," eHL4 "Feel safe and in control," eHL5 "Motivated to engage with digital services," eHL6 "Access to digital services that work," and eHL7 "Digital services that suit individual needs [22]." Kayser further created the eHL Questionnaire, an assessment tool based on seven dimensions of e-health containing 35 items. Even though many studies have implied the importance and benefit of EMR, the adoption process in many hospitals still needs to be met with challenges, especially in resource-limited settings and healthcare facilities undergoing transition from paper-based media records to EMR, which, as stated by Yilma et al., might contributed from poor management of basic digital training and EMR knowledge [23]. While technology acceptance is mainly used to assess personnel willingness to use EMR, e-health Literacy could be employed instead to assess users' experience and knowledge during the implementation of EMR. Hence, this study investigates if e-Health Literacy could influence technology acceptance to increase intention to use EMR.

With these tools, we aim to understand how e-health literacy could moderate technology acceptance to improve their intention to use EMR. Based on these aims and theory, we formed the following hypothesis: Hypothesis 1 (H1): Technology Acceptance has a positive impact on intention to use without moderation of e-health literacy; Hypothesis 2 (H2): Technology Acceptance moderated with e-health literacy has a positive impact toward intention to use EMR; and Hypothesis 3 (H3): e-Health Literacy by itself has a positive impact toward intention to use EMR.

The contributions from Examining the Influence of e-Health Literacy on Healthcare Workers' Acceptance of Electronic Medical Records: An Insight Into System Transition include:

a. Understanding the Role of e-Health Literacy

This research explores the importance of e-health literacy in shaping health workers' attitudes and behavior toward the implementation of Electronic Medical Records (EMR). It also highlights how digital literacy impacts the ease of transition from traditional to electronic systems, which is critical in improving overall healthcare delivery.

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b. Integration of Technology Acceptance Models

By examining EMR acceptance, this research builds on and expands existing models, such as the Technology Acceptance Model (TAM). This model includes e-health literacy as a key factor, offering a nuanced perspective on system adoption. This approach bridges the gap between theoretical models of technology acceptance and practical implications in health care.

c. Focus on Healthcare Workers During System Transition

In contrast to many studies that focus on patients or administrative aspects, this study emphasizes the perspective of healthcare workers, an important but often overlooked stakeholder group in the digital transformation of healthcare systems. Insights into employee buy-in can inform strategies for a smoother transition to EMR in the clinical setting.

The research gap for this quantitative study is the need for more research that examines e-health literacy among health workers, who play an important role in implementation. Research on how e-health literacy influences the adoption of this technology is lacking, especially in overcoming technical and usage barriers. Plus, most research is conducted in developed countries with good digital infrastructure, so it needs to reflect the social, cultural, and economic context in developing countries [24].

2. MATERIALS AND METHOD

A. Study Design and Study Setting

This cross-sectional research was conducted in Dr. Soetarto Army Hospital, a first level Indonesian National Army Hospital serving as a regional army healthcare center in Yogyakarta, Indonesia. By the time of this research being conducted, the hospital has undergone medical record transition into EMR implementation for 6 months. Data collection was performed on March 2024, using total sampling collection.

B. Sample Size and Sampling

Respondents involved in this research were healthcare personnel who act as caregivers to patients while also acting as inputters and documenters of patients medical data, meaning data containing patient's medical information such as anamnesis, vital signs, S.O.A.P (Subjective, Objective, Assessment, and Plan), laboratory results, expertise of radiology imaging, and therapy plan. The initial collected data consists of 155 respondents, consisting of 95 nurses, 9 general practitioners, 11 specialistic practitioners, 5 radiographers, 7 laboratory staff, 5 physiotherapists, 5 pharmacists, 12 midwives, and 6 head of care units. This number was then reduced with exclusion criteria of personnel with less than 1-year of working experience and staff positioned as the care unit's head. After the exclusion, there was a total of 114 respondents' data.

C. Variables

Variables in this modified questionnaire consists of items from UTAUT-1 and eHL Questionnaire, which consists of Performance Expectancy (PE) containing 2 items, Effort Expectancy (EE) containing 3 items, Social Influence (SI) containing 3 items, and Facilitating Conditions (FC) containing 4 items, eHL 1 containing 4 items, eHL 2 containing 3 items, eHL 3 containing 4 items, eHL 4 containing 5 items, eHL 5 containing 5 items, eHL 6 containing 5 items, eHL7 containing 4 items, and Intention to Use (IU) containing 4 items.

D. Data Collection Instruments

This research uses a questionnaire adapted from UTAUT and an eHL questionnaire with 46 items. These statements were measured using a Likert scale ranging from 1 to 5, with the lowest and the highest interpreted as strongly disagree and strongly agree, respectively. We explain to the respondent on how to fill the questionnaire and distributed it using kuesio.id platform. The respondents filled out the questionnaire by themselves without assistance.

E. Statistical Analysis

Data gained was analyzed using Smart-PLS 4.0. The questionnaire's validity and reliability were tested using outer loadings to determine convergent validity, with a value less than 0.7 will bedeemed invalid and removed from the model. We then assess construct reliability, construct validity, and discriminate validity, with reliability achieved when the value of Cronbach-α was higher than 0.7 and validity achieved when Average Value Extracted (AVE) was higher than 0.5 according to Fornell & Larcker. Data bootstrapping is then employed to analyze the model fit, using Chi-square, Standardized Root Mean Square Residual (SRMR), and Normed Fit Index (NFI) as parameters, with good fit was deemed when Chi-square value is non-significant, SRMR value is <0.08, and NFI value close to 1, respectively [25].

F. Ethical Concerns

This study is approved by University of Muhammadiyah Yogyakarta, Health Research Ethics Committee, with the date 24 February 2024, and approval number of No. 115/EC-KEPK FKIK UMY/II/2024 . Before data collection performed, all respondents were explained about the purpose of this study and asked to fill written inform consent, which all respondents have consented their willingness to participate in the study.

3. RESULTS

A. Demography of Respondents

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Table 1 shows the demography of respondents participating in this research. Most of the respondents are nurses who often being both medical data inputter and medical caregiver. Majority of the respondents are are also dominated by young adult populations, while female respondents also become the majority number.

Table 1. Distribution of Respondents

	Frequency (n)	Percentage (%)
Profession		
Nurses	95	61.3
General Practitioners	9	5.8
Specialist Practitioners	11	7.1
Radiographers	5	3.2
Laboratory Staffs	7	4.5
Physiotherapists	5	3.2
Pharmacists	5	9.0
Midwives	12	7.7
Working Experience		
More than 1 year	114	73.5
Age		
20-30	73	64.0
30-40	21	18.4
40-50	20	17.5
Gender		
Male	20	17.5
Female	94	82.5

B. Construct's Validity and Reliability

In the initial outer loading, some of the variable's value, namely EHL1-2, EHL1-3, EHL4-1, EHL4-3, EHL4-4, EHL6-2, EHL6-3, EHL6-4, EHL6-5, EE3, FC3, FC4, and PE1 are found to be less than 0.7, and because of this, these variables are considered invalid and thus will be removed from model fit. After removal, convergent validity shows the remaining loadings value higher than 0.7, with the exception of IU2 and IU3. However, considering IU2 and IU3 is not too far from 0.7, both are still retained and included in the model fit. Table 2 shows all values of Cronbach-α, Composite reliability, and AVE shows values higher than 0.5, meaning that all variables achieved construct reliability, while Fornell-Larcker criterion shows most of the constructs value less than 1, except for the moderating effect value since it was correlated with itself. This means that all constructs have achieved discriminants validity.

Further explanation in Table 2 above shows that Cronbach-α measures the internal reliability (consistency) of the items used to measure certain constructs. A generally accepted value is > 0.7 to indicate good reliability—composite Reliability: Measures overall reliability (similar to Cronbach-α but more sensitive to model structure). A value > 0.7 indicates good reliability. Average Variance Extracted (AVE): Assesses convergent validity, namely the extent to which the construct explains the variance of the items. A value > 0.5 indicates adequate validity. Intention to Use Technology Acceptance: Displays the relationship (correlation) value between variables. Higher values indicate stronger relationships.

Table 2. Construct Reliability and Discriminant Validity (Fornell-Larcker Criterion)

	Cronbach-α	Composite reliability	Average Value Extracted (AVE)	Intention to Use	e-Health Literacy	Moderating Effect	Technology Acceptance
Intention to Use	0.718	0.814	0.526	0.725			
e-Health Literacy	0.967	0.969	0.602	0.810	0.776		
Moderating Effect	1.000	1.000	1.000	0.525	0.468	1.000	
Technology Acceptance	0.908	0.925	0.608	0.700	0.853	0.296	0.780

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Table 3. Model Fit Summary

	SRMR	Chi-Square	df	p-value
Saturated Model	0.087	1389.755	27	0.0001
Estimated Model	0.088	1399.194	27	0.0001

SRMR: Standardized Root Mean-Square Residual; NFI: Normed Fit Index

Thus, Intention to Use: Cronbach-α 0.718 (fairly reliable), Composite Reliability 0.814 (good reliability), AVE 0.526 (adequate convergent validity), and the relationship with other variables is moderate to strong (example: 0.725 with e-Health Literacy). E-Health Literacy: Cronbach-α 0.967 (very reliable), Composite Reliability 0.969 (very good), AVE 0.602 (adequate convergent validity), and the relationship with other variables has a fairly strong correlation, such as 0.776 with the Moderating Effect. Moderating Effect: Cronbach-α, Composite Reliability, and AVE: All value 1,000, indicating perfect measurement. This usually occurs when the moderation effect is calculated as a single construct without separate items. The relationship with other variables shows a low to moderate correlation with other variables (example: 0.525 with Intention to Use). Meanwhile, Technology Acceptance: Cronbach-α 0.908 (very reliable), Composite Reliability 0.925 (very good reliability), AVE: 0.608 (adequate convergent validity). The relationship with other variables has a fairly strong correlation with other variables (example: 0.780 with e-Health Literacy). Overall, the reliability (Cronbach-α and CR) and validity (AVE) values show that the constructs in this research are quite strong and valid. The relationship between variables shows that there is a relevant relationship to explain the research conceptual model. However, some variables have a weaker correlation (for example, 0.296 between Moderating Effect and Technology Acceptance).

C. Model Fit Summary

Table 3 shows the saturated model and estimated model. The value of SRMR, even though it is higher than 0.08, is still considered to be reasonably fit, considering that the value is still in the range of accepted value, though higher. NFI value also shows a reasonable fit, even though it is close to the mid-value of 0.5. However, with a Chi-Square value of 1389.755 and probability (p-value) of 0.0001, it is deemed significant, and the model may not fit perfectly.

D. Regression and Moderation Effect Analysis

Table 4 and Figure 1 show the regression analysis of the model. E-Health Literacy by itself ($\beta = 0.621$, $p < 0.001$) significantly impacts Intention to use. In contrast, the moderation effect of e-Health Literacy on Technology Acceptance ($\beta = 0.251$, $p = 0.006$) also significantly impacts Intention to Use. On the other hand, Technology Acceptance by itself ($\beta = 0.111$, $p = 0.391$) does not significantly impact the Intention to Use, thus the hypothesis is rejected. R-Square value shows that all of the independent variables used in the model, namely Technology Acceptance, e-health Literacy, and Technology Acceptance moderated with e- health Literacy, are able to explain 68.6% variation of Intention to Use EMR.

Table 4. Regression and Moderation Effect Analysis

Hypotheses	Independent Variable	Dependent Variable	Path Coefficient	Sample Mean	Standard Deviation	P-Value	Decision	R-Square	R-Square Adjust
H1	Technology Acceptance	Intention to Use	0.111	0.111	0.129	0.391	Rejected	0.686	0.678
H2	Technology Acceptance * e-Health Literacy		0.251	0.248	0.092	0.006	Supported		
H3	e-Health Literacy		0.621	0.631	0.142	<0.01	Supported		

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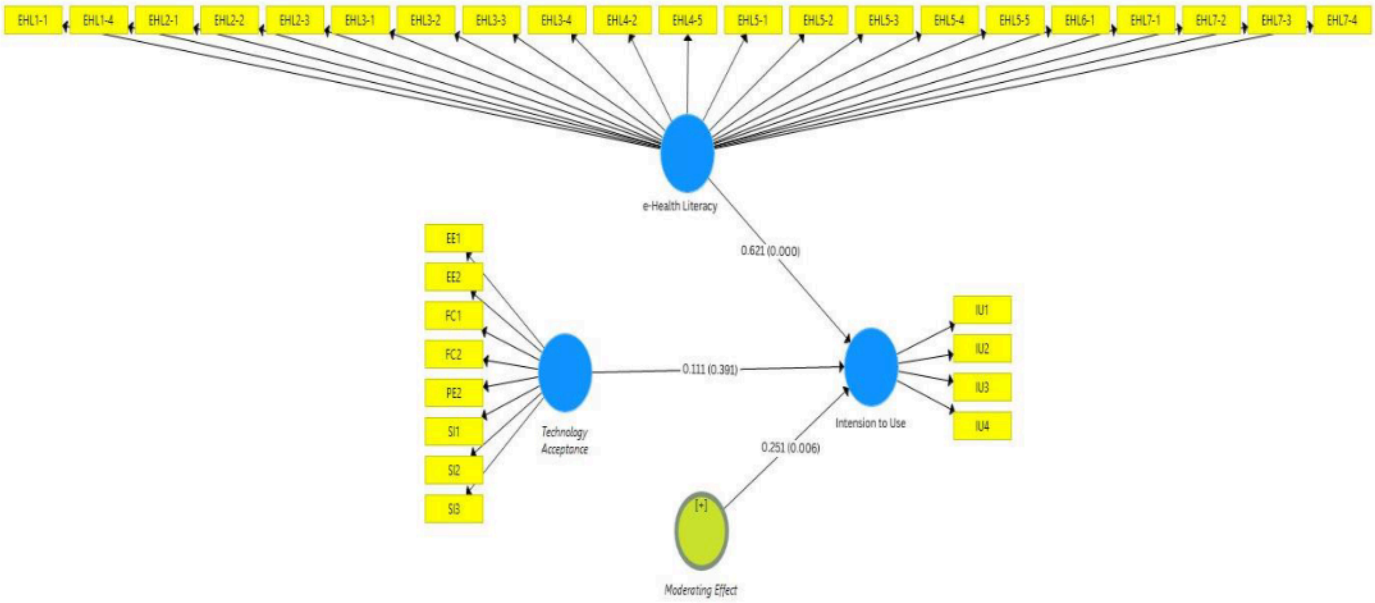

Fig. 1. Result of Regression Analysis.

Designed by Kayser as a tool to assess healthcare personnel's literacy and knowledge of health technology and also how it influences technology acceptance to increase intention to use health technology [20]. Our findings reveal that e-health Literacy significantly impacts the intention to use by itself and by moderating technology acceptance. In Dr. Soetarto Army Hospital, we find that respondents scored high ("strongly agree") in most of the statements, signifying their understanding of the system used. These findings are consistent with a study conducted by Cheng et al. that found e-health Literacy was strongly associated with EMR use, where those with better literacy are 3 to 4 times more willing to use EMR than those with lower literacy [26]. Hailegebreal et al. stated that people with good knowledge tend to be more willing to use EMR [11], and Ankit et al. also stated that the ease of learning the system used will increase personnel's willingness to use it and further become expert in using it [27].

Increased literacy will also help mitigate the challenges encountered during the implementation of EMR since healthcare personnel are the end-users of EMR and thus play an essential role in ensuring the continuity of EMR usage. Walle et al. said that increased digital literacy help increase user's intention to use the system [28]. Abore et al. states that the lack of staff training and socialization to use EMR might contribute to concern personnel have that their workflow will be disrupted because they do not understand the system and encounter difficulties with it, while Ayamolowo et al. found that the difficulties to understand terminologies and the system itself might contribute to less intention to use [29], [30].

4. DISCUSSION

This study shows that personnel's e-health literacy might have increased after EMR usage as it does significantly impact assessing personnel literacy and how it influences their EMR usage after interacting with said system. Kayser performed a study in Denmark using an e-health Literacy Questionnaire to assess healthcare personnel literacy and system experience after three months of EMR implementation [16]. According to this, good training during implementation help increases user's willingness to use the system, by helping the user to understand this new system and give them positive experience using the system in their workflow. As stated by Senishaw, providing training to learn the system will contribute to increased understanding, particularly computer skills. With this increase, user's willingness to use it will also be improved because they are more comfortable using it with these understanding on how the system works [9].

The lower significance of technology acceptance and its impact on intention to use is intriguing. According to Loveth, lower acceptance might be caused by the awareness that there are challenges in adopting the system, like infrastructure (electricity and connectivity) or training [1]. On the other hand, a study by Akwaowo et al. stated that while infrastructure is necessary, the system's security and the data's safety are more of a concern to users [31]. Van Poelgeest also found that even though the ability to access patient's data is important, the lack of data caused by missing information might cause a hindering system [32]. This similar situation, combined with the enforced Indonesian Ministry of Health instruction, might have a negative impact on the adoption of EMR as usage of EMR is being enforced while healthcare facilities and their personnel might still not be ready to start the implementation, be it from the infrastructure, the user, or even the management itself.

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The proven hypothesis of this study shows that technology acceptance gains a more significant impact on intention to use EMR when moderated with e-health Literacy compared to itself. While Venkatesh created UTAUT itself to complement Davis's first technology acceptance model to improve validity, the condition shown in this study does not mean that UTAUT is insignificant [15]. Instead, UTAUT may become a starting point for assessing the initial implementation of health technology by determining what the user expects when a new technology is introduced into their workflow. At the same time, e-health Literacy might be used as a tool to evaluate the system and the user's experience and thought during their time using the new technology, and thus using the data gained as a guide to improve the system into a better one that fits every user's needs.

As presented in the results section, while the model fit and hypothesis testing are acceptable, there is potential for improvement. The complexity of the instruments used may have influenced the fit in Indonesia's Healthcare setting, and thus requires further proper and systematic adaptation [33]. Additionally, a cross-sectional study design might only partially capture the hospital's current conditions and representative sample size [20]. However, despite these limitations, the model remains acceptable for decision-making in improving EMR adoption. Therefore, a longitudinal study is highly recommended for future research to provide a more comprehensive understanding. Moreover, further studies on the proper translation and adaptation of instruments within the Indonesian healthcare setting are suggested to enhance their applicability and accuracy.

E-health is an important innovation development in the world of health because it is considered capable of making it easier for health workers to treat patients [34]. Health literacy refers to an individual's knowledge, motivation, and competence in accessing, understanding, assessing, and applying health information to make appropriate judgments and decisions regarding health care, disease prevention, and health promotion in daily life [35]. eHealth literacy encompasses the set of skills and knowledge necessary for effective engagement with technology-based health devices [36].

In the United States, more than 90 million people have low health literacy [37]. The result is that individuals who demonstrate low health literacy are less likely to utilize preventive services and eHealth resources, which is correlated with poor health outcomes [36]. The same findings are found in Africa, which is the country with the lowest health literacy, so naturally, this country is concerned about poor nutrition [38]. Meanwhile, in India, it shows that digital health literacy is in rural areas (20.1%) and urban areas (20.8%); this finding is supported because in urban areas, 36.5% have smartphones, and 45.9% have analog phones. Standard, whereas in rural areas, the figure is 19.5% for smartphones and 38.4% for standard analog phones [39].

In contrast, Bangladesh, with a population of 115 million, has experienced significant progress in IT adoption since 2009. In the last 2-3 years, Bangladesh established a data center in the Ministry of Health to consolidate data from various health facilities, using OpenMRS in hospitals, along with Electronic Civil Registration and Vital Statistics (CRVS) integrated with National Unique ID. DHIS2 is used for reporting systems at the central and regional levels. Like other developing countries, Bangladesh continues to face challenges related to inadequate infrastructure and limited human resource capacity [40]. Indonesia itself is still classified as having medium health digital literacy; the 2022 Kominfo data confirm this condition; the Indonesian people's digital literacy index is at 3.54 on a scale of 5 [41] Thus, increasing digital literacy is important to ward off hoax health information in the digital era [42].

5. CONCLUSION

This study reveals that e-health Literacy empowers technology acceptance to increase healthcare personnel's intention to use EMR. While technology acceptance might be used as an initial assessment of implementation, increasing users' e-health literacy plays a critical factor in supporting the adoption of EMR so that it will not disrupt personnel's workflow and instead integrate it smoothly. This study suggests that integrating targeted e-health literacy programs into professional development will help improve EMR usage and healthcare efficiency, with the aim to increase user's literacy so they will be more comfortable in using the system. The analysis of the research data indicates that the P-value for the Independent Variable, Technology Acceptance (0.391), was rejected, whereas Technology Acceptance e-Health Literacy (0.006) and e-Health Literacy (<0.01) were supported. The utilization of technology among the broader population remains unevenly dispersed, particularly in rural regions classified as distant, where infrastructure continues to lag. Future policies made by organization or government should be focused on training for users that will help them be more encouraged, with the training should be proper and easy to understand for users. Future studies should further explore long-term impacts of eHL in EMR implementation, and how eHLF could be applicable in Indonesia healthcare setting.

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