

Users' Perception on Factors Contributing to Electronic Medical Records Systems Use: A Focus Group Discussion Study in Healthcare Facilities Setting in Kenya

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Abstract

Background Electronic Medical Records systems (EMRs) adoption in healthcare to facilitate work processes have become common in many countries. Although EMRs are associated with quality patient care, patient safety and cost reduction, their adoption rates are comparatively low. Understanding factors associated with usage of implemented EMRs are critical for advancing successful implementations and scale-up sustainable initiatives. The aim of this study was to explore end users' perceptions and experiences on factors facilitating and hindering EMRs use in healthcare facilities in Kenya.

Methods Focus group discussions were conducted with EMRs users (n=20) each representing a healthcare facility determined by the performance of the EMRs implementation. Content analysis was performed on the transcribed data and relevant themes derived.

Results Six thematic categories for both facilitators and barriers emerged, and these related to: (1) system functionalities; (2) training; (3) technical support; (4) human factors; (5) infrastructure, and (6) EMR operation mode. The identified facilitators included: easiness of use and learning of the system, efficiency of EMRs in patient data management, responsiveness of Information Technical (IT) support, user training on EMR system upgrades. The identified barriers included: frequent power blackouts, inadequate computers, retrospective data entry (RDE) EMRs operation mode, lack of continuous training on system upgrades, and delayed IT support.

Conclusion Users in an LMIC setting generally believed that the EMRs improved work process, with multiple identified facilitators and barriers to their use. Most users perceived system functionality and training as motivators to EMRs use, while infrastructure challenge was the greatest barrier.

Introduction

Adoption of Electronic Medical Records systems (EMRs) has been on the rise in both developed and developing countries (1,2). By nature, healthcare organizations are complex and introduction of EMRs can bring further complications, which can lead to rejection of the system or failure of the implementation regardless of the setting (3). As an example, users are likely to embrace systems that do not interfere with their workflow (4). Consequently, successful EMRs implementations require careful planning and balancing of service delivery needs in order to optimize the anticipated benefits.

Information system (IS) use is the utilization of information technology (IT) within users' processes either individually, or within groups or organizations (5). Implementation of a health information system does not mean that the system will be necessarily used in the way it was intended or used at all. Many factors affect use of implemented information systems which vary among system users (6). While these factors could be generalized regardless of the settings, organizational and user needs can be different due to cultural factors and unique challenges such as inadequate computer to user ratio and power blackouts, among others. Such challenges jeopardize the system's availability when required for daily use in health care delivery.

Most health professionals generally believe that information technology can eliminate the burden of paper-based documentation and delays in retrieval of patient records especially in emergency situations. However, users get easily discontented if the adopted system or support does not meet their expectations(1,7,8). Furthermore, a study by Myongho also reveals that physicians shun systems that interferes with their workflow and how they attend to their patients (9). In fact, several studies have also reported comparatively low adoption rates of EMRs despite the reported benefits such as improved quality of care, patient safety and cost reduction (9–12). Oftentimes, users hold first-hand knowledge on what can contribute to or limit the use of EMRs implementations as they incorporate these into their work environments (13).

There is a corpus of studies conducted to explore barriers and facilitators to EMR/EHR implementations (14–18). However, only a limited number of evaluation studies are available concerning EMR use in work processes once the systems are

implemented. To the best of our knowledge, none of the previous studies have looked at the increasingly deployed national-level systems in LMICs. Given the significance of users in information system utilization, users' perceptions are critical in exploring the facilitators and barriers to EMRs use. This qualitative study set out to identify facilitators and barriers to the nationally-deployed KenyaEMR (KeEMR) system use in a resource-constrained setting, in order to advance successful implementations and scale-up strategies. In this context, 'use' refers to a full and/or partial use of the EMRs in all activities relevant to patient care as enabled by the EMRs. This study is part of an ongoing evaluation study of the state of EMRs implementations in Kenya (Philomena *et al*, under review).

Methods

Study design

A qualitative study design was used to explore perceptions of the users of the electronic medical records system, KeEMR. The focus was to uncover barriers and facilitators on system use, non-use or underuse in their healthcare facilities.

Study Setting

This study was conducted in Kenya, a country in East Africa with approximately 50 million persons (19). In 2012, the Ministry of Health (MoH) in Kenya, with the support of international donor funding and local partners, embarked on development and implementation of EMRs in public healthcare facilities with a view to improve patient data management (20). Different types of EMRs have been implemented across the country. Nevertheless, two main implemented EMRs (KeEMR and IQCare) have been rolled out in over 1,000 healthcare facilities countrywide (20). These systems mainly serve HIV, Tuberculosis (TB), and Maternal and Child Health (MCH) clinics, with a view to expanding them to other health care domains in future (21). The implementation of these systems varies in the mode of operation from one healthcare facility to another. The modes include paperless, point of care (POC), retrospective data entry (RDE), and hybrid modes that include both POC and RDE within the same facility. In 2019, MoH together with technical working group and the donors agreed to support KeEMR system as the only national EMRs for future use in public facilities for HIV and TB care.

This study involved a representative sample of healthcare facilities implementing KeEMR system spanning eleven counties in Kenya (Table 1 - Appendix I). The EMRs implementations in these facilities took place on varying dates in the period 2012 to 2018. These study facilities were determined from facility performance assessment conducted in our ongoing evaluation study on the actual use of EMRs implemented in healthcare facilities in Kenya (Philomena *et al*, under review).

The assessment utilized computer-generated EMRs use empirical data based on various EHRs use indicator measures (22). The selection criteria was guided by facility performance outcome determined by the weighted mean calculated from empirical data of two EHRs use indicators: *Staff System Use* (proportion of active system users) and *Patient Identification* (percentage of patient records with national identification number). Of the 213 facilities which participated in the assessment study, a convenience sample of 20 facilities was selected to provide primary data for this study. The 20 sites selected for this study were drawn from the facilities performance list as follows: six best performing, seven moderate, and seven worst performing facilities. This criteria ensured representation of views and perspectives from facilities at all performance levels. Table 1 (Appendix I) presents geographical location, weighted mean and characteristics of the healthcare facilities that participated in the study.

KeEMR System

KeEMR is an opensource electronic medical records system that supports HIV and TB care and treatment programs. The system is customized from the open source OpenMRS platform (23). It is comprised of different modules used in the various sections of care by different categories of users. The KeEMR products include: mUzima which is a mobile phone and tablet platform used for HIV testing and counselling (HTS) in offline/online mode, interoperability layers (IL) which is used for data exchange between systems (e.g. Viral load system from National AIDS and STI's Control Programme

(NASCOP) to EMRs), Text messages for adherence (ETS), ARV dispensing tool (ADT) and Data warehouse API (DWAPI) - an application interface that facilitates transmission of HIV indicator data from EMRs to the national data warehouse (NDW). To date, KeEMR system has been rolled out in over 370 Public, Non-governmental organizations (NGO) and Faith-based healthcare facilities (24).

Study Participants

Purposive sampling was used to select the study participants from the 20 study sites. Criteria for inclusion in the study was the ability of the participant to inform the conversation around EMRs usage, and facilitators and barriers to usage. Emphasis was placed on assuring that multiple perspectives were represented in the deliberations. Therefore, the participants' selection included all categories of EMRs users including (1) Clinical staff, (2) Nursing staff, (3) Health Records Information Officers (HRIOs), (4) Data entry clerks, and (5) IT staff. Additional participants were drawn from four of the service development partner (SDPs) organisations responsible for EMRs implementations in the selected facilities. The aim of including this group of participants in the study was to get the management's perspective on EMRs implementations. All potential study participants were contacted via telephone and email. A total of 24 participants agreed to participate in the study: twenty (20) users of the EMRs (one from each participating facility) and four participants each from a different SDPs. All participants filled a consent form (Appendix II) via email before taking part in the study.

Data Collection

Data were collected through a two-hour Focus Group Discussions (FGDs) sessions conducted online via Zoom video-conferencing platform (25). The choice to use online platform was inevitable due to the social distancing and travel restrictions occasioned by COVID 19 pandemic. However, Reisne *et al*, argue that online FGDs allows participation across a wide geographical coverage, providing the potential for greater diversified views, among other advantages(26). Focus group is defined as organized, highly interactive group discussions that aim to explore a given specific topic or an issue to generate data (27). Studies have reported varied number of participants per group, ranging from four to fifteen, are considered sufficient for an FGD. Generally, ten participants are considered large enough to gain a variety of perspectives and small enough to control (28,29). We chose this methodology because focus groups are quite suitable for investigating experiences, attitudes and emerging ideas from the group.

A total of three FGDs were formed. The participating EMRs users from the facilities were randomly assigned two of the groups, each comprising 10 participants while the SDPs representatives formed the third group. A list of key questions (Appendix III) were used to guide the discussions process. The discussions were conducted in English through a secure Zoom enterprise platform. The primary researcher (PN), with FGD training, moderated the FGDs. The discussions were recorded after explicit permission to record and consent was obtained from each participant.

The FGDs were initiated by asking all participants to reflect and share briefly on their experiences in supporting care to patients in their respective capacities/roles since the introduction of the KeEMR system in their facilities. This ensured that all participants had a chance to share their views. After this introduction, the moderator's questions guided the rest of the groups' discussions. The participants were refunded the cost of internet connection charges incurred to connect to the Zoom platform.

Data Analysis

The recorded discussions were downloaded and transcribed verbatim by the researcher, then re-played once to verify accuracy and authenticity. Any participant identifiers or other identifying information were stripped from the data to ensure confidentiality. The anonymized and validated transcripts were then analysed using qualitative content analysis. Content analysis is a systematic analysis of text commonly used in social science (30,31). The content analysis process involved coding of the transcribed data followed by categorization into major themes mapping onto the questions asked (32).

Finally, the codes were categorized as either a facilitator or a barrier (or both)within their respective themes. Nvivo ver12 qualitative data analysis tool was used to facilitate the data analysis (33). The study followed consolidated criteria for reporting qualitative studies (COREQ) guidelines (34).

Ethical Consideration

The study was approved by the Institutional Review and Ethics Committee at Moi University, Eldoret (MU/MTRH-IREC approval Number FAN:0003348). The Ministry of Health (MOH) also approved the study. Permission to collect data was obtained from County Directors of Health of each county as well as Service Delivery Partners (SDPs) responsible for EMRs implementations and HIV data at the facility level. Participants were informed that participation in the focus group was voluntary and they were free to leave the discussion at any time.

Rigor

The study followed Guba and Lincoln's criteria of dependability and authenticity (35). To confirm the contents of the transcribed data from the focus group discussions, the transcriptions were sent to the participants via email to read through and confirm the correctness. During the data collection and analysis, the researchers applied reflexivity to avoid biases associated to their own experience on the phenomenon under study (36).

Results

Characteristics of the Participants

Twenty two of the 24 participants (91.7%) who agreed to be part of the study participated. Of these, 20 were EMRs users participated who completed the socio-demographic questionnaire. Two of the four SDP partners gave late apologies due to unplanned emergency meetings. The participants' average age was 30.5 years. While the participants represented diverse professional areas, majority of them were Health Records Information officers (75%). Table 2 presents detailed socio-demographic characteristics of the participants.

Facilitators and Barriers to EMRs use/non-use

From the qualitative analysis of the FGDs data, we identified six categories: (1) System functionalities/capabilities, (2) training, (3) technical support, (4) EMR mode, (5) human factors, and (6) infrastructure. We categorized the coded data as either motivator or barrier of EMRs use. Additionally, recommendations for improvement in EMRs implementation and use were also categorized. Results presented below are organized according to the different themes derived from the qualitative content analysis (Figure 1).

Facilitators

Facilitators refers to the perceptions deduced from the participants as motivators to the use of the EMRs in their work process.

System functionalities/Capabilities

The users of the EMRs who participated in the FGDs generally believed the KeEMR system is loaded with lots of benefits and it is easy to learn and use. Thus, introduction of the EMRs has been of tremendous help in improving patient care. Before the EMRs implementation in the facilities, patient care was marred with delays and frustrations due to misplaced patient files, wasted time in patient files retrieval and clinicians sieving through the patients' files resulting in fewer patients being attended. Staff suffered burn-out occasioning to 'cooking of data' in an effort to meet the mandatory monthly reporting requirement to the national MoH aggregate system.

G1: "Actually before we started using the system, we had a lot of challenges like patients' files were missing sometimes, they were not missing that they were lost but they were being misplaced, so when a client comes it was very hard to find that file [and such,] the delay was there".

Perceived benefits as a result of introducing the EMRs in care delivery include improved patient data management and consequently routine reporting. EMRs functionalities have made possible easy retrieval of patient files by a click of a button, easy patient record updates, and ease of generating lists of patients who have missed appointments and defaulted in care.

R7: "it was difficult to retrieve the information of patients because the patient could transfer and there could be difficult in tracing the file if the patient returns after a while - could be after 2 or 3 years. The introduction of EMR has made it possible to get the patient file by the click of a button (...) we are able to conduct defaulter case management, and later on lost to follow-up after they miss clinical visits".

With information about that patients in the system, clinicians now attend to more patients and have more time with each patient:

R3: "So after that we started using KenyaEMR, actually we realised that we are taking a lot of time with the patients, asking patients what is really going on and things are very easy"

Additionally, the system users also perceived that the EMRs have greatly helped in timely routine reporting as required by both the Ministry of Health (MoH) and service delivery partners (SDPs) based on very reliable data. Most participants indicated that EMRs data and paper register records are 100% concordant at the point of care. This has gone a long way in supporting decision making at all levels.

G4: "Without the EMR, generating reports like the quarterly and the semi-annual reports could be so tedious. We could spend a whole day in a single facility trying to generate a report for a single quarter. Now our MoH 731 and DATIM reports does not keep changing because we have all these things in place"

G1: "I want to appreciate the guys working with KenyaEMR because at [facility name], we have gone very far. We are even sending our reports direct to DHIS2. Actually, we have no problem with reporting (.....). We are using DWAPI to send our data to the national data warehouse, we are using the system to send our 731 report direct to DHIS2 whereby nobody can enter it manually it just goes automatically."

G3: With my experience, Kenya EMR is a good thing to use. It is really making our work easier and gives us data quality that we can use for decision making at any level.

Continuous improvement of the system through regular system upgrades with enhancements of the system's capabilities was perceived a great motivator in the usage of the system. At the same time the upgrade process was perceived as non-disruptive.

G2: "I would like thank the KenyaEMR for continuous upgrading. We came from version 16.0now we are in version 17.1.1 which has come up with various improvements missing from the previous versions. For example, we used to have problems generating the LTF patients which initially included other factors...now all that has been sorted"

U3: it is done within a few minutes; it is done and then you are able to continue with your work normally

Some participants' perceived implementation of the EMRs in all points of care (records, triage, consultation, pharmacy & laboratory) as providing seamless flow of patient data in all sections of HIV-care making.

G1: we are using it in the CCC alone but here we are using Kenya EMR, like HTS counsellors are using it for testing any person that comes into the facility even the 'boda boda' people and the TB clients both through (...) we are putting in the system. We are also enrolling clients who are HIV positive and even mothers who are pregnant, who are not positive - we are enrolling them in the system, and even mothers who are also positive that is non-positive mother we are also capturing them. We are also capturing the children both exposed and non-exposed that's makes us get even the immunization records (...).The system is capturing a lot.

Patient data management

Another important enabler to the use of the system is the ease of managing patient data. This includes easy retrieval of patients who have missed on appointments, flagging of patients due for viral load, easy way of defaulter tracing and then lost to follow-up patients, management of indicators such as VLs, ability to quickly tell current on care and those in differentiated care model. Further the participants are able to provide prompt and correct information to social department for patient follow-up.

R1: Currently what I am appreciating is the management of appointment keeping which we have the calendar in the system which is able to support us as clinical staff. We are able to see how many patients we have booked, what days, so that we do not overbook and under-book on certain days. This has been a very good thing

R7: Another thing is better patient data management; we can now be able to retrieve a list of patients who have missed on appointments

U2: "I don't strain like it used to be before EMR looking for transfer in /out, LTF, I used to strain...In terms of missed appointments, it was hard for us to understand missed appointments. At times you will find that there is a client who has not been booked, now I can be able to tell missed appointments"

R7: Through EMR we are able to conduct defaulter case management, and later on lost to follow-up after they miss clinical visits. With the system we able to pull a list of those patients who have missed appointments, tell the number of days the patients have missed, so we submit the list to the social worker department where they are able to contact the patients so they can back up to the clinic. The EMR version 17.1.1 is able to give us a list of patients active on care who are differentiated care model

Training

Use of the EMRs in care delivery involves mastery of the system. Therefore, users need training to effectively use the system. The study participants perceived the initial training offered at the introduction of the system in facilities, supplemented by on-job-training (OJT) for new untrained staff, equipped them with the skills needed to use the EMRs. Nevertheless, they expressed the need to have regular trainings in line with the EMRs upgrades.

G6: "we had a very thorough training of three days including clinicians, nurses and all the users"

G5: "So there should be that regular training to continue giving us morale"

Some participants further explained that the system upgrades did not disrupt their work while the training they received on how to upgrade the EMRs as a good experience. However, other participants depend on SDPs on the system upgrade task.

G2: "our implementing partner has done in the whole [County name]with the new version, it is done within a few minutes and then you are able to continue with your work normally. However, they do not take time to explain to you what has been added".

U3: "I have been taken through doing the upgrade, and it is a good experience"

Technical Support

Another important motivator in the use of the EMRs was the technical support provided by the system developers through the help desk toll free line. The participants' felt that this addressed their needs in time and at the same time added to their technical skills. Further the participants explained access to developer's website provided information on new system upgrades as well as general support.

U2: "Actually the challenges that I incur is that there is that error that normally come which takes most of our time. But I want to thank XX from [organization name- EMR developers] who really helped sort that problem. I am also able to sort out some challenges alone without seeking help from [organization name- EMR developers]"

U6: "but even before the implementing partners had upgraded, I had already seen there is a package in the EMR website supported by [organization name-EMR developers]"

Human factors

Participants reported collegial support as a motivator in the use of the system where untrained colleagues learned to use the system through on-job-training (OJT). Initially the EMRs was perceived as a reserve for the young users but through training and teamwork that changed the attitude and young and old are using the system.

R1: "As much we are getting new staff, the trained ones are able to OJT to them. Therefore, it has not been difficult for the new staff coming into the facility."

R3: "I think everybody in the facility and within the sub-county I'm working around, they are okay. I think even the HTS ...I've done OJT and they are using the EMR"

G1: "So there were bad attitudes towards the system from some of our guys. But actually, after training and having some internal meetings and making sure that the old guys like the facility in charge, she was very old, she was saying she didn't even know how to touch even the mouse, but actually through the encouragement they have changed ... But right now, everybody likes the system".

Infrastructure and mode of EMRs

The participants perceived the implementation of the system at all points of care motivated use of the system. It also enabled paperless and/or point of care mode of EMR which meant less work for system users. Further, participants reported upgrading of the computers was a boost in ensuring system availability.

R1: "but recently we have been supported with tablets in the facility, therefore point of care has a tablet where every client being seen at different delivery points they are details are entered in the system".

G5: "the good thing is we had moved to point of care and our concordance is at 100%."

Barriers

The study participants highlighted several factors that hindered use of the system partially or totally, presented here as EMR use barriers under the identified thematic areas.

System functionalities/capabilities

Despite the frequent enhancements of the EMRs for additional functionalities, the study participants felt that most of the implementing partners delayed in performing the upgrades at the facilities, thus creating a negative attitude towards the system. Additionally, lack of updates on the EMRs products releases e.g., the most current - COVID-19 EMR was also perceived as a usage barrier.

U6: "The upgrading issue solely lies on the implementing partners, how fast they are".

U3: "Because one of it is that the modules that were added were not many but this one for COVID I am not sure if it is there because I haven't seen it or told about it... The champions have not been told about this and they do not know that there is this COVID-19 module coming into the system"

However, the participants felt the use of the system in only HIV care is a hindrance to its full acceptance and use as they have to revert to paper records while attending to the patients' other ailments like TB or Malaria.

G2: "However, it is mostly used in the CCC department. So, you find for example, somebody who is at the NCH will see only CCC clients using the KenyaEMR and then the other clients will be seen and then the documentation will again have to be done on paper".

Infrastructure and EMRs operation mode

The most important perceived barrier that cut across nearly all participants was lack of appropriate power backup arrangement due to frequent power blackouts. The facilities' inability to have standby power supply forced the users of the system to revert to paper documentation and consequently retrospective data entry, which meant double/repeated work with negative impact on user attitude towards the system.

G3: "The main challenge I experience in my facility is power surge and during that power surge we do not have proper backups in our facility so you will have to wait till the power is back for you to start again and this find you when you have even 2-3 days' work and the network issue at times... if we can have that power backup so that we do not only depend on only electricity".

U6: "we wish we could get a power backup so that we can move from hybrid to POC because as much as I am getting my reports from EMR, I do that retrospectively, and that is in hybrid system"

R5: "we don't have back up, and at the same time we are doing RDE so most of the time we have blackout, like right now we don't have power so the files are pending until the day power will be back even if it is after one month so it's really giving us a hard time"

Another barrier identified by the participants was lack of enough computers for every point of care. As a result, EMRs operates in RDE mode where patient data is captured on paper and transferred later to EMRs. Affected users perceived this as cumbersome due to the repeated work which is very demotivating. Further, lack of local area network to link service delivery points for seamless data flow as well as integrated care with other clinics within a facility was cited as a barrier.

U3: "what is bringing trouble because there are some machines that need to be repaired and those which in computing part have failed, so I don't know what is the way forward"

G3: "The only challenge is the replacement of hardware and RAM is slow- speed of the machine. Otherwise, if we can improve on that I am ok. If it can be upgraded am somehow ok"

Training

Lack of comprehensive and continuous training especially on system upgrades was another barrier identified by most of the participants which hamper morale in using the EMRs. While OJT was perceived a good stop gap measure in equipping untrained users, the participants reported that it was not as comprehensive. Further, the participants explained that they are not sure who should organize the trainings after the change in the implementation structures by the MoH.

G1: "These upgrades, the additional of the modules in the system, they just come do the installation or do the upgrades, then they quit and the team who are back there in the facility, they don't know how to use it".

G5: "When the EMR is upgraded, there should be a training for the staffs, all the staffs in the facility. Because you see when it is upgraded some data sets increase and then there is no OJT from the program maybe from palladium. So, there should be that regular training to continue giving us morale".

G2: "I would say the first training that I received was long way back four years ago I think when I started using EMR yet upgrades have come up"

G: "I don't know who is to organise all these trainings. Because like right now I can say that almost three years we have never seen something like training but everything is changing".

The participants perceived that little or lack of IT skills was a barrier in executing simple technical or back-end of the system tasks such as running queries.

G2: "if something happens, we have to wait for the IT guys to come to our aid on very basic tasks. If at all she had a little background training on the IT, then she can actually perform tasks and make the system up and running and the facility can always continue. So I think as the champions we should get an IT training so that the EMR can keep on running whether the IT person is around or whether they are not around"

Another factor barrier identified as a barrier in effective use of the system is lack of updates by the MoH/NASCOP on standards, guidelines and on definitions such as the period that a patient is considered lost to follow (LTF) which is configured in the system.

U7: "KenyaEMR is defining LTF as those who have missed their appointments up to 90 days while in other cases is defined as those missed appointment 29-30 days. These are some of the discrepancies that should be sorted in the system by the supporting partners or NASCOP have to come up with the clear definition of LTF".

Human factors

High staff turnover was perceived by most of the participants as barrier in the use of the system as most of the replacements do not have the capacity to use the system. This was further worsened by the delays in conducting training. Some participants further explained that there were negative attitudes towards the system by staff who are not part of the HIV program. Additionally, other staff dismissed the system as belonging to the specific staff.

R7: "The other thing is staff turnover. A staff who is trained on the system could be transferred to another facility. So, we get staff from other facilities who are not trained on the usage of the system. They could be new staff all together".

R5: "and then also other health workers how they embrace the system it is all believed to be the work of a HRIO to some extent"

U5: "as our colleague has been saying about, there has been an attitude that the EMR is for records personnel only. But I think for training to be done not only to the program staffs, the training should cover all the staff of the facilities so as not see as if the system is only installed to be used by only the program personnel alone"

A summary of the perceived facilitators and barriers to EMRs use are presented in Table 3 (see Additional file 1).

Recommendations for enhanced EMRs use

The study participants provided vital ideas that would address some of the barriers to EMRs use in order to improve its usage. A major recommendation was for the MoH at the national level to take up KenyaEMR ownership and lead in the implementations instead of the funding agencies or partners for sustainability when the partners go. Further, the structure of the EMR implementation should be clear with the roles of the County government (host of the EMR implementations), EMR developers, and SDPs clearly defined.

U3: "Let the EMR be for MoH, partners will go..."

G2: "Some partners are not willing to support as they are supporting facilities are doing OpenMRS. So, I think in a way we should find I do not know from which direction that partners supporting facilities that are using KEMR purely accept and embrace KEMR given that it is the way that the nation decided we are going KEMR nationally. Two, the county level should also embrace the KEMR because if county does not embrace this then this issues to do with power backup you cannot leave everything to partners"

Participants strongly recommended that all facilities be supported in running the EMRs in paperless or POC mode to avoid duplication of work dominant in RDE and hybrid modes. Thus, EMRs implementations should be extended to other points of care not just in HIV clinics as well as have in place a proper power backup plan (standby generators or solar power) to address the power blackout challenges which can last even 2-3 working days halting usage of the system.

G1: "[facility name] is the model facility in [county name]. So, if every facility is installed the way [facility name] was installed so many challenges across in KEMR will be sorted and this can only happen if the county government embraces the use of KEMR in our facilities".

U6: "It is our hope from this discussion we can come up with a way to help the facilities come POC system so that we will be able to have our power back up 24/7 we move from hybrid system so that our clinicians can be able to do POC".

All-inclusive (program & MoH staff) training was recommended by almost all the participants to eliminate the negative attitude towards the system in terms of who should use. To address the user skills gaps in system usage, regular refresher trainings at the facility level as well as system users' inter-facility forums to share real/practical experiences were recommended. Additionally, the training content should be revised to include basic IT content to enable system champions do basic back-end staff like running queries at the command prompt

U6: "Every staff to be trained on EMR use (not just program staff) because we are going forward to use technology"

U1: "Refresher trainings needed whenever there is system upgrades and again due to the dynamic IT field"

Lastly, the MoH should allow facilities with 100% RDQA concordance to drop some of the paper-based registers to avoid duplication of work, and to make EMRs role in routine reporting relevant. The developers can improve the functionality of the system to generate the reports on a single sheet, instead of having to run a number of other reports.

U6: "it should come out clearly from MoH or NASCOP that for those facilities with EMRs and are 100% concordance, they drop some registers, because I have got some issues that facilities which are a 100% concordance, they are still asked to do things like DR of which DR is not important if indeed you migrated and a 100% concordance with EMR and paper.

U1: "... only thing I can talk about KenyaEMR right now is about getting reports on a single sheet, do you know at the moment, you must run a lot of reports on KeEMR while you can just give it on a single sheet and get the report"

Discussion

This study set out to explore the EMRs users' perceptions on factors influencing EMRs use or under-use (facilitators and barriers) in healthcare facilities. Factors related to system functionalities/capabilities, (2) training, (3) technical support, (4) EMR mode, (5) human factors, and (6) infrastructure were identified as barriers or facilitators to EMRs use. The EMRs users perceived implementation of EMRs in healthcare facilities to have significantly improved patient data management bringing about quick access to patients' files, high quality data, efficiency in routine reporting, and generally freeing clinician to have more time with the patients. Users perception that EMRs support routine reporting is consistent with Ngugi *et al*/recent study on assessment of HIV data reporting performance by facilities during EMR system implementations in Kenya (21). Largely, the perception was that all EMR users regardless of job category were willing to use the system because of the perceived benefits.

The EMRs functionalities/capabilities were perceived adequate in assisting the users in performing their tasks. Nevertheless, the discussions did not delve into system functions specifics. Several factors motivated EMR use including ease of use, learn qualities of the EMR, and its feature sets such as easy retrieval of patient files and easy patient record updates, among others. The study finding was consistent with the study by Holden et. al. on physicians' attitudes towards EMRs, which indicated that a good mental model of EHRs information structure facilitate EMRs use (37). In their review study on user satisfaction with information systems, Zviran & Erlich revealed that systems that are easy to use and learn are easily accepted by the users. In this study, we observed that system acceptance leads to use (6). Additionally, Mostafa et al study on users' views and attitudes towards the key elements of successful implementation of hospital information system revealed system functionality as the most important critical success factor (3). Conversely, systems with missing features and poor performance are a use barrier (38). Our study demonstrates that regular upgrades of the EMRs to address missing functionalities, as well as enhancements coupled with regular user training can influence users' attitude in using the system. Nonetheless, systems that interfere with the workflow are rejected by users leading to non-use.

The participants elucidated that training gave them the capacity to use the EMRs. Many studies emphasize the importance of training as a precursor to EMR use, and indeed, any type information system (15,16,39). This study found out that training was offered through formal training sessions to the system users or on job training (informal). Most of the participants underscored the need for continuous user training especially on release of EMRs upgrades. The study identified a knowledge gap on the functionalities of the system among the participants during the discussions. This was unexpected as all had experience of >2 years in their current positions. Thus, they would have been expected to be familiar with all the system functionalities. Some participants indicated they were unaware of COVID 19 EMRs module released to support in the COVID 19 pandemic statistics at the County level. Pole, in his study of EMRs implementation in Sri Lanka, states that "*the main secret of success was continuous training of hospital staff over a 2 or 3 year period*" (4). Holden also assessed the challenges of physicians' EMR use and found that unfamiliarity with specific features of a system was a barrier to using the EMRs fully, which can be attributed to the quality of training (37). It is important that users of the EMRs at all levels receive training for effective use of the system. The participants recommended that the training content should include technical basics to supplement any gap created by delayed IT technical support. Apart from slow response from the IT department reported by some participants, this study found the technical support from the system developer's helpdesk adequate, which motivated use of the system.

Factors identified in the study touching on human factors as EMRs use enablers included peer or collegial support, as well as change of attitude on users' age factor as result of training. Initially, the belief was that computers (IT technology) was for the young people. Human factors identified as barriers to use included high staff turnover and negative attitude created by the fact that the EMRs is implemented only in HIV care section of the facility. Therefore staff in other sections have nothing to do with it (14,40). This is aggravated further by training selected staff hence resulting to negative attitude by those left out. Jowhari *et al*/holds the view that human factors affecting EMRs uptake in resource-constrained settings are complex and need to be better characterized (18).

EMRs continuous availability was identified as a barrier due to the state of infrastructure in the healthcare facilities limiting its use. Many studies highlight the importance of appropriate information system infrastructure such as computers, reliable power supply, networking capabilities where EMRs are deployed (41–43). Challenges related to infrastructure are however mostly prevalent in low and medium income countries (LMICs) (14,18,44). In our study, the challenge of infrastructure not only affected EMRs availability but also the mode of its use. Frequent power blackouts resulted into most facilities using the EMRs in RDE or hybrid modes (see current status in Table 1 and Appendix I) occasioning double work (transfer of paper documentation to EMRs) for the users. Furthermore, facilities that lack enough computers on all points of care and interconnectivity to other sections of care majorly use the EMRs in RDE mode. Hospital workflows are interconnected where the activity in one department affects the other. Therefore, there is need to implement the EMR in all departments to avoid the undesired shift from EMRs to paper documentation in the process of patient care. Other remedies recommended by study participants are consistent with recommendations by a number of authors which include installation of multiple power supplies (e.g. solar, generator, & uninterrupted power supply) for resource-limited settings (41,42,45). However, due to lack of clearly defined roles in the EMRs implementation endeavour in the study setting, participants were unsure of who amongst the stakeholders should replace the old and slow computers. Such organizational barriers add implications to the system usage.

This study identified a gap in the EMRs implementation organizational structure. The roles of MoH, County government and SDPs around EMRs implementations and management are unclear. This poses a challenge in implementation leadership and EMRs ownership. For instance, the participants were unsure who should organise for the trainings while some facilities were yet to have their EMRs upgraded to latest release. The study also identified that facilities were running different versions of EMRs despite the upgrades being available to all. Such is again pointed to leadership challenges.

A key strength of the study was the inclusion of participants from facilities at different performance levels (best, medium, and poor) whose characteristics cut across in terms of Kenya Essential Package for Health (KEPH) level, ownership, services and EMR mode (Table 1 and Appendix I). This ensured that all EMR implementation status were represented. Two of the focus groups were a mix of participants, regardless of the performance level of the facility they represented. Further, the participants represented all potential users of the system; clinicians, data clerks, HRIOs and IT staff. The inclusion of the SDPs in the study also added value in understanding their role in EMR implementations and in supporting use of the EMR. The response rate was very high 22/24 (91.7%) from 20 facilities and two SDPs organizations, which can be attributed to personal calls and emails to the prospective participants. The interview guide and appropriate probes ensured that all participants were measured using the same standards (46). The FGD forum made the participants realize the need for similar forums in supporting each other for optimal use of the EMRs features for better patient data management.

There were limitations to this study. First, due to COVID-19 pandemic, FGDs were conducted using an online modality and therefore we did not collect observational data. Secondly, the three focus groups (two for EMRs users and one for SDPs) were the only ones formed and thus the concept of saturation was not applicable. However, enough time was spent within the discussions until there was saturation, with no new information shared. Lastly, the study is limited in generalizability of its findings due to the fact that it was conducted in only one country Kenya, and with one type of EMRs, KeEMR (47). Rather, we seek transferability to LMICs contexts similar to the one this study was undertaken. Nevertheless, the study sites selected covered all the counties with KeEMR system implementation as per the time of the study. Limitations notwithstanding, our study offers important information that will be helpful to decision makers at the different levels, including: MoH, funding agencies and local implementing partners for successful EMRs implementations. This is especially important as systems get scaled nationally. It is notable that the MoH of Kenya plans to expand the KeEMR to all other health facilities. It is expected that the results of this study will greatly inform use of these systems across the country. In particular, power blackout challenges and user training should be given more attention to motivate system usage. Further, the need for clear EMRs implementation structure cannot be over emphasized.

Conclusion

The study investigated the factors that influence use, under-use and non-use of EMRs using qualitative analysis. Use of EMRs is affected by numerous factors. Among the most important ones identified in this study include EMRs functionalities, user training, technical support, infrastructure, human factors, and EMRs mode of use. The results of this study show users generally believe the KeEMR system is loaded with lots of benefits that support efficient patient data management while at the same time being easy to learn, driving the desire to use it. Nevertheless, under-use/non-use of the EMRs was attributed to lack of continuous user trainings and retrospective data entry (RDE) mode of use arising from infrastructural challenges. Clearly established EMRs implementation leadership structure was considered a panacea to users' motivation to the use of the system.

Abbreviations

| | |
|--------|---|
| ADT | Antiretroviral Dispensing Tool |
| COREQ | Consolidated Criteria for Reporting Qualitative studies |
| DWAPI | Data Warehouse Application Interface |
| EHR | Electronic Health Record |
| EMR | Electronic Medical Records |
| ETS | Text Message for Adherence |
| FGD | Focused Group Discussion |
| HRIOs | Health Records Information Officers |
| HTS | HIV Testing and Counselling |
| IL | Interoperability Layer |
| IS | Information System |
| IT | Information Technology |
| KeEMRs | KenyaEMR system |
| KEPH | Kenya Essential Package for Health |
| LMIC | Low- and Medium-Income Countries |
| MCH | Mother and Child Health |
| MoH | Ministry of Health |
| NASCOP | National AIDS and STI Control Programme |
| NDW | National Data Warehouse |
| NGO | Non-Governmental Organization |
| POC | Point of Care |

| | |
|------|--------------------------------|
| RDE | Retrospective Data Entry |
| RDQA | Routine Data Quality Assurance |
| SDPs | Service Development Partners |
| TB | Tuberculosis |

Declarations

Ethical Approvals

The study was approved by the Institutional Review and Ethics Committee at Moi University, Eldoret (MU/MTRH-IREC approval Number FAN:0003348).

Availability of Data and Materials

The data analyzed in this study is in the custody of the researchers and is available on request.

Competing Interests

All authors report no competing interests to declare.

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Authors' Contribution

P.N. and A.B. conducted the focused group discussions. P.N. transcribed the recorded discussions. P.N. and A.B. participated in content analysis and derivation of relevant themes. All authors provided critical feedback and helped shape the manuscript.

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Disclaimer

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Tables

Table 1: Study facilities performance and characteristics

| Facilities Code | County | Weighted Mean | Keph level | Facility_type_category | Owner Type | EMR Implementation Dates | Services | EMR mode |
|-----------------|-----------|---------------|------------|------------------------|------------|--------------------------|-----------|----------|
| 13793 | Migori | 65% | Level 2 | MEDICAL CLINIC | NGO | 12.03.2014 | CT&IL | POC |
| 13657 | Kisumu | 62% | Level 4 | HOSPITALS | MoH | 01.12.2018 | CT | HYBRID |
| 15855 | Bungoma | 62% | Level 4 | HOSPITALS | MoH | 27.09.2013 | CT | HYBRID |
| 13468 | Kisumu | 61% | Level 4 | HOSPITALS | MoH | 01.09.2018 | CT&IL | POC |
| 13782 | Kisumu | 61% | Level 3 | HEALTH CENTRE | MoH | 01.02.2013 | CT | HYBRID |
| 14825 | Nandi | 61% | Level 3 | HEALTH CENTRE | MoH | 04.07.2013 | CT | RDE |
| 19858 | Homa Bay | 41% | Level 3 | HEALTH CENTRE | MoH | 18.09.2014 | CT&HTS&IL | HYBRID |
| 13673 | Kisii | 40% | Level 4 | HOSPITALS | MoH | 02.07.2013 | CT | RDE |
| 15961 | Kakamega | 40% | Level 4 | HOSPITALS | MoH | 25.09.2013 | CT | POC |
| 10419 | Nyandarua | 40% | Level 3 | HEALTH CENTRE | MoH | 26.05.2014 | CT | HYBRID |
| 13933 | Kisii | 39% | Level 3 | HEALTH CENTRE | MoH | 24.06.2014 | CT | RDE |
| 16117 | Vihiga | 39% | Level 3 | HEALTH CENTRE | MoH | 04.08.2014 | CT | HYBRID |
| 15662 | Turkana | 39% | Level 2 | DISPENSARY | FBO | 23.07.2013 | CT | RDE |
| 16119 | Kakamega | 12% | Level 3 | HEALTH CENTRE | MoH | 20.08.2014 | CT | HYBRID |
| 16158 | Vihiga | 12% | Level 3 | HEALTH CENTRE | MoH | 10.06.2013 | CT | HYBRID |
| 15977 | Kakamega | 10% | Level 3 | HEALTH CENTRE | MoH | 20.08.2014 | CT | HYBRID |
| 14623 | Nandi | 10% | Level 3 | HOSPITALS | MoH | 10.12.2013 | CT | RDE |

| | | | | | | | | |
|-------|--------|-----|------------|---------------|-----|------------|--------|--------|
| 16151 | Vihiga | 10% | Level 3 | HEALTH CENTRE | MoH | 17.04.2014 | CT | RDE |
| 10019 | Kiambu | 9% | Level 2 | DISPENSARY | FBO | 06.11.2013 | CT&HTS | HYBRID |
| 14749 | Nandi | 9% | Level 4 | HOSPITALS | MoH | 19.12.2012 | CT | POC |

Keph - Kenya essential package for health, NGO - Non Governmental Organization, MoH - Ministry of Health, FBO - Faith Based Organization, CT-Care & Treatment, HTS - HIV counselling & Testing services, POC - point of care, RDE-Retrospective data entry , Green-best performing facilities, yellow medium performing and Red - poor performing

Table 2. EMRs users focus group participants characteristics (n=20)

| Gender | | | | |
|---------------------------|---|--------------|----------|--------------------------------|
| Male | | Female | | |
| 9(45%) | | 11(55%) | | |
| Age | | | | |
| 20-30 years | | 31- 40 years | | 41-50 |
| 10(50%) | | 10(50%) | | 0 |
| Profession | | | | |
| Data clerk | Health records information officer (HRIO) | | IT staff | Medical/clinical officer Other |
| 1(5%) | 15(75%) | | 2(10%) | 1(5%) 1(5%) |
| Work experience | | | | |
| <2 years | | 2 -5 years | | 6 - 10 years >10 years |
| 1(5%) | | 10(50%) | | 8(40%) 1(5%) |
| EMR use experience | | | | |
| < 2 years | | 2 - 5 year | | < 5 years |
| 3(15%) | | 13(65%) | | 4(20%) |

Figures

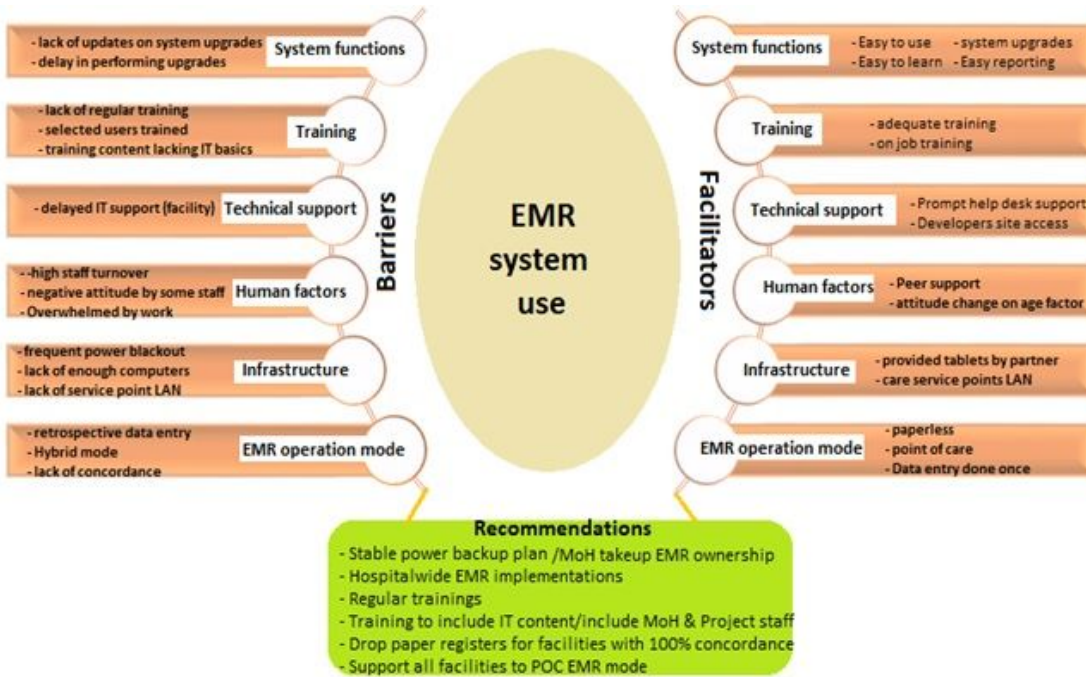


Figure 1

Codes and categories that emerged from the analysis and a summary of the participants' recommendations

Supplementary Files

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