Association between Human Resource Factors and Utilization of IQCare System for Clinical Decision Support in HIV Care Clinics in Nakuru County, Kenya

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ABSTRACT: *Electronic medical records (EMR) are computerized medical information systems that are used to collect, store, and display patient information. EMR systems can strengthen pathways of care and close gaps in patient tracking, care, and management of chronic diseases such as HIV&AIDS. Conventionally, health care workers (HCWs) face difficulties in locating, sorting, and identifying key information in paper records. To counter these challenges, in the year 2010 the Ministry of Health in Kenya approved the use of two EMR platforms, namely the International Quality Care (IQCare) system and the KenyaEMR. These systems were initially set to support HIV&AIDS clinical decision making. In 2014, Nakuru County was among the first counties to roll out the utilization of IQCare system for clinical decision support (CDS). In its implementation, appropriate support was provided, which included human resource and ICT infrastructure. Despite the substantial investment in IQCare in Nakuru County, its utilization for CDS remained low. As such, this study investigated the influence of human resource factors on the utilization of IQCare for CDS in the provision of HIV&AIDS care services in health facilities in Nakuru County. This cross-sectional study was conducted in 13 health facilities where IQCare had been deployed since January 2014 and enrolled 81 HCWs. Data was collected using questionnaires and focus group discussions. The results from the study revealed a significant association between human resource factors and utilization of IQCare for CDS. Specifically, IQCare training (p=0.023) and mentorship support (p=0.049) were significantly associated with use of IQCare for CDS. These results showed that staff training on IQCare and mentorship support are drivers to utilization of IQCare for CDS in Nakuru County. The study recommends that decision-makers at facility, county and national level should invest in HCWs training and mentorship support to guarantee optimal utilization of IQCare systems for CDS.*

KEYWORDS: Human Resource Factors, IQCare System, Clinical Decision Support, HIV Care Clinics

INTRODUCTION

Human immune-deficiency virus (HIV) remains a major public health problem in the sub-Saharan Africa (SSA), which is home to 25.7 million (15.9 million women vs 9.8 million men) people living with HIV by 2020, 73% (18.8 million) of whom receive antiretroviral therapy (ART) (UNAIDS, 2020). In Kenya, there were about 1.6 million HIV-infected persons in 2020 with 86% coverage of adults and children receiving ART (UNAIDS, 2020). Along the HIV and AIDS care cascade, medical errors have been discovered to be both more costly and harmful when documentation is not readily accessible (Jao & Hier, 2010).

Electronic medical record (EMR) is an organized assortment of health information by electronic means about a particular patient (Boonstra, Broekhuis & Affiliations, 2010). There are many EMR systems that have been developed and utilized globally (Lee *et al.,* 2018). The most widely used EMRs by physicians, according to Medscape's EHR report, are Epic at 23%, Cerner at 9%, Allscripts 10%, eClinicalWorks at 6% and NextGen at 6% (Holroyd-Leduc *et al.*, 2011). The first EMR system to be used in the sub-Saharan African was Academic Model Providing Access To Healthcare (AMPATH) Medical Record System (AMRS) for comprehensive and clinical care of patients infected with HIV (Noormohammad *et al.*, 2010).

In 2009, the National AIDS and STI Control Programme (NASCOP) and Health Information Systems (HIS) commissioned an assessment on the functionality of existing EMR systems implemented in Kenya. Three (CPAD, OpenMRS-AMPATH and IQCare) out of these 17 systems incorporated clinical decision guidelines and could generate alerts or provide reports that could support clinical decisions (Kang'a *et al.*, 2017). Of the 17 systems, three had an average score above 77%, and they were OpenMRS-AMPATH (95.2%), IQCare (90.3%) and C-PAD (77.1%) (MOH, 2011). In 2013, after the national assessment, the MOH selected the two top-ranked (OpenMRS-AMPATH and IQCare) EMR systems for roll-out in Kenya.

International Quality Care (IQCare) system is a freely available Windows-based EHR application system that offers a variety of features for managing clinical care for primary HIV&AIDS patients (Muinga *et al.*, 2018). IQCare is one of the EMR systems rolled out in Kenya for HIV Care patient management. As early as 2010, IQCare system was used in 622 sites in 10 countries that included Nigeria, Kenya, Uganda, Tanzania, Rwanda, Zambia, South Africa, Haiti, Guyana and Ethiopia (Fraser & Blaya, 2010). By May 2019, there were 678 HIV Care sites in Kenya using IQCare system. IQCare was implemented in Kenya through the support of the Palladium Group (formerly Futures Group) and is donor-funded through AIDS Relief (Muinga *et al.*, 2018). In Kenya, the IQCare system was implemented in the South Rift Valley, Nairobi, coastal and eastern regions of Kenya. By 2014, Nakuru County, located in South Rift Valley, had the highest number of health facilities implementing the IQCare system (Muthee *et al.*, 2018).

Despite the progress made in the rollout of EMRs in Kenya, lack of a comprehensive legal policy framework on adoption and use of eHealth systems and services remains a challenge that could expose patients and healthcare providers to unlawful and unethical practices (Ministry of Health Kenya, 2016). A study in Kenya identified gaps in standard operating procedures on data security

and confidentiality, which affects HCWs perspective on data quality and utilization of EMRs (MeSH Consortium, 2016). In establishing a regulatory framework favourable for the adoption of eHealth in Kenya, the Ministry of Health launched standards and guidelines for EMR as mandated under the Kenya Communications Act of 2012, in line with the ICT policy of 2016 and implemented under the eHealth Strategic Plan (2011-2017) (Ministry of Health, 2017). These developments were expected to support the management of patients with chronic conditions such as HIV and AIDS (Ministry of Health, 2017).

Statement of the Problem
Despite the rigorous implementation of IQCare system for patient information in HIV care clinics in Nakuru County, there is still low utilization of IQCare system for CDS. IQCare system has been designed to enable clinicians to access longitudinal and previous clinic visits data for monitoring patient viral load suppression, drug dosing, lab test ordering, defaulter tracing, and managing referral of patients from one health facility or provider to another. While with paper systems clinicians encounter challenges accessing patient information from previous clinic visits and historical data to ascertain treatment progress and management of chronic conditions such as HIV&AIDS, IQCare is deemed to facilitate faster information access, exchange and meaningful use.

According to NASCOP 2018 DQA report in Nakuru County, IQCare system has been in use from 2013 to 2017 where data entry is done retrospectively and accessed mostly by data clerks as opposed to the clinicians at point of care which leads to duplication of tasks. Despite the benefits of CDS, results from a national assessment conducted in 2009 on the functionality of EMRs used in Kenya rated CDS among the lowest-performing indicators at 17.6% compared to a mean score of 71.8% for health information and reporting functionality. This is quite low compared to the utilization situations in the United Kingdom and the Netherlands, which are at 96% and 99%, respectively. The public health problem in Nakuru is inaccessibility of information by clinicians for CDS.

Previous studies have shown that acceptance rate of such systems like CDS has been quite low and has encountered opposition from clinicians. Knowledge gaps exist in the literature on the utilization of IQCare system for CDS. Therefore, the study investigated the factors influencing utilization of IQCare system for clinical decision support in HIV care clinics in Nakuru County, Kenya. This paper examines the study findings on the influence of human resource factors on the utilization of IQCare for CDS in Nakuru County, Kenya.

Influence of Human Resource Factors on Utilization of IQCare for CDS
Human resource component is key to any EMR system, since personnel are the ones to expedite the planning, implementation and maintenance of the EMR system (Aguirre *et al*., 2019). Inadequate and poorly trained health workers are a key challenge to the enactment of e-health in developing countries (Msiska *et al.*, 2017). A study done in Japan found that the diagnostic error rate was 2% for HCWs trained and mentored on an updated computer-based clinical system, while the error rate for those not trained nor mentored was 24% (Shimizu, Nemoto & Tokuda, 2018).

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Among the 57 countries classified by the World Health Organization (WHO) as having an acute shortage of health workers, 36 are in the sub-Saharan Africa and Kenya is one of them (Oluoch & De Keizer, 2016). In addition, little evidence exists on the adoption of EMR-based CDSS on quality of HIV care and treatment in the sub-Saharan Africa (Oluoch *et al.*, 2012). In 2014, some facilities were discontinued from using IQCare system in Kenya due to lack of trained staff to support the use of EMR system (MeSH Consortium, 2016). Having an in-house support system technician brings full comprehension of existing frameworks and the abilities to fully utilize the EMR (Boonstra *et al.*, 2010).

Designers of clinical summaries/reports are required to be in constant communication with the HCWs to understand their training requirements (Were *et al*., 2011). The role of the troubleshooter is to provide technical support to maintain the server and network, which is crucial to smooth operation (Trivedi *et al.*, 2009). For instance, beginners require the support of an EMR champion to help in understanding the EMR system features (Williams & Boren, 2008). Some selected super users can also be deployed per site to provide mentorship to health care workers. Indeed, a certain level of computer skills by EMR users (clinicians) is required to allow them to use the system as a point of care (Boonstra *et al.*, 2010).

Regardless of cost, there is need to maintain investment in EMR training which is critical to maximizing competence and the quality of patient care (Lopez *et al.*, 2018). The use of mentors to build the skills of HCWs in decision-making is encouraged for sustainability (Aguirre *et al.,* 2019). When using EMR systems, an increase in productivity depends on the provision of quality training and organizational support (Udo & Davis, 1992). EMR training helps HCWs to gain a better understanding of the system by introducing features and functions with which they may not be familiar with (Dhillon *et al.*, 2018). A study conducted in Saudi Arabia revealed that 48% of the core EMR features were not utilized by physicians because they were unaware of their availability in the EMR system hence the need for training and mentorship (Msiska *et al.*, 2017).

Other previous studies have shown that training is a critical component that would improve HCWs competence and ultimately lead to high quality of patient care (Lopez *et al.*, 2018; Essuman *et al.*, 2020). A study conducted in Tanzania revealed that out of the 77 HCWs who were trained on EMR, only 40.7% were using EMR in their clinics; this is a much lower proportion compared to the results in Ireland where 63.5% of the 150 HCWs who were found to be using computers two year after the training (Kortteisto *et al*., 2012). Productive usage of an EMR system requires comprehension of existing frameworks and a committed interdisciplinary team that supports EMR implementation (Boonstra *et al.*, 2010).

According to a study in Massachusetts General Hospital to evaluate EHR use in ambulatory appointments, 24% of the respondents had never used any EHR functionality throughout patient appointments (Marie *et al.*, 2011). Evidently, human resource constraints can limit utilization of EMR such as IQCare. Therefore, it is important to constantly evaluate the influence of training, mentorship and availability of human resources on the utilization of IQCare system for CDS along the HIV/AIDS care cascade.

MATERIALS AND METHODS

The study was conducted in Nakuru County located in the south-eastern part of the former Rift Valley Province, Kenya. Nakuru County has an estimated population of 2,176,581 people, female (1,110,056) and male (1,066,525) (Kenya National Bureau of Statistics [KNBS], 2019). The County is served by a total of 541 health facilities, of which 41 are hospitals and 500 primary care facilities. Nakuru County contributes 3.4% of the total number of people living with HIV in Kenya and is ranked ninth nationally. The County has an ART coverage of 82% and viral suppression of 83% according to the routine programme data (National AIDS Control Council, 2016). The thirteen (13) facilities selected for this study have IQCare EMR system deployed since 2014.

A cross-sectional research design was used in the study. The study assessed the experiences of health care workers in the HIV care clinics using IQCare system. The health care workers included HTS counsellors, health records and information officers/data clerks, nurses, nutritionist's pharmacists and clinical officers. The study population comprised 112 health care workers (HCWs), working in 13 health facilities of which 10 were public, 2 faith-based, and 1 private HIV care clinics that had IQCare EMR system deployed by January 2014, out of the total 39 current HIV Care clinics in Nakuru County. These 13 health facilities ranged from levels three and four according to the MOH ranking.

Each of the facilities consisted of an average of 3-11 health care workers assigned to the HIV care clinics. The sample size was determined using the Krejcie and Morgan's sample size determination table (Krejcie & Morgan, 1970). Therefore, the sample size was 86 HCWs. A random selection was done of 13 health facilities across Nakuru County that had been using IQCare system in their HIV care clinics since 2014 without interruption. From the 13 facilities, health care workers working in HIV care clinics were sampled proportionately by staff cadre to have each cadre proportionately represented in the overall sample size of HCWs.

For the above selected facilities focus group discussions were administered, starting in 5 facilities with the highest number of clients and staff working in the HIV care clinics in different sub-counties of Nakuru County, based on purposive sampling strategy. The study also utilized a semi-structured questionnaire for data collection. Focus group discussion (FGD) guides were used to collect data from all cadre of HCWs. Quantitative data were analysed using SPSS, version 21. The association between human resource factors and the utilization of IQCare for CDS was determined using the Chi-square test. Qualitative data from the FGDs were extracted from audio recordings and transcribed thematically. Preliminary analysis entailed open coding and progressive categorization of issues based on inductive approaches in which analytical categories are derived gradually from the data. Data was analysed using the NVivo, version 12, to generate sub-themes. These categories and themes were further refined as findings emerged from the data. The researchers analysed the data using an inductive thematic analysis approach. To manage the data analysis a codebook was developed to guide the data analysis. Fifty-three codes were identified, using an inductive approach; the researchers then identified themes from the codes. The coding

process was a journey that started with the immersion of the data based on the FGD guides, which generated 12 sub-themes.

RESULTS

The study sought to establish how human resource factors such as training, mentorship and availability of staff to support troubleshooting in their health facilities influenced the utilization of IQCare for CDS. Table 1 outlines the frequency distribution of the human resource factors and its utilization for CDS among HCWs in Nakuru County.

Distribution of Human Resource Factors and Utilization of IQCare System for CDS
Table 1 shows the distribution of human resources availability characteristics and utilization of IQCare system for CDS among HCWs in Nakuru County. Out of 67(82.7%) respondents who received training, 59(88.1%) reported using IQCare for CDS compared to 8(11.9%) respondents who reported non-use. Among the 14(17.3%) who were not trained, 7(50.0%) respondents reported using IQCare for CDS while another 7(50.0%) reported non-use (Table 1). Further, of the 66(81.5%) respondents who received mentorship, 58(87.9%) reported using the IQCare for CDS while 8(12.1%) respondents reported non-use. Among the 15(18.5%) who did not receive any mentorship, 8(53.3%) utilized the IQCare for CDS compared to 7(46.7%) reported non-use (Table 1).

Most of the respondents, 67(82.7%) reported having personnel capable of troubleshooting EMR within their health facilities. Out of this, 52(77.6%) were using IQCare for CDS while 15(22.4%) reported non-use. Of the 14(17.3%) who did not have personnel capable of troubleshooting EMR, all, 14(100.0%) were using IQCare for CDS. Table 1 shows the proportion distribution of human resource factors characteristics and utilization of IQCare system for CDS. The results of the $P \leq$ 0.05 implies that use of IQCare for CDS was dependent on the trainings done, mentorship provided to HCWs and availability of a troubleshooters to identify and resolve faults in case it arises in the system.

Table 1: Frequency of human resource factors and utilization of IQCare for CDS

Human Resource Characteristics		Total respondents	Use	Non-use	*P* value
		n (%)	n (%)	n (%)	
Staff training on IQCare	Yes	67 (82.7)	59 (88.1)	8 (11.9)	**0.001**
	No	14 (17.3)	7 (50.0)	7 (50.0)	
Mentorship support	Yes	66 (81.5)	58 (87.9)	8 (12.1)	**0.002**
	No	15 (18.5)	8 (53.3)	7 (46.7)	
Availability of troubleshooter	Yes	67 (82.7)	52 (77.6)	15 (22.4)	**0.050**
	No	14 (17.3)	14(100.0)	0 (0.0)	

Data are presented as numbers and proportions (%) of subjects, unless otherwise indicated. Statistical analysis was performed using Chi-square (χ^2) test. Statistical significance was set at $P \leq 0.050$. Significant *P*-values are indicated in bold.

Association between Human Resource Factors and Utilization of IQCare System
In order to determine the relationship between availability of human resource characteristics and utilization of IQCare for CDS in Nakuru County, binary regression analysis, was performed in a model that weighted the human characteristics equally (Table 2). The results showed that HCWs trained on the use of the IQCare system were 5.4 times more likely to use IQCare for CDS (Odds ratio, OR=5.475, 95% confidence interval, CI=1.261-23.775, P=0.023) compared to those not trained. Further, health care workers who received mentorship support were 4.2 times more likely to use IQCare for CDS (OR=4.261, 95% CI=1.005-18.067, P=0.049), relative to participants without mentorship support. There was no significant difference in utilization of the IQCare for CDS and availability of personnel to perform trouble shooting (P=0.998) (Table 2).

Table 2: Association between Human Resource Factors and Utilization of IQCare System for CDS

Characteristics	95% C.I.			
	Odds Ratio	Lower	Upper	*P* Value
Staff training on IQCare	5.475	1.261	23.775	**0.023**
Mentorship support	4.261	1.005	18.067	**0.049**
Availability of troubleshooter	0.000	0.000	.	0.998
Constant	2253934.835			0.999

Binary logistic regression analysis was performed to assess the association between human resources factors and utilization of IQCare for clinical decision support. Health care workers were grouped into those using the IQCare system (n=66) and non-use (n=15). Data was presented as odds ratios and 95% confidence interval (CI). Statistical significance was set at $P \leq 0.050$. Significant P values are shown in bold.

Emerging Themes on Human Resource Factors from Focus Group Discussion
FGDs were conducted in five facilities to understand the participants' views on how human resource factors impacted the use of IQCare system in their HIV care clinics. Each FGD was composed of 6-8 members of different cadres of healthcare workers drawn from the HIV care clinics. Information was extracted from the FGD transcripts for sub-themes on human resource factors. Data was analysed using the NVivo 12 software to generate sub-themes that emerged. Table 3 presents the findings.

Table 3: Emerging Themes on Human Factors and IQCare Utilization

Category / themes	Sub-themes	Quote
Human Resource Factors	Training received on the EMR	"Proper training of HCWs on judicious usage of IQCare CDS functionalities is required for maximum benefit. These can introduce a considerable number of medical errors, which results in poor patients' treatment outcomes" (F1).
	Frequency of mentorship support	"By 2015 our facility was using both paper and EMR which meant double work, with refresher training and continuous

	mentorship we are now running a paperless system in all departments in this HIV Care clinic" (F5).
Availability of technical personnel to install and operate IQCare system	"One of our clinicians who has been well trained in IQCare has helped in trouble shooting some IQCare system we had last year hence troubleshooting can be performed by any other staff who has been well trained or mentored" (F2).

Thematic analysis revealed four sub-themes surrounding human resource factors and usage of IQCare for CDS (Table 3). Majority of the respondents cited training as the most important component towards the utilization of the IQCare for CDS, followed by the frequency of mentorship support received (Table 3).

DISCUSSION

The study set out to determine if training and mentorship of staff on the utilization of IQCare system had any influence on its utilization for CDS. The results indicated that there was a significant association between trained *(P*=0.023) and mentored *(P*=0.049) HCWs and utilization of the IQCare for CDS. These results were consistent with other previous studies, which showed that EMR training is a critical component that could improve HCWs' competence and ultimately lead to high quality of patient care (Lopez *et al.*, 2018; Essuman *et al.*, 2020). In concurrence, consistent capacity building of HCWs in Kenya can fast-track the clinicians' acceptance and increase the rate of adoption and utilization of CDS systems (Oluoch *et al.*, 2015). In addition, other studies have found that inadequate and poorly trained health workers are a key challenge to the implementation of e-health in developing countries (Msiska *et al.*, 2017; Essuman *et al.*, 2020).

In this study, 87.9% HCWs received mentorship support on the utilization of IQCare for CDS. This finding was in line with other study findings, which showed that HCWs need continuous support for them to utilize the clinical decision support features in the EMR system (Essuman *et al.*, 2020; Silow-Carroll, Edwards & Rodin, 2012). The study findings also concurred with another study that found that mentors are selected super-users who support peer-to-peer approach, which facilitates training as peers communicate and speak the same language (Aguirre *et al.*, 2019). Mentorship enables HCWs with similar roles to share knowledge and experience on the IQCare system, rapidly increasing the level of EMR proficiency. Rogers' (2003) diffusion of innovations theory was key in this study as it describes the pattern and speed at which new ideas, practices, or products spread through a population (Helitzer *et al.*, 2003), hence in line with this study on determining if training and mentorship has resulted in enhanced utilization of IQCare for CDS.

The study found no association between having someone to troubleshoot and the utilization of the IQCare system for HIV care CDS (*P*=0.998). This concurred with FGD results that showed that troubleshooting roles can be performed by any other staff who has been properly trained or mentored. These results differed from other studies (Silow-Carroll *et al.*, 2012; Msiska *et al.*, 2017)

which showed that maximum utilization of EMR system is dependent on availability of an in-house problem solver (troubleshooter) who plays a key role in aiding beginners to move forward in realizing the benefits of EMR.

The study findings highly supported those of another study done in Japan, which revealed that the diagnostic error rate was 2% for HCWs trained and mentored on an updated computer-based clinical system, while the error rate for those not trained nor mentored was 24% (Shimizu *et al.*, 2018). Taken together, the findings of this study revealed concurrence of qualitative and quantitative results. Specifically, it was found that human resource factors, such as training and mentorship, influence the utilization of IQCare for CDS in HIV clinics in Nakuru County, Kenya.

Limitations/Delimitations
This paper it provides empirical literature on application of technology in healthcare in the developing world. The factors are relevant and applicable to all EMRs because IQCare system transitioned in 2021 to KenyaEMR following a change in government policy that required the country to adopt EMR systems that use OPENMRS platforms for interoperability purposes. As such, this paper provides a framework for examining the factors that inform the rate of adoption of technology in health care sector in the developing world.

CONCLUSION AND RECOMMENDATIONS

Training staff on IQCare and mentorship support are key human resource drivers of utilization of IQCare for CDS. Therefore, the Ministry of Health at facility, county and national level should invest in HCWs training and mentorship support on EMR to guarantee optimal utilization of IQCare systems for CDS. Further, effective EMR training and mentorship packages are needed to facilitate utilization of CDS features in EMR systems.

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