Journal of Health Informatics in Africa

Perceptions of Primary Healthcare Practitioners on the Effectiveness of Electronic Health Records Systems for Decision Support in Tanzania

Augustino Mwogosi [a, *], Steven Kibusi [b], Deo Shao[a]

[a] Department of Information Systems and Technology, University of Dodoma, Dodoma City, Tanzania
[b] Department of Public Health, University of Dodoma, Dodoma City, Tanzania

Background and Purpose: This study examined primary healthcare practitioners' perceptions of the effectiveness of Electronic Health Records (EHR) systems in providing decision support in Tanzania.
Methods: The study employed a quantitative research approach, utilising surveys and structured observations to collect data from healthcare practitioners in PHC settings. Descriptive statistical analysis was conducted to assess the functionalities and utilisation of EHR systems.
Results: The findings revealed that while EHR systems in PHC facilities offer certain benefits, such as facilitating access to patient information and improving administrative processes, there are limitations in their ability to support decision-making tasks effectively. Specific areas for improvement are identified, highlighting the need for targeted interventions to enhance the functionality of EHR systems in PHC settings.
Conclusions: This study underscores the importance of addressing the identified limitations in EHR systems to optimise their effectiveness in supporting decision-making tasks in PHC settings in Tanzania. Targeted interventions are essential to enhance EHR functionality and improve healthcare delivery outcomes.

Keywords: Electronic Health Records, Decision Support, Primary Healthcare, Tanzania, EHR systems, Implementation

1 Introduction

Digital technologies have revolutionised several industries worldwide, bringing a new era of productivity, accessibility, and operational efficiency. Technology developments, in particular, have created creative solutions that have transformed patient care and medical practice [1]. Electronic Health Records (EHR) are organised collections of digital health data for specific individuals or groups of patients. They originated from the first attempts to computerise medical data in the 1960s [2]. These technologies, which offer thorough records of patient contacts and streamline workflows in healthcare settings, are incorporated into network-connected information systems called EHR systems that span the healthcare enterprise [3]. EHR systems enhance safety through evidence-based decision support, quality management, and outcome reporting, improving care quality, efficiency, and continuity while fostering coordinated care among healthcare providers [4].

In addition to facilitating patient engagement and care coordination, EHR systems simplify population health management and research endeavours. Researchers and healthcare professionals can learn more about trends in population health, treatment effectiveness, and sickness patterns by combining identified patient data [5], [6]. Communities' health and well-being can be enhanced by using this data to identify public health problems, customise care, and allocate resources wisely. Moreover, seamless sharing among healthcare providers is made possible by the accessibility of medical records via EHR systems, which improves care transitions and raises the bar for safety and quality across the board [7], [8]. Technology

*Corresponding author address: mwogosia@gmail.com
 J Health Inform Afr. 2024;11(3):1-18. DOI: 10.12856/JHIA-2024-v11-i3-493

integration, especially with EHR systems, improves individual patient care, advances population health management and research, and improves overall healthcare.

EHR systems enhance healthcare practitioners' decision-making capabilities by integrating clinical decision-support tools such as alerts, reminders, and recommendations embedded within EHR systems. It improves diagnostic accuracy and adherence to best practices, reducing errors and upholding clinical standards. Furthermore, EHR systems generate large volumes of data, which can be leveraged for analytics and predictive modelling, assisting healthcare practitioners in identifying patterns, assessing patient risk, and formulating treatment strategies. Moreover, EHR systems streamline care coordination by providing a centralised platform for accessing and updating patient data, ensuring effective collaboration among the care team and informed decision-making [9].

Tanzania's healthcare system operates within a well-structured pyramidal framework from local to national. Primary healthcare (PHC) services, including dispensaries, health centres, district hospitals, and community-based health services, serve as the foundation of this structure, emphasising prevention and health promotion. Health centres provide inpatient and outpatient care, while dispensaries focus on basic labour, delivery, and outpatient services. District hospitals handle referrals from health centres for medical and surgical procedures. In contrast, regional referral hospitals offer specialised care and serve as educational institutions [10]. The Ministry of Health (MoH) is responsible for health and social welfare services, setting policies, providing guidance, and mobilising resources. PORALG oversees service delivery at regional and council levels, with Regional Health Management Teams (RHMTs) monitoring and enhancing local government agencies' capacity. District Council Health Management Teams (CHMTs) offer support for preventive, rehabilitative, and curative health services through capacity building and supervision.

Both public and private healthcare organisations in Tanzania have embraced technology, particularly EHR systems, to enhance healthcare delivery. The government of Tanzania recognised the potential benefits of EHR systems. It developed the Government of Tanzania Health Operations Management Information System (GoT-HoMIS) to address challenges associated with paper-based systems [11]. Various hospitals in Tanzania utilise vendor-based EHR systems such as JEEVA and MedPro to manage hospital functions comprehensively, improving the standard of treatment by providing medical professionals with access to patient information stored across different locations. Moreover, systems like webERP, Care2x, Harmony, Bumi Expert, Daisa, and the locally developed Electronic Health Management System (eHMS) contribute to Tanzania's diverse electronic healthcare management environment, streamlining administrative procedures and improving care quality [12]. Private healthcare facilities have also implemented EHR systems, revolutionising patient data management and improving healthcare service delivery. Despite slower adoption in PHC facilities, recent efforts aim to incorporate EHR systems to enhance the effectiveness, accuracy, and accessibility of patient data, ultimately improving the standard of care provided at these facilities [13], [14].

Tanzania's adoption of EHR systems marks a significant advancement in healthcare technology. However, there remains a critical gap in understanding how PHC practitioners perceive the effectiveness of these systems, particularly in the context of decision support. In this study, "decision support" refers to the suite of functionalities within EHR systems designed to assist healthcare practitioners in making informed clinical decisions [15]. These functionalities include, but are not limited to, drug-allergy interaction checks, detection of duplicate treatments, and drug dosage warnings. Furthermore, decision support extends to tools that facilitate clinical data interpretation, such as preventive care reminders and diagnostic support [16], [17], [18], [19], [20]. While features like order administration and information retrieval are essential for overall workflow efficiency, this study focuses on those EHR functionalities that directly impact the quality and safety of clinical decision-making. Given these considerations, the central research question guiding this study is: How do primary healthcare practitioners in Tanzania perceive the effectiveness of EHR systems in supporting clinical decision-making, mainly through specific decision-support tools such as drug-allergy interaction checks, duplicate treatment detection, and dosage warnings? By examining PHC practitioners' perceptions of these specific decision-support tools, the study seeks to identify the strengths and limitations of current EHR implementations in Tanzanian PHC settings.

Understanding how frontline healthcare practitioners perceive these systems is crucial for identifying gaps in current EHR system implementations and guiding future improvements in EHR system design and training programs, ultimately enhancing patient care quality and safety in Tanzanian PHC settings.

 J Health Inform Afr. 2024;11(3):1-18. DOI: 10.12856/JHIA-2024-v11-i3-493

The rest of the paper is structured as follows: First, we present the synthesis of the literature review. Then, we describe the conceptual framework of our study. We describe the material and methods that guide this study, followed by the results. Finally, we discuss the implications of the findings and conclude the study.

2 Literature Review

The implementation and effectiveness of EHR systems in healthcare settings have been widely studied, particularly in developed countries[21], [22], [23], [24]. However, the unique challenges and opportunities in low-resource settings, such as those in Tanzania, remain underexplored. This literature review synthesises current research on the role of EHR systems in supporting clinical decision-making, focusing on their perceived usefulness, ease of use, and actual usage by healthcare practitioners in PHC facilities.

EHR systems are digital platforms designed to store, manage, and share patient health information across different healthcare settings[25], [26], [27], [28]. These systems are known for their potential to improve healthcare delivery by enhancing the accuracy and accessibility of patient data, streamlining administrative processes, and supporting clinical decision-making through integrated decision-support tools[5], [29], [30], [31]. According to Mwogosi [32], EHR systems are integral to modern healthcare, providing a comprehensive and accessible record of patient interactions that improve the continuity of care and facilitate coordinated treatment across providers.

In Tanzania, the adoption of EHR systems has been driven by the government's efforts to modernise healthcare delivery and address the inefficiencies of paper-based records [33]. The Government of Tanzania Health Operations Management Information System (GoTHoMIS) is one such initiative aimed at enhancing the management of patient information and improving healthcare outcomes[34], [35]. Despite these advancements, the effectiveness of EHR systems in supporting clinical decision-making, particularly in resource-constrained PHC facilities, has been mixed [36].

Studies have shown that when healthcare practitioners perceive EHR systems as valuable, particularly in supporting clinical decision-making, they are more likely to integrate them into their daily workflows. For instance, Kruse et al. [5] found that EHR systems that provided robust decision-support tools, such as alerts and reminders, were more likely to be used effectively in clinical settings. However, the ease of use of these systems also plays a significant role. Systems that are difficult to navigate or require significant time to input or retrieve data can hinder their perceived usefulness, leading to lower adoption rates[37].

Clinical decision support (CDS) systems embedded within EHR platforms are designed to assist healthcare providers in making more informed and timely decisions [15]. These tools can include drug-drug interaction checks, dosage recommendations, preventive care reminders, and diagnostic support [38], [39]. According to Sutton [40], effective CDS systems can potentially reduce medical errors, enhance diagnostic accuracy, and improve adherence to clinical guidelines. However, the integration and effectiveness of these tools vary significantly across different EHR systems.

The adoption and effectiveness of EHR systems in low-resource settings like Tanzania face several unique challenges. Infrastructure limitations, such as unreliable electricity and internet connectivity, can significantly hinder the implementation and use of EHR systems. Furthermore, the lack of technical support and training for healthcare practitioners further exacerbates the difficulties in effectively utilising these systems [41].

Moreover, cultural and organisational factors are crucial in accepting and using EHR systems [42]. For instance, resistance to change among healthcare practitioners, particularly those accustomed to paper-based records, can slow the adoption of EHR technologies [43]. Furthermore, the perceived complexity of the systems and concerns about data security and patient privacy may further discourage their use [44], [45].

There is limited knowledge about the effectiveness of EHR systems in supporting clinical decision-making within PHC facilities in Tanzania. While EHR systems have been implemented to modernise healthcare delivery, the extent to which these systems truly enhance decision-making processes at the PHC level remains underexplored. The scarcity of empirical data on how healthcare practitioners perceive and utilise these systems for decision support highlights the need for focused research to understand better and optimise the role of EHR systems in improving patient care in Tanzania's PHC settings.

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3 Conceptual Framework

The conceptual framework for this study is anchored in the Technology Acceptance Model (TAM), a well-established theory used to understand how users come to accept and use technology[46], [47]. TAM suggests that two primary factors, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), significantly influence an individual's intention to use and actual use of technology[45], [48]. In the context of this study, which examines the effectiveness of EHR systems in supporting clinical decision-making in PHC facilities in Tanzania, TAM provides a valuable lens through which healthcare practitioners' perceptions can be understood.

Perceived Usefulness (PU) in this framework refers to the degree healthcare practitioners believe EHR systems enhance their job performance, particularly in clinical decision-making[47]. The study measures PU by evaluating practitioners' perceptions of the effectiveness of various decision-support functionalities within EHR systems, such as alerts, reminders, drug-allergy interaction checks, and diagnostic support tools[16], [20], [49], [50]. These functionalities are critical as they directly impact the ability of healthcare providers to make informed clinical decisions, which is a crucial goal of implementing EHR systems in healthcare settings[51], [52], [53].

Perceived Ease of Use (PEOU) is another vital concept in this framework. It pertains to how healthcare practitioners find the EHR systems user-friendly[47], [54]. It includes the ease with which practitioners can navigate the system, access patient data, and use the available tools without undue effort. The study assesses PEOU through feedback on the usability of EHR systems like GoTHoMIS Lite, eHMIS, Care2X, and AfyaPro. Systems that are easier to use are expected to be perceived as more beneficial, thus influencing their overall acceptance and utilisation [47].

The concept of actual system use is also central to the framework. It represents the degree to which EHR systems are adopted and utilised in daily clinical practice. This is measured by the frequency of use of decision-support features, the duration of experience practitioners have with the systems, and the variability of system use across different facilities (public versus private). The framework posits that the more valuable and easier-to-use an EHR system is perceived, the more likely it is to be used regularly by healthcare practitioners [48].

Clinical decision support (CDS) within the EHR systems is another crucial component, encompassing tools designed to aid healthcare providers in making more accurate and timely clinical decisions [15]. The study evaluates the effectiveness of these CDS tools, including functionalities like drug-drug interaction checks, dosage warnings, and preventive care reminders [31]. The actual use of these tools is hypothesised to improve clinical decision-making and, ultimately, patient care quality in PHC settings.

In this framework shown in Figure 1, the relationships among these concepts are interconnected. The PEOU of an EHR system is expected to positively influence its perceived usefulness, which in turn impacts the actual usage of the system. The more a system is used, particularly its decision-support features, the more it is expected to enhance clinical decision-making processes. This conceptual framework not only guides the analysis of the data collected from healthcare practitioners but also helps identify areas for targeted improvements in EHR systems to optimise their effectiveness in supporting clinical decisions in Tanzanian PHC facilities.

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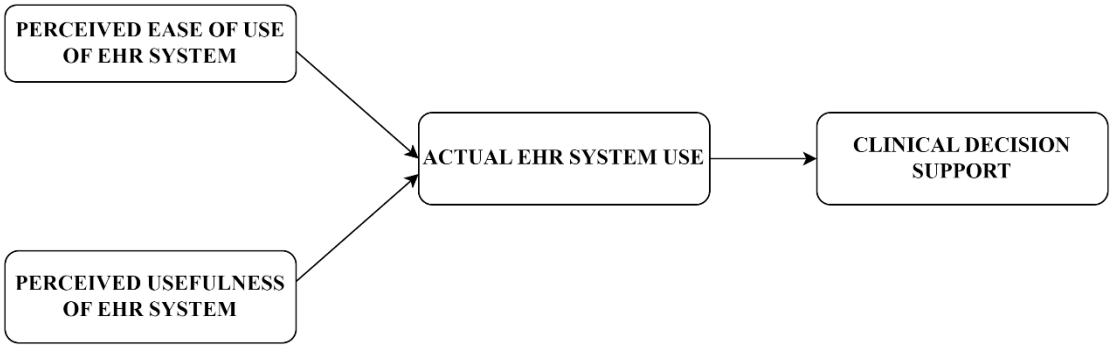

Figure 1: Conceptual Framework (**Source:** Researchers' work)

4 Materials and methods

4.1 Study Setting and Design

This study was conducted in the Dodoma region of Tanzania, a rapidly growing area with over 3 million residents and 644 healthcare facilities, including 475 PHC facilities. The region was selected due to its representative nature and the availability of diverse healthcare facilities, making it an ideal setting for evaluating the implementation and impact of EHR systems on decision-making processes in PHC settings.

A cross-sectional, quantitative research design was adopted to assess primary healthcare practitioners' perceptions of the effectiveness of EHR systems in providing decision support. This design was chosen for its ability to provide objective, quantifiable insights across a large sample of healthcare practitioners, enabling generalisable findings relevant to similar contexts.

4.2 Participants and Sampling

The study targeted a diverse group of participants, including medical doctors, clinical officers, nurses, laboratory staff, healthcare managers, health information personnel, IT professionals, and policymakers working in PHC facilities within the Dodoma region.

The inclusion criteria were:

1. Healthcare practitioners and administrators are directly involved in PHC delivery in the Dodoma region.
2. PHC facilities that had implemented and utilised EHR systems.
3. Facilities representing a mix of public and private ownership types

Exclusion criteria included:

1. PHC facilities that had not implemented or utilised EHR systems.
2. Facilities located outside the Dodoma region.
3. Facilities serving specialised populations exclusively.
4. Practitioners who did not consent to participate.

A multi-stage sampling procedure was employed, combining random, stratified, purposive, and snowball techniques to ensure a representative sample of PHC facilities. Initially, a comprehensive list of PHC facilities was compiled and categorised by facility type (e.g., district hospitals, health centres, dispensaries). Among the 475 PHC facilities in the region (see Table 1), only 49 had implemented and used EHR systems.

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Table 1: Number of PHC facilities in Dodoma region

Facility Type	Managing Authority	Total number of facilities	Facilities using EHR systems
District Hospital	Public	7	7
Hospital at the district level	Private	3	3
Health center	Public	55	20
	Private	6	6
Dispensary	Public	325	3
	Private	79	10
Total		**475**	**49**

Source: Researchers' work

4.3 Sample Size Calculation and Allocation

The sample size was determined to include 37 out of the 49 PHC facilities in the Dodoma region that had implemented EHR systems. This size was calculated to ensure a 95% confidence level with a 5% margin of error, providing a representative sample of facilities. The sample was then proportionally allocated across different facility types, as summarised in Table 2, to ensure that each type was appropriately represented in the study.

Table 2: Sample Size Calculation for each stratum

Facility Type	Managing Authority	N_i	$\frac{N_i}{N} * n$
District Hospital	Public	7	5
Hospital at the district level	Private	3	2
Health centre	Public	20	15
	Private	6	5
Dispensary	Public	3	2
	Private	10	8
Total		**49**	**37**

Source: Researchers' work

4.4 Data Collection Instruments

Data were collected using a structured questionnaire and an observation checklist. The questionnaire was developed for this study and aimed to capture detailed information on EHR system functionalities' use and perceived effectiveness, focusing mainly on decision-support capabilities. The questionnaire included closed-ended and open-ended questions to allow for comprehensive responses. The instrument was pre-tested with a small group of practitioners to ensure clarity and relevance before full deployment.

Structured observations were conducted in a subset of PHC facilities to assess how practitioners directly interacted with the EHR systems. Observations focused on critical activities such as data entry, navigation, patient information retrieval, and decision-support features.

4.5 Data Analysis

Descriptive statistics, including frequencies and percentages, were used to summarise the characteristics and functionalities of the EHR systems implemented in the PHC facilities. Crosstabulation analyses were performed to assess the decision-support capabilities of various EHR systems, followed by chi-square tests to identify any significant correlations between the type of EHR system used and its decision-support

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functionalities. Moreover, a One-Way Analysis of Variance (ANOVA) was conducted to determine if there were significant differences in the decision-support capacities among the various EHR systems employed in the studied facilities. These statistical methods were crucial in objectively evaluating the effectiveness of EHR systems in supporting clinical decision-making processes.

5 Results

5.1 Socio-demographic characteristics of the respondents

The demographic analysis revealed that most respondents were male (60.6%), with the largest age group being 18-34 (65.5%). Most respondents had attained an ordinary-level diploma (72.1%), followed by those with a university degree (24.2%). Clinical officers comprised the most significant proportion of healthcare workers (44.2%), followed by nurses (29.7%). The distribution of healthcare professionals across facility types showed that clinical officers and nurses were predominantly employed in dispensaries and health centres. At the same time, medical doctors and midwives were more commonly found in health centres and district hospitals. A significant association was observed between the healthcare workers' roles and the type of facility they worked in, indicating variations in their familiarity and capacity to use EHR systems effectively. Notably, district hospitals reported a higher presence of ICT officers (10.9%), reflecting a greater demand for technical support in these more extensive facilities. These socio-demographic characteristics suggest that the successful implementation and utilisation of EHR systems in primary healthcare facilities may depend on adapting training and support to different healthcare worker groups' specific needs and capabilities.

5.2 EHR systems implemented at the PHC facilities in Tanzania

The study revealed that GoTHOMIS Lite was the most commonly implemented electronic health record (EHR) system in Tanzanian PHC facilities, utilised by approximately 56.8% of surveyed facilities. eHMS was the second most popular system, adopted by 18.9% of facilities, while AfyaPro and Care2X were adopted by 8.1% and 5.4%, respectively. Various healthcare facilities also implemented other EHR systems like AfyaCare, Magnone, Medex, and Paracare (Table 4).

Table 3: EHR System Implemented in the PHC Facilities in Tanzania

EHR system	Frequency	%
AfyaCare	1	2.7
AfyaPro	3	8.1
Care2X	2	5.4
eHMS	7	18.9
GoTHoMIS Lite	21	56.8
Magnone	1	2.7
Medex	1	2.7
Paracare	1	2.7
Total	37	94.5

Source: Researchers' work

Publicly owned facilities predominantly utilised GoTHOMIS Lite (95.5%), while privately owned facilities favoured eHMS (53.3%). Significant differences in EHR system adoption between public and private facilities were noted ($\chi 2$ (37.926, n = 37) = 7; P = 0.000), as shown in Table 5.

Table 4: Association between the type of EHR System and the Facility Ownership

EHR System	Facility Ownership				Total
	Public		Private		
	No	%	No	%	
Afyacare	0	0	1	6.7	1
AfyaPro	1	4.5	1	6.7	12
Care2X	0	0	2	13.3	8
eHMS	0	0	8	53.3	31
GoTHoMIS	21	95.5	0	0	95
Magnone	0	0	1	6.7	1
Medex	0	0	1	6.7	1
Parecare	0	0	1	6.7	1
Total	22	100	15	100	165

Pearson Chi-Square = 37.926a, DF = 7, P = 0.000

Source: Researchers' work

5.3 Years of using EHR Systems across different working Units

Descriptive statistics were used to summarise the distribution of years of experience using EHR systems across working units and healthcare facilities. The histograms in Figure 7 and Figure 8 were used to visualise the distribution of years of using the EHR System for each group. The visual representations of this distribution reveal varied experiences across different facilities and working units. General clinical services, health centres, and district hospitals exhibited higher concentrations of EHR system usage.

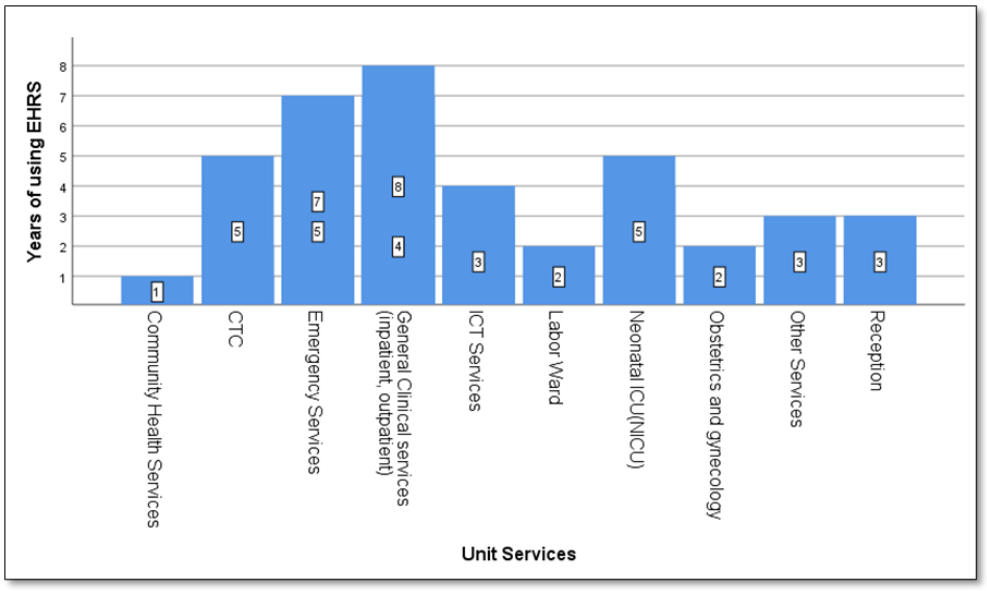

Figure 2: Distribution of years of using the EHR System across different working Units (

Source: Researchers' work

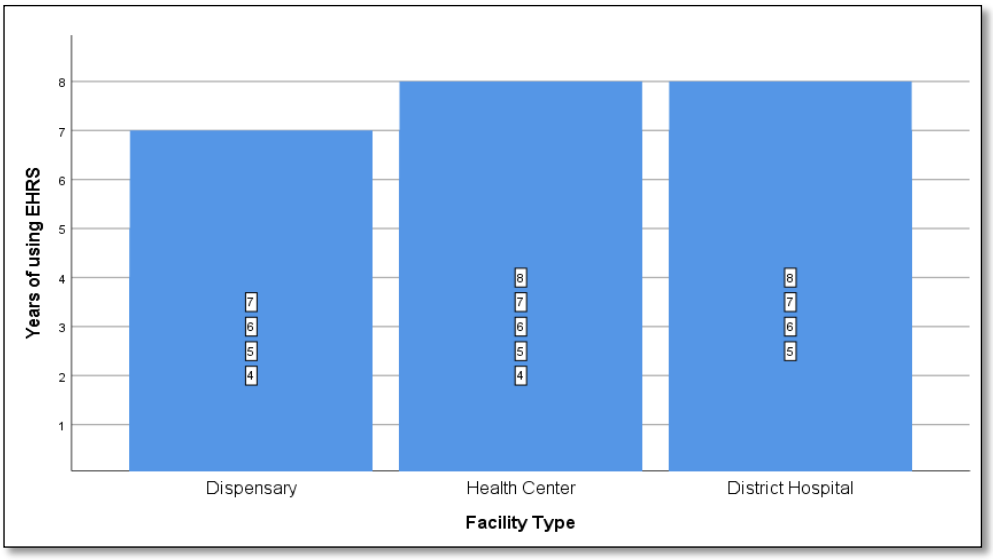

Figure 3: Distribution of years of using EHR System across different Healthcare Facilities

Source: Researchers' work

5.4 Years of using EHR Systems by ownership of Healthcare Facilities

Table 5 summarises the descriptive statistics for using EHR Systems by ownership of healthcare facilities. The results in Table 6 include the mean and standard deviation for each group (private and public). The histograms in Figure 4 and Figure 5 were used to visualise the distribution of years of using the EHR System for each group.

Table 5: Ownership of Healthcare Facilities and Years of Using EHR System

Ownership	Mean years of using EHR System	Standard Deviation
Private	2.77	1.823
Public	2.93	1.473

Source: Researchers' work

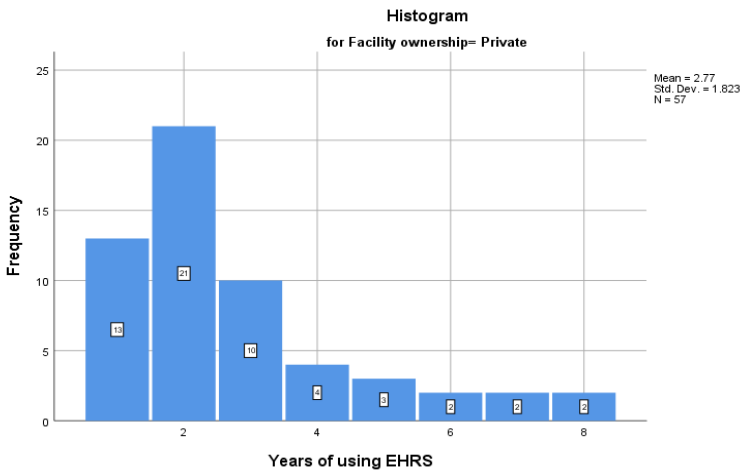

Figure 4: Distribution of years of using EHR System for Private Facilities

Source: Researchers' work

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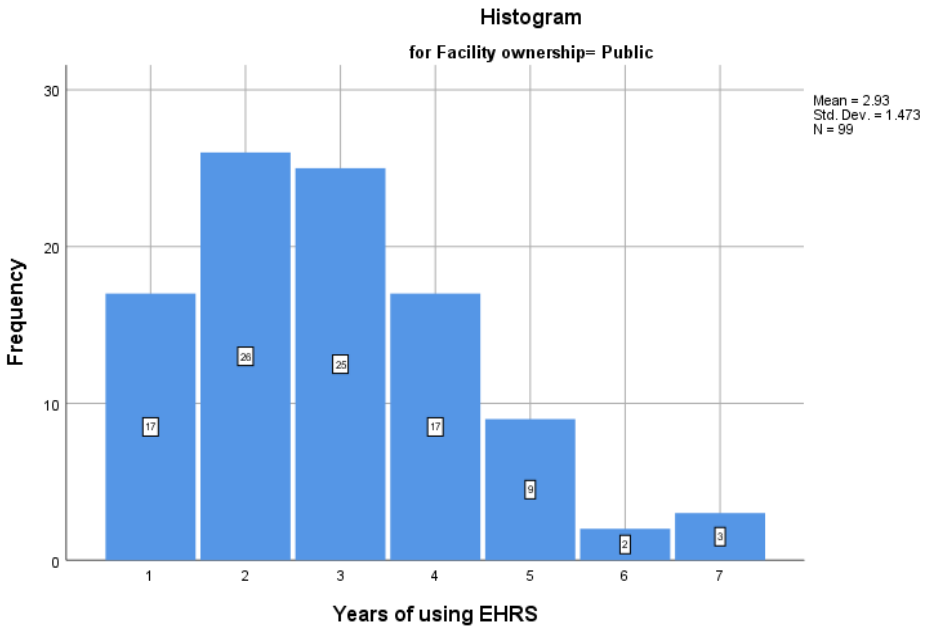

Figure 5: Years of using EHR System for Public Facilities

Source: Researchers' work

The boxplot in Figure 6 illustrates the distribution of years of using EHR Systems for private and public healthcare facilities. The boxplot for public facilities is skewed to the right, indicating a more extended EHR System use than public facilities. The mean years of using the EHR Systems for public facilities was 2.93 years, with a standard deviation of 1.473. In contrast, the mean years of use of the EHR Systems for private facilities was 2.77 years, with a standard deviation of 1.823.

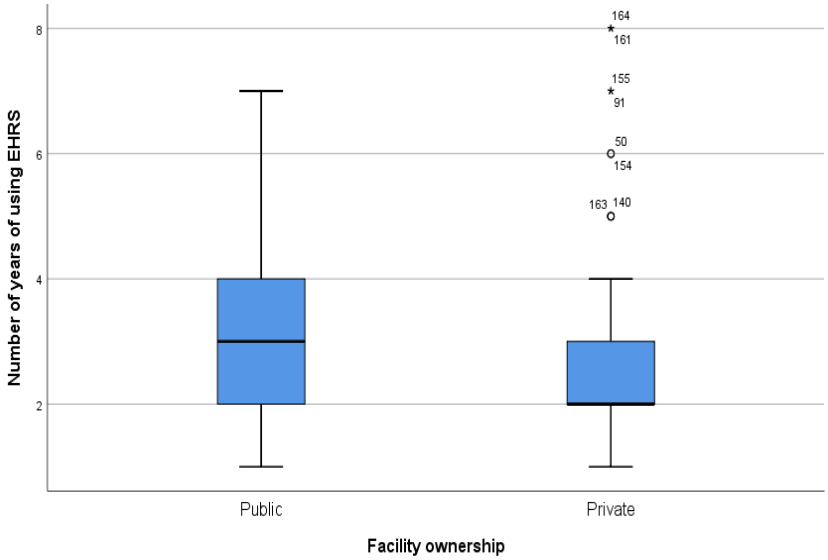

Figure 6: Boxplot of years of using EHR System by ownership of Healthcare Facilities

Source: Researchers' work

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5.5 The perception of healthcare practitioners on the effectiveness of EHR System functionalities in providing decision support in PHC facilities in Tanzania

The study findings reveal that healthcare professionals in the Dodoma region view EHR systems as essential tools in healthcare delivery, particularly for their ability to facilitate quick access to patient information—a feature that 89.7% of respondents found beneficial. Moreover, 87.3% of respondents appreciated the ease with which laboratory results could be shared through these systems, and 81.2% recognised the systems' utility in managing orders. These functionalities are crucial for maintaining efficient workflows in healthcare settings and ensuring clinicians can access critical patient data on time. However, while these features are valuable for general healthcare delivery, they do not fully address the specific requirements of clinical decision-making.

Despite the overall utility of EHR systems, significant limitations were identified in their ability to support more complex decision-making processes. Only 24.2% of respondents felt that EHR systems effectively aided clinical decisions, suggesting that the systems are falling short in this critical area. Moreover, only 26.4% of respondents recognised the effectiveness of provider-to-provider communication features within these systems, indicating that the communication tools necessary for collaborative decision-making are not fully optimised.

Specific decision-support functionalities, essential for ensuring patient safety and preventing errors, were reported to be notably lacking. For instance, only 15.8% of respondents found the drug-allergy interaction checks compelling, and just 37.6% reported that the systems could reliably detect duplicate treatments. Furthermore, only 23.6% of respondents believed that the drug dosage warnings provided by the systems were adequate. These figures highlight a significant gap in the ability of EHR systems to support clinical decisions, as these tools are critical for guiding safe and effective patient care.

ANOVA was conducted to assess whether there were significant differences in the decision-support capabilities of various EHR systems used in PHC facilities. The analysis focused on crucial functionalities critical to clinical decision-making, including drug-drug interaction checks, drug-allergy interaction checks, dosage warnings, preventive care reminders, and diagnostic support. The results indicated no significant differences among the EHR systems in any of these decision-support functionalities, as reflected by p-values that all exceeded the threshold for significance (p-values: 0.467, 0.688, 0.410, 0.413, and 0.860, respectively).

These findings suggest that, across the board, the EHR systems evaluated in this study perform similarly in their decision-support roles, regardless of the specific platform or system used. This uniformity, however, does not point to strength but highlights a consistent shortfall across all systems in adequately meeting the decision-support needs of healthcare practitioners in Tanzanian PHC facilities. The lack of variability in performance underscores the pervasive issue that no current EHR systems provide the robust decision support required to enhance clinical outcomes significantly.

Direct observations further revealed specific strengths and weaknesses of the EHR systems. While all systems were praised for their usability, mainly their ease of access to patient data, there were notable differences in their decision-support functionalities. Care2X stood out for its comprehensive decision-making tools and functional direct messaging, facilitating better communication and clinical decisions, though it lacked predictive analytics. In contrast, systems like GoTHOMIS Lite and AfyaPro were lacking in these areas, with no observed direct messaging capabilities, clinical decision support algorithms, or predictive analytics tools. eHMIS, while slightly better with direct messaging, still fell short in providing robust decision-support functionalities and lacked advanced tools like comprehensive diagnostic support and integration with external data sources. These observations align with the feedback from healthcare practitioners and point to a need for targeted enhancements in the decision-support capabilities of these EHR systems, particularly those used in resource-limited settings.

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Table 6: Summary of EHR System Systems' Usability, Functionality, and Decision-Making Tools

EHR system	Usability	Functionality	DSS features
GoTHoMIS Lite	Easy to use	Limited functionality for decision-making	No direct messaging, no clinical decision support algorithms, and no other communication tools observed
eHMIS	Easy to use	Limited functionality for decision-making	Direct messaging was observed but had limited functionality; it lacks advanced clinical decision support tools like predictive analytics and comprehensive diagnostic support.
Care2X	Easy to use	Robust decision-making tools	Direct messaging observed with good functionality; comprehensive clinical decision support tools, including diagnostic support
AfyaPro	Easy to use	Limited functionality for decision-making	No direct messaging, no clinical decision support algorithms, and no other communication tools observed

Source: Researchers' work

6 Discussion

This study aimed to explore PHC practitioners' perceptions of the effectiveness of EHR systems in providing decision support within Tanzanian PHC settings. The key findings highlight that while EHR systems are widely recognised for improving administrative processes and facilitating access to patient information, their effectiveness in supporting clinical decision-making remains limited. Only 24.2% of respondents agreed that EHR systems effectively support clinical decision-making, with significant gaps identified in functionalities such as drug-allergy interaction checks, duplicate treatment detection, and drug dosage warnings.

The limited effectiveness of EHR systems in supporting clinical decision-making can be attributed to several factors, such as the lack of advanced decision-support tools, including drug-allergy interaction checks and predictive analytics, which are critical for informed clinical decisions. The analysis highlights that while functionalities such as drug-allergy interaction checks and drug dosage warnings are crucial for effective decision-making, their underutilisation, as revealed through the study's statistics, suggests that EHR systems in Tanzanian PHC facilities may not be fully equipped to support these critical aspects of clinical care. This underscores the importance of not just the availability of these tools but also their integration and the training provided to ensure that healthcare practitioners can effectively utilise them in their decision-making processes. Moreover, insufficient integration of EHR systems with existing healthcare workflows and the absence of user-friendly interfaces can hinder practitioners' ability to utilise these systems efficiently. Moreover, inadequate training and support for healthcare practitioners and infrastructural challenges such as unreliable power supply and internet connectivity further exacerbate the limitations of EHR systems in these settings.

The analysis revealed that most EHR systems, particularly GoTHoMIS Lite and AfyaPro, lack comprehensive decision-support tools such as direct messaging capabilities and clinical decision-support algorithms. These deficiencies hinder the ability of healthcare practitioners to make informed clinical decisions, thus impacting the overall quality of care. The study's findings suggest that while these systems benefit data management and administrative tasks, they fall short in providing the necessary support for complex decision-making processes in clinical settings, consistent with findings from other low-resource settings.

The findings of this study align with previous research, indicating that the adoption and effectiveness of EHR systems are influenced by their perceived usefulness and ease of use resource settings [37], [55]. EHR systems often have robust decision-support features, such as drug interaction alerts, predictive analytics, and clinical decision algorithms, significantly enhancing clinical decision-making [53], [56]. For example, the United States and Europe have shown that well-integrated CDS systems within EHR platforms can reduce medical errors, improve diagnostic accuracy, and ensure adherence to clinical guidelines[57].

However, resource-constraints environments like Tanzania present a plain contrast. The lack of these critical functionalities reflects broader systemic challenges, including limited infrastructure, inadequate training, and resistance to technological adoption [36], [38]. This aligns with research in other low- and middle-income countries where similar issues, such as unreliable electricity, limited internet connectivity, and insufficient financial resources, often hamper the adoption of EHR systems[58]. Moreover, the cultural context, practitioners' familiarity with technology and organisational resistance to change further complicates the effective use of EHR systems for decision support [59].

The gap between the capabilities of EHR high- versus low-resource settings underscores the need for personalised solutions that address the specific challenges faced in environments like Tanzania. For instance, while EHR systems in developed countries are increasingly integrated with advanced AI-driven decision-support tools[60], [61], [62], [63], the systems in PHC facilities in Tanzania are often limited to basic functionalities, which may not meet the complex needs of clinical decision-making. This disparity calls for re-evaluating the strategies to implement EHR systems in resource-constrained settings, ensuring they are designed to overcome these unique barriers.

The study's findings underscore an urgent need to enhance the functionality of EHR systems in Tanzanian PHC settings by adding advanced decision-support tools such as predictive analytics, drug interaction alerts, and comprehensive diagnostic support and addressing critical usability and integration issues identified through practitioner insights. While specific functionalities, such as detecting duplicate treatments or providing drug dosage warnings, are essential, practitioners' perceptions reveal that these gaps extend beyond mere functionality. Issues like lack of user-friendly interfaces and limited integration into daily workflows hinder effective adoption, even when specific capabilities exist. Combining functionality assessment with practitioner insight, this dual approach clarifies how EHR systems can be optimised by aligning features with practitioners' real-world challenges. These findings suggest that developers focus on both functional enhancements and practical usability improvements, ensuring that decision-support tools are both present and effectively integrated, ultimately fostering a more supportive clinical environment in Tanzanian PHC facilities.

From a policy perspective, the findings suggest the need for a national strategy to standardise and improve EHR systems across all healthcare facilities. Policymakers should consider investing in the infrastructure to support more advanced EHR functionalities, including reliable internet access and power supply. Moreover, policies should promote the implementation of EHR systems with robust decision-support capabilities as a standard requirement in all PHC facilities. This could be supported by government incentives or funding programs to reduce the cost burden on healthcare providers in adopting these systems. Moreover, policies that mandate regular training and certification for healthcare workers in EHR systems could ensure consistent and effective utilisation nationwide.

Theoretically, this study contributes to understanding technology adoption in healthcare settings, particularly within low-resource environments. It reinforces the relevance of TAM in explaining the factors that influence the adoption and use of EHR systems. However, it also highlights the need to expand TAM to account for contextual factors unique to low-resource settings, such as infrastructure limitations and cultural resistance to technology. Future research could build on this by exploring how these additional variables impact EHR systems' perceived usefulness and ease of use in different contexts. Furthermore, the study calls for developing new theoretical models that integrate these contextual factors to predict better the successful implementation of health technologies in low-resource settings.

One of the critical limitations of this study is its focus on a single region in Tanzania, which may limit the generalizability of the findings to other regions with different healthcare infrastructures and resources. Moreover, the study relied on self-reported data from healthcare practitioners, which may be subject to bias. Observational data, while valuable, was limited in scope and may not capture the full extent of EHR system utilisation in real-world settings.

Future research should explore the impact of specific enhancements to EHR systems on clinical decision-making outcomes in PHC settings. Besides, expanding the study to include multiple regions across Tanzania could provide a more comprehensive understanding of the challenges and opportunities associated with EHR system implementation in diverse healthcare environments. Research should also investigate the role of continuous professional development in improving the use of EHR systems for decision support among healthcare practitioners.

While EHR systems in Tanzanian PHC facilities are valuable tools for data management and administrative tasks, their current limitations in supporting clinical decision-making highlight the need for

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targeted improvements. By addressing these gaps, EHR systems can be optimised to better support healthcare practitioners in delivering high-quality care, ultimately enhancing patient outcomes in Tanzania.

7 Conclusion

This study has provided valuable insights into the perceptions of healthcare professionals in the Dodoma region regarding the effectiveness of EHR systems in supporting clinical decision-making within PHC settings. While EHR systems are widely recognised for enhancing administrative efficiency and providing quick access to patient information, their effectiveness in directly supporting clinical decisions remains limited. Key decision-support functionalities, such as drug-allergy interaction checks, detection of duplicate treatments, and drug dosage warnings, were underutilised or inadequately implemented, raising concerns about the systems' capacity to improve patient safety and care quality.

As revealed in this study, healthcare practitioners' perceptions reflect a significant awareness of the limitations of current EHR systems. This perception is correct; the study's findings indicate that the current EHR systems lack the necessary decision-support functionalities to reduce errors and improve clinical outcomes. As such, these perceptions highlight a genuine need for system upgrades to include more robust decision-support tools, such as predictive analytics, comprehensive diagnostic support, and advanced alert systems.

However, the study also suggests that the underutilisation of existing functionalities may be partly due to a lack of awareness or insufficient training among healthcare practitioners. Therefore, it is essential to address this issue from both angles: upgrading the EHR systems to include the missing functionalities and providing comprehensive training to ensure that healthcare practitioners can fully leverage these tools in their decision-making processes.

In conclusion, while the current perceptions of EHR systems' decision-support capabilities are largely accurate, they also point to an opportunity for improvement. Policymakers and healthcare administrators should prioritise both the enhancement of EHR systems and the provision of targeted training programs. By doing so, it will be possible to fully realise the potential of EHR systems to support clinical decision-making, reduce errors, and ultimately improve the quality of healthcare delivery in Tanzanian PHC settings.

Acknowledgements

We extend our sincere gratitude to all who contributed to completing this study. We are thankful to the participants who generously shared their time and insights, and this work would not have been possible without everyone involved's collective effort and encouragement.

Statement on conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Author Contributions

AM, SK, and DS conceptualised the study. AM conducted data collection, performed the analysis, and drafted the manuscript. SK and DS supervised the research. All authors (AM, SK, and DS) critically reviewed the manuscript and approved the final version for publication.

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