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Healthcare Workers' eHealth Competences in Private Health Centres in Urban Tanzania

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Abstract

Background: Healthcare workers' eHealth competence is a significant, but often overlooked, factor for successful eHealth implementation. The implementation of eHealth has radically transformed health sector workforce's competency requirements, and has created challenges, especially in low- and middle-income countries.

Aim: The aim of the study was to identify healthcare workers' existing eHealth competences in private health centres in urban Tanzania.

Methods: The data were collected in private health care facilities by using both a survey questionnaire and semi-structured interviews. Data were analysed by SPSS and Atlas.ti software.

Results: Tanzanian healthcare workers had several weaknesses in computer and informatics competences, and eHealth technology-related competences varied widely among the participants. However, generally participants had positive perceptions towards eHealth. The majority of the healthcare workers had quite limited training for and exposure to eHealth technologies, which consequently appeared to hinder the competency development.

Conclusion: To increase the likelihood for successful eHealth implementations, findings emphasize the importance of identifying individuals' eHealth competences prior to eHealth implementation, providing eHealth trainings that are targeted at the specific needs of groups and individuals, and support the on-the-job use of eHealth technologies. The positive perceptions towards eHealth suggest that healthcare workers are ready to take on such technologies. Further studies to determine how to improve healthcare workers' eHealth competences and what kind of training should be provided would be useful in addressing the identified challenges and overcome the weaknesses.

Keywords: Basic computer and informatics competences; eHealth attitudes; eHealth competences; Healthcare workers; Tanzania

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1. Introduction

Like many low-income countries [1,2], Tanzania is facing challenges in providing adequate health services, such as rising healthcare costs, shortages of healthcare workers, and inefficient use of available resources [3]. To respond to these financial, epidemiological, and demographical pressures and challenges, several sub-Saharan African countries are actively deploying eHealth technologies [4, 5, and 6]. Tanzania is no exception [7]. For example, the Government of Tanzania's Health Sector Strategic Plan (HSSP IV) 2015-2020 has set a goal that by 2020 at least 25% of the primary health care facilities will use ICT systems and technologies, starting in urban areas [3]. Moreover, the increased Internet access and use of mobile technologies, availability of cheaper and more robust power hardware, and the appearance of various open source software have supported the diffusion of eHealth initiatives to many low- and middle-income countries [8].

WHO Global Observatory for eHealth [9] defines eHealth as "a cost-effective and secure use of Information and Communication Technologies (ICT) in support of health and health-related fields". Generally, the term eHealth is used as an umbrella term to cover the wide and overall use of ICTs in health sector [10-13], such as electronic health records (EHR) [14], telehealth devices [15], mobile based health devices [16], health information technology [17], and electronic health information systems [4].The implementation of eHealth into the healthcare systems has radically transformed health sector workforce's competency requirements [18]. In addition to traditional healthcare and clinical work, healthcare workers must understand information and communication technology [19] and possess basic computer knowledge and skills [15]. The ability to use eHealth efficiently is also connected with broader informatics competences, such as being aware of privacy and confidentiality issues related to electronic data and information [20]; being able to manage, validate, analyse, and interpret data and information [21]; as well as considering recording patient data as means to inform decision making or guide quality improvement [22]. Finally, healthcare workers should also adopt a positive attitude toward eHealth use in the workplace [20], as attitudes and beliefs towards eHealth have been recognised to influence implementation and acceptance of eHealth [23].

The new required eHealth competences that healthcare workers should exhibit have created challenges, especially in low-and middle-income countries [21]. For example, studies conducted in Tanzania and Ghana [24], Ethiopia [25-27], Iran [28], Turkey [29], Nigeria [30], Uganda [31], and South Africa [32] revealed that the health sector workforce lacked adequate eHealth competences. Particularly in low- and middle-income countries, healthcare

workers' eHealth competences are a significant factor influencing eHealth systems implementation and acceptance [33].

The utilization of eHealth demands appropriate eHealth competences to accompany new technology [34]. Identifying healthcare workers' existing eHealth competences and training needs before costly eHealth implementation has been highlighted as a necessity [26, 27]. The identified barriers may help to overcome future challenges [35] and support notoriously difficult eHealth implementation processes [36]. However, previous studies conducted in low-and middle-income countries are still relatively few in numbers [37] or have relied merely on participants' self-assessment on their competences [38] or on quantitative methodologies [39]. Therefore, in the study reported here, both a survey questionnaire and semi-structured interviews were employed to gain insight into healthcare workers' self-assessed as well as existing eHealth competences in Tanzania. The aim of the study was to identify healthcare workers' current state of eHealth competences in private health centres in urban Tanzania.

2. Methods

2.1 Study Design and Setting

The study focuses on exploring healthcare workers' eHealth competences in private health centres in urban Tanzania. To investigate healthcare workers' eHealth competences, qualitative interviews and quantitative survey study were carried out.

In Tanzania, the primary health care services, mainly dispensaries and health centres, constitute the basis of the referral structure of health care services, and are managed by both public and private providers [3]. Participating health centres were identified in collaboration with the Association of Private Health Facilities in Tanzania (APHFTA), an umbrella organization of the private health facilities, and Christian Social Services Commission (CSSC), a coordinating body of faith-based health facilities in Tanzania. The health centres consisted of not-for-profit and for-profit private health centres. The level of computerization varied among the studied centres. Most of the health centres used an excel-based system. Some of the health centres routinely used electronic health records system (e.g. Care2x). Few of the health centres had faced previous implementation failures of electronic system such as Care2x and were again using excel-based system.

2.2.Sampling and Participants

Research participants were chosen by using purposeful and snowball sampling strategy. Participants were selected among the healthcare workers working in private health centres in Dar es Salaam and in Arusha regions. While there are different occupations subsumed under the term “healthcare workers”, this research refers to all those who are working in the health centres, including doctors, nurses, laboratory technicians, pharmacist, IT support officers, health administrative workers, and receptionists, since all these actors will interact with eHealth in the future.

2.3 Study’s Conceptual Framework

The eHealth competences framework was synthesized from diverse sources of existing literature [22, 39, and 40]. The study’s conceptual framework of eHealth competences consists of three components: (1) basic computer competence, (2) basic informatics competence, and (3) eHealth attitudes.

Basic computer competences consist of, but are not limited to, the basic knowledge and skills on the computer’s hardware system and its functions, Internet and email, external peripheral devices, basic software applications, keyboarding (typing) skills, and the ability to resolve common troubleshooting, and to use computer technology in a safe way.

Basic informatics competences consists of, but is not limited to, knowledge and skills on confidentiality when processing computerized data and health records; articulating the value of eHealth and its links to improved quality; recognizing the computer is only a tool to provide better healthcare; recognizing the value of clinicians’ involvement in the design, selection, implementation of eHealth applications in healthcare; assessing the reliability of health information on the Internet; analysing the data and applying the findings appropriately, and performing basic troubleshooting in applications.

eHealth attitudes consist of both positive and negative attitudes. Positive attitudes include, but are not limited to, willingness and motivation to use and learn new eHealth technologies to improve quality of patient care, perceived usefulness, willingness to enrol in computer courses, feelings that applying technologies can help elevate efficiency or increase competitiveness. Negative attitudes include, but are not limited to, fear of using technology, doubts that these systems can improve the quality of care or clinical outcomes, distrust in the systems, beliefs that electronic systems would disrupt the delivery of care, and general resistance to change.

2.4 Data Collection Instrument

To investigate healthcare workers' eHealth competences, we used both a survey questionnaire and semi-structured interviews. A survey questionnaire was designed to collect data on healthcare workers' self-assessed and existing basic computer and informatics knowledge and skills, as well as to explore how the self-rated responses reflect participants' existing basic computer and informatics knowledge and skills. The questionnaire was translated into Kiswahili and contained three sections:

- The first section covered socio-demographic information such as age, sex, and professional qualifications; and previous computer training and use.
- In the second section, participants were asked to assess seven self-perceived knowledge and skills statements on a five-point scale ranging from none, minimum, average, good to excellent. Self-assessed competences have been stated to reflect individuals' confidence and some level of understanding towards technological applications [31] which has been stated to influence eHealth acceptance [37]. The questionnaire included a description of the competency scale as guidance for respondents to estimate their personal competency level.
- In the third section, respondents answered 27 multiple-choice questions assessing existing basic computer and informatics knowledge and skills. Questions in the third section were designed in a way that three to four test questions corresponded with one self-assessment statement. Participants were required to select one option for each question and earned one point for each completely correct response or no points for an incorrect or "I don't know" response.

Qualitative approaches have been emphasized to give more insight on factors affecting eHealth uptakes [5, 24, 27, and 41]. We conducted semi-structured interviews to gain further insights on healthcare workers' eHealth knowledge, skills and attitudes. The interview was designed to collect data on opinions and experiences about eHealth, general use of computer at the workplace, personal computer and informatics knowledge and skills, as well as possible training needs.The survey questionnaire and the interview template were piloted before actual data collection began. Minor revisions were made to both.

2.5 Data Collection

The data were collected between July 12 and August 25, 2018 in nine different health centres in Dar es Salaam and Arusha regions by the first author (AL). The survey

questionnaire was conducted at nine different health centres and distributed to forty healthcare workers. In the recruitment of research participants, it was not possible to select only those healthcare workers who used computers. Among these forty respondents, two reported that they did not use computer at all. Because the aim of the study was to produce comparatively coherent information on the existing computer and informatics competences, these two non-users were excluded from the analysis.

Semi-structured interviews were conducted at six different health centres. A total of twenty-five healthcare workers were interviewed; nineteen in Dar es Salaam and six in Arusha. Interviews took fifteen to forty minutes each and were audio recorded and transcribed. One interview was conducted without audio recording because the participant did not give permission. Detailed notes were written of this interview. All interviews were conducted primarily in English, but a local interpreter assisted if language difficulties occurred or if an interviewee preferred to answer in Kiswahili, the local language of the study area. Prior to the interviews, interpreters were explained the fundamentals of interview method. Table 1 presents the summary of the data collection in each of the nine health centres.

Table 1 The number of **s**urvey questionnaire and interview respondents in each of the health centres

	Survey Questionnaire	Interviews	Location
Health Centre 1	5	5	Dar es Salaam
Health Centre 2	4	5	Dar es Salaam
Health Centre 3	5	4	Dar es Salaam
Health Centre 4	6	5	Dar es Salaam
Health Centre 5	4	0	Dar es Salaam
Health Centre 6	2	3	Arusha
Health Centre 7	5	3	Arusha
Health Centre 8	5	0	Arusha
Health Centre 9	4	0	Arusha
Total	40	25	

2.6 Data Analysis

Data analysis was primarily conducted by the first author (AL). Quantitative survey data were analysed with SPSS version 23. Respondents' general characteristics, self-assessments, and multiple-choice questions' answers were analysed using descriptive statistics, including, frequencies, percentages, and means. Audio recorded interviews were transcribed and entered into Atlas.ti version 8.3.16. Data was analysed by using thematic analysis [42].

2.7 Ethical Consideration

Prior to commencing the study, the research protocol was approved by the Tanzania Commission for Science and Technology (COSTECH) (Research permit number: 2018-414-NA-2018-171). The first step in data collection at each site was to explain the aim of the research to the participants and to obtain their informed consent. All the data and information collected is confidential and anonymous. The identities of the respondents were not documented at any point in the study.

3. Results

3.1 Self-Reported Survey Questionnaire

3.1.1 Demographics

Out of the thirty-eight respondents to the survey, 17 were females and 20 were males (Table 2). Most of the respondents were in the age group of 26 – 35 years. One respondent held a master's degree, fourteen held bachelor's degrees, and twenty held diplomas or certificates. Nurses and doctors represented more than half of the respondents. The rest of the respondents consisted of health administration workers, laboratory technicians, pharmacists, IT support officers, receptionists, and insurance officers. Regarding the years of work experience, the majority had five years or less. The most common places to use the computer were at work and at home. Sixty-five percent had participated in computer training, however, the extent varied from a few days to a few years. Often training was conducted as part of professional education or at school. More than half of the respondents were using a computer every day.

Table 2 Socio-demographic characteristics of respondents [N = 38]

Variable	Category	n (%)
Gender	Female	17 (44.7)
	Male	20 (52.6)
	Unknown/missing	1 (2.6)
Age	18-20	1 (2.6)
	21 - 25	8 (21.0)
	26-35	16 (42.1)
	36-45	7 (18.4)
	> 45	6 (15.8)
Educational status	Diploma/Certificate	19 (50.0)
	Bachelor's Degree	13 (34.2)
	Master's Degree	1 (2.6)
	Unknown/missing	5 (13.2)

Variable	Category	n (%)
Profession	Nurse	10 (26.3)
	Medical doctor	8 (21.1)
	Laboratory technician	4 (10.8)
	Pharmacist	4 (10.8)
	Administrative worker	4 (10.8)
	IT officer	3 (8.1)
	Other	4 (10.8)
	Unknown/missing	1 (2.6)
Work experience	< 1 year	9 (23.7)
	1-5 years	14 (36.8)
	5-10 years	8 (21.1)
	> 10 years	7 (18.4)
I use computer…	at home	23 (57.5)
	at work	28 (73.7)
	at Internet café	8 (21.1)
	at friends/ neighbours	6 (15.8)
How often using computer	Every day	22 (57.9)
	1-2 times a week	7 (18.4)
	Few times a month	7 (18.4)
	Few times a year	0 (0.0)
	Other	1 (2.6)
	Unknown/missing	1 (2.6)
Have participated in computer training	Yes	26 (68.4)
	Unknown/missing	1 (2.6)

3.1.2 Self-assessed Basic Computer and Informatics Competences

To determine how healthcare workers perceived their eHealth technology competences, confidence, understanding, and experience [24], participants were asked to self-assess a set of seven statements.

Out of 38 respondents, 36 completed the self-assessment section. Generally, healthcare workers perceived their basic computer and informatics competences as “average” or “good” (Table 3). The highest competences and rated as “good” were on basic computer technology & their functions (median 3.0), using Office software (median 3.0), using Internet & email (median 3.0), and information security & privacy (median 3.0). Respondents generally rated their competences as ‘average’ in searching reliable health information (median 2.5), basics of the systems & data management (median 2.0) and utilizing health information to make decisions if necessary (median 2.0). However, as shown in Table 3, respondents’ self-assessed competences varied among individuals and across competency areas.

3.1.3 Existing Basic Computer and Informatics Competences

To determine healthcare workers’ eHealth technology knowledge and skills, participants were asked to answer 27 multiple-choice questions. Out of 38 respondents, all completed the questions. Of the maximum of 27 points, the median number of earned points was 20.0 (Table 4). As in the self-assessment section, respondents’ median scores were highest on basic computer technology & their functions (4.0/4.0) and using Internet & email

(4.0/4.0). The median number of correct answers on using Office software, information security & privacy, and utilizing health information to make decisions if necessary was 3.0/4.0. Basics of the systems & data management had median scores of 2.5/4.0. The lowest median score of correct answers was on searching reliable health information (1.0/3.0), only seven of the respondents had all the answers correct, and four had none of the answers correct. However, as indicated in Table 4, respondents' levels of basic computer and informatics competences varied among individuals and competence areas.

Table 3 Respondents' self-assessed eHealth knowledge and skills [N = 36]. Table shows the median score for each competence area and the detailed frequency of responses.

		n (%)				
	Median	**None**	**Minimum**	**Average**	**Good**	**Excellent**
Basic computer technology & its functions	3.0	0 (0.0)	0 (0.0)	8 (22.2)	13 (36.1)	15 (41.7)
Using Office software	3.0	0 (0.0)	1 (2.8)	12 (33.3)	13 (36.1)	10 (27.8)
Using Internet & email	3.0	0 (0.0)	1 (2.8)	12 (33.3)	9 (25.0)	14 (38.9)
Information security & privacy	3.0	0 (0.0)	3 (8.3)	11 (30.6)	13 (36.1)	9 (25.0)
Basics of the systems & data management	2.0	0 (0.0)	1 (2.8)	22 (61.1)	7 (19.4)	6 (16.7)
Searching reliable health information	2.5	0 (0.0)	1 (2.8)	17 (47.2)	13 (36.1)	5 (13.9)
Utilizing health information to make decisions if necessary	2.0	1 (2.8)	3 (8.3)	16 (44.4)	11 (30.6)	5 (13.9)

Table 4 Respondents' existing eHealth knowledge and skills [N=38]. Table shows the possible maximum points, the median number of correct answers within each of the competence areas and more detailed frequency of correct answers within each area.

	Max points	**Median**	**Number of correct answers n (%)**				
			0	**1**	**2**	**3**	**4**
All the questions	27.0	20.0					
Basic computer technology & its functions	4.0	4.0	1 (2.6)	0 (0.0)	2 (5.3)	13 (34.2)	22 (57.9)
Using Office software	4.0	3.0	0 (0.0)	5 (13.2)	11 (28.9)	13 (34.2)	9 (23.7)
Using Internet & email	4.0	4.0	0 (0.0)	0 (0.0)	2 (5.3)	9 (23.7)	27 (71.1)
Information security & privacy	4.0	3.0	1 (2.6)	2 (5.3)	10 (26.3)	13 (34.2)	12 (31.6)
Basics of the systems & data management	4.0	2.5	0 (0.0)	7 (18.4)	12 (31.6)	12 (31.6)	7 (18.4)
Searching reliable health information	3.0	1.0	4 (10.5)	15 (39.5)	12 (31.6)	7 (18.4)	
Utilizing health information to make decisions if necessary	4.0	3.0	0 (0.0)	4 (10.5)	8 (21.1)	8 (21.1)	18 (47.4)

3.2 Interviews

Out of the twenty-five interviewees, nine were females and sixteen males. Most of the interviewees were doctors and nurses, and the rest of the interviewees consisted of health

administration workers, laboratory technicians, pharmacists, IT support officers, receptionists, and insurance officers.

3.2.1 Basic Computer and Informatics Competences

The first finding was that eHealth technology related competences varied widely among the participants. Some of the informants considered their knowledge and skills good and adequate, whereas some reported that their skills were poor or even non-existent. Even basic IT functions, such as typing, turning on the computer and basic troubleshooting, presented a challenge for some of the healthcare workers. As a nurse described the situation: '*Most [healthcare workers] are supposed to know basics of computer, how to use the mouse, to type or to see all the things in a computer. -- But in hundred people [healthcare workers] I think maybe thirty have computer skills and seventy don't'.* Generally, healthcare workers considered that the current levels of healthcare workers' computer competences were inadequate for efficient eHealth utilization. Informants emphasized that before implementation of eHealth technologies; staff should receive basic computer training and become more aware of electronic systems. A nurse said: *'We just try ourselves to do this [using computers]. But we don't have people that teach us. They give us instructions just to do this [electronic system] but no computer training. -- For example, in the case of this place, the system was just brought here and there was a person to train them [healthcare workers] about how to use this system…Only this system but without even giving them the basic computer skills'.*

The second finding, which did not clearly emerge from the survey questionnaire's self-assessment data, but which is consistent with the findings in the literature, relates to the weaknesses in privacy and security competences. Although some of the healthcare workers were conscious about the risks related to electronic systems in terms of security and privacy, some comments revealed the inadequate understanding on security and privacy issues. For example, a doctor reported that electronic systems are used to *'keep the privacy of the patient'*, but s/he also considered the ability to save data in memory stick as a safe and secure thing: '*They can put it [data] in the flash disc and then go and also be very secure'.* In addition, it was reported that healthcare workers sometimes use their own computers to enter data and prepare reports and documents. This is a threat to security and safe handling of data, however, no informants acknowledged this.

The interviews also revealed that familiarity with ICTs enhanced some of the informatics competences among the healthcare workers. Interviewees who did not consider

their eHealth knowledge and skills good, or who were not using ICTs actively, did not consider that users should be part of the system design process nor adequately understand the reasons for or consequence of poor data quality. However, those who showed more interest and experience in eHealth mentioned that incorrect data presents a threat to effective decision-making and safe healthcare, as well as highlighted that users should be involved in the design process, and systems should be designed to fit the local needs. A doctor said: *'It would make more sense if somebody like a doctor or any health profession from here is incorporated into the designing of a system which will be implemented here. -- I am assuming they're made maybe outside and then they are just brought here, and they try to make it fit. And sometimes you may find diseases [system's list of diseases] which are common outside the country, but you might have some disease which we haven't even seen here before'*.

Finally, lack of training, routine and practice were considered as a major factor hindering or weakening the healthcare workers' eHealth competences. Interviewees who reported to have basic computer training in the school, college or university, were often the ones who considered themselves more competent than those who have never attended computer courses. Though there were exceptions, for example a health administrative worker said, *'My computer skills are good, though it is my hard work because I didn't go to attend any computer course'*. However, even those who received ICT training often considered that their skills had deteriorated due to the lack of practice and routine work. Moreover, several informants expressed their concerns that the scarce access to eHealth technologies and applications, such as lack of computers at health centres, reduced healthcare workers' skills, knowledge, familiarity, confidence, and created anxiety and lack of ownership towards the electronic systems.

3.2.2. eHealth Attitudes

Informants expressed both positive and negative perceptions towards the eHealth in healthcare. eHealth was considered as a method to provide more efficient and equal healthcare by saving time from data/file retrieval and transfer, enhancing documentation and monthly reporting, expediting treatment and diagnosis processes, and improving communication between different facilities and health professionals. It was often reported that eHealth could deliver safer healthcare by improving security, accuracy and quality of the data, reducing handwriting errors, and preventing loss of patient data and files. For example, it was often mentioned that paper records could easily disappear, be destroyed by fire or water, or contain missing information or unreadable handwriting. Healthcare workers

described that eHealth reduced financial constraints that many of the facilities were facing by improving healthcare delivery process and decreasing paper stocks and physical storage spaces. One nurse expressed eHealth as an inevitable path for health facilities: '*Nowadays most of the hospitals are using computers--. Maybe it's changes of development'.*

Informants expressed frustrating experiences because of the healthcare workers' poor or inadequate ICT capacities, technological failures related to ICT infrastructure deficiencies, and poor IT support system. Interviewees reported that time was taken off from patient care due to the healthcare workers' slowness and unfamiliarity to use technologies, Internet and electricity cut offs and slowness, poor software design and updates, as well as long waiting times to fix IT problems. As an IT personnel said: '*For example, use of NHIF, the national health insurance fund. So, sometimes the system is corrupted -- which means we are stuck to do something else because you can't enter the patient if not recognized by them'*.

4. Discussion

This study explored Tanzanian healthcare workers' eHealth competences in private health centres in urban areas. In Tanzania, private health facilities are self-financed mainly from fees which are collected from patients who attend the health facilities for healthcare services. Despite their limited resources, private health facilities are obliged to provide quality services as per national health standards and guidelines. Although private health facilities are privately run as self-financed, they are supposed to maintain proven eHealth care delivery systems that report data into the national health system, which requires support of competent health workers on eHealth technology.

Study showed that the both self-assessed and existing basic computer and informatics competences' levels varied from inadequate to adequate among the healthcare workers. This finding is consistent with a study by Mohammed et al. [25] who found that the levels of computer knowledge differed among the healthcare workers in urban Ethiopian hospitals. Moreover, results showed that healthcare workers had challenges in several eHealth competence areas. Some had weaknesses even in basic computer competences, such as using computers, Internet, email, and Office software, whereas more prevalent challenges were within privacy and confidentiality issues, as well as in assessing the accuracy of health information on the Internet and recognizing the use of collected data for improving practice and to inform decision-making. These findings are consistent with the results from a South African case study [21]. Nevertheless, findings showed that healthcare workers had relatively high self-perceived confidence on basic computer technology and its functions, Office

software, Internet and email, and information security and privacy, which may have a positive influence on eHealth acceptance [37].However, healthcare worker's inadequate knowledge and skills combined with overconfidence on information security and privacy issues can be detrimental to safe use of eHealth technologies.

Second, we identified that limited exposure and support to eHealth technologies appeared to affect the levels of healthcare workers' computer and informatics competences. Informants reported that limited practical experience was deteriorating their competences and confidence in using electronic devices. These results support those of Saleh et al. [43], who found that Lebanese healthcare workers who used the computer at the centre daily basis believed more that they had the necessary skills for the implementation of electronic systems, compared to those who never used computers at the centre. In our study, even the ones who had participated in computer training considered that their skills were mostly forgotten due to the lack of practice and routine at the work place. These results reflect those of Sukums et al. [24], who found that in Ghana and Tanzania some healthcare workers had rarely used computer systems since they received training, and hence, they had forgotten most of what they had learned. In addition to hindering skills development, lack of practice after the trainings is enormous waste of resources, such as time and money, in already low-resource environments.

Third, the study revealed that attitudes towards eHealth varied, which is in accord with the literature [14]. Consistent with other studies [24, 31, 44,45], we found that healthcare workers, regardless of their eHealth competence levels, had generally positive attitudes towards eHealth, and nearly all participants acknowledged the importance and relevance of eHealth in healthcare services and were willing to use eHealth technologies and to participate in IT trainings. This result is encouraging regarding the future eHealth implementation plans in Tanzanian healthcare facilities, because positive attitudes have been acknowledged to underpin the implementation of eHealth initiatives [46]. However, informants concurrently expressed concerns about how the lack of skills and adequate infrastructure disturbs the workflow or might cause loss of time. These results reflect those of Yagos, TaboOlok, and Ovuga [47], who found that Ugandan healthcare workers generally perceived ICTs as beneficial in relation to work performance, but the common barrier for the implementation and use of ICT was staffs' inadequate ICT knowledge and skills and poor ICT infrastructure.

As the utilization of eHealth demands appropriate computer and informatics competences to apply new technology [34], Tanzanian health training institutions and individual health facilities should support interventions, such as training courses or on-the-job

training, to increase healthcare workers' knowledge, skills and awareness of eHealth. However, in Tanzania private health facilities' workers do not enjoy similar benefits of continuing training programmes as their public healthcare worker counterparts do. Tanzanian public health system is subsidised by the government coupled with several health interventions funded by the development partners (DP) such on HIV/AIDS, maternal health, immunization, and TB. Hence, given the interdependence between the two sectors on quality services improvement, joint competence development programmes on eHealth are emphasized.

We suggest that providing trainings, not only about the basic computer use but also about broader eHealth and health informatics, can make a significance difference in data collection security and quality as well as system adaptation and acceptance in health care. Corresponding with previous studies [21], we emphasize that the basic computer and informatics training must be versatile, be targeted to the specific needs of groups and individuals, and be adapted to the local context. However, the varying levels of knowledge and skills among trainees might be a challenge to develop appropriate training for all healthcare workers [48].We highlight the necessity to increase healthcare workers accessibility, and thus practice using computers, before the main eHealth systems are implemented [27]. Furthermore, we echo the principle that health professionals should be engaged in the design of eHealth systems, and it is pivotal to identify and address possible barriers to their participation, such as gaps in initial technical capability of participants, limited motivation to engage in such processes or poor availability of resources [49].

Our study explored Tanzanian healthcare workers' eHealth competences in private health centres in urban areas. We emphasized that healthcare eHealth competences are not just related to basic computer competences but also include broader informatics competences and attitudes towards eHealth. However, study's eHealth competences are not definitive; the list was developed by the researchers. Thus, authors advocate that training should first be based on articulating what the basic competences should be, either for the country or healthcare providers or health centres.

4.1 Limitations

The findings of this study must be interpreted with caution because the fairly small sample size together with the relatively heterogeneous sample of healthcare workers could have limited the extent to which the results can be generalized. Data collection only at the private health centres in urban areas was purposeful to increase the internal validity of the

study but may have limited the generalizability of our results to other levels of health facilities and facilities in rural areas. However, the data and results provide a picture of current eHealth competences among health workers in certain setting.

5. Conclusion

The utilization of eHealth demands appropriate eHealth competences. The results revealed that although Tanzanian healthcare workers had weaknesses in their computer and informatics competences, as well as lack of access to eHealth technologies, they had generally positive perceptions towards eHealth. The levels of basic computer and informatics competences were also found to vary among individuals. To increase the likelihood for successful eHealth implementations, the findings emphasize the importance of identifying individuals' eHealth competences and support the on-the-job use of eHealth technologies. Moreover, future eHealth trainings must be designed to target groups and individuals with different needs. The positive attitudes towards eHealth highlight that healthcare workers are ready to use such technologies. The results of the study can be used for the planning of eHealth training courses, as well as to guide the implementation of new eHealth programs at the health facilities in Tanzania. Further studies to determine healthcare workers' competences in greater detail would be useful in addressing the problems identified in this study.

6. Declaration of Conflicting Interests

The authors declare that they have no competing interests.

7. Acknowledgements

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8. References

1 Mugo DM, Nzuki D. Determinants of Electronic Health in Developing Countries. *International Journal of Arts and Commerce* 2014;3(3):49-60.

2 Bagayoko CO, Anneb A, Fieschi M, Geissbuhler A. Can ICTs contribute to the efficiency and provide equitable access to the health care system in Sub-Saharan Africa? The Mali experience. *Yearbook of Medical Informatics* 2011; 20(1):33-38.

3 Ministry of Health and Social Welfare. Health sector strategic plan July 2015 - June 2020. *Ministry of Health and Social Welfare* 2015:135.

4 Sligo J, Gauld R, Roberts V, Villa L. A literature review for large-scale health information system project planning, implementation and evaluation. *InternationalJournal of Medical Informatics* 2017; 97:86-97.

5 Jawhari B, Ludwick D, Keenan L, Zakus D, Hayward R. Benefits and challenges of EMR implementations in low resource settings: a state-of-the-art review. *BMC Med InformDecisMak* 2016; 16(116):1-12.

6 Koivu A, Hederman L, Grimson J, Korpela M. Vertical Interventions and Parallel Structures: A Case Study of the HIV and Tuberculosis Health Information Systems in South Africa. *Journal of Health Informatics in DevelopingCountries*2017; 11:2.

7 Ministry of Health and Social Welfare. Tanzania National eHealth Strategy July 2013 - June 2018. Dar es Salaam: Ministry of Health and Social Welfare, *The United Republic of Tanzania;* 2013.

8 Fraser HS, Blaya J. Implementing medical information systems in developing countries, what works and what doesn't. AMIA ...*Annual Symposium proceedings*. AMIA Symposium 2010; 2010:232-236.

9 WHO Global Observatory for eHealth. *Building foundations for eHealth: progress of member states: report of the Global Observatory for eHealth*. Geneva: World Health Organization; 2006.

10 Eysenbach G. What is e-health? *J Med Internet Res* 2001; 3(2): e20.

11 Howitt P, Darzi A, Yang G, Ashrafian H, Atun R, Barlow J, et al. Technologies for global health. *The Lancet* 2012 August 4;380(9840):507-535.

12 Kim H, Xie B. Health literacy in the eHealth era: A systematic review of the literature. *Patient Education and Counseling* 2017 June 1;100(6):1073-1082.

13 Shuvo T, Islam R, Hossain S, Evans J, Khatun F, Ahmed T, et al. eHealth innovations in LMICs of Africa and Asia: a literature review exploring factors affecting implementation,

scale-up, and sustainability. *Innovation and Entrepreneurship in Health* 2015 Oct; 2:95-106.

14 Nguyen L, Bellucci E, Nguyen LT. Electronic health records implementation: An evaluation of information system impact and contingency factors. *International Journal of Medical Informatics* 2014;83(11):779-796.

15 van Houwelingen CT, Moerman AH, Ettema RG, Kort HS, Ten Cate O. Competencies required for nursing telehealth activities: A Delphi-study. *Nurse Educ Today* 2016 Apr; 39:50-62.

16 Khatun F, Heywood AE, Ray PK, Hanifi S, Bhuiya A, Liaw S. Determinants of readiness to adopt mHealth in a rural community of Bangladesh. *International Journal of MedicalInformatics* 2015;84(10):847-856.

17 Jamal A, McKenzie K, Clark M. The impact of health information technology on the quality of medical and health care: a systematic review. *Health Information ManagementJournal* 2009 December;38(3):26-37.

18 Kokol P, Saranto K, BlažunVošner H. eHealth and health informatics competences. *Kybernetes* 2018 May 8;47(5):1018-1030.

19 Hersh W, Margolis A, Quiros F, Otero P. Building A Health Informatics Workforce In Developing Countries. *Health Affairs* 2010 Feb 1;29(2):274-277.

20 Barakat A, Woolrych RD, Sixsmith A, Kearns WD, Kort HSM. eHealth Technology Competencies for Health Professionals Working in Home Care to Support Older Adults to Age in Place: Outcomes of a Two-Day Collaborative Workshop. *Medicine2.0* 2013;2(2): e10.

21 Koivu A, Mavengere N, Ruohonen MJ, Hederman L, Grimson J. Exploring the Information and ICT Skills of Health Professionals in Low- and Middle-Income Countries. In: Brinda T, Mavengere N, Haukijärvi I, Lewin C, Passey D, editors. Stakeholders and Information Technology in Education. SaITE 2016. IFIP Advances in Information and Communication Technology Cham: *Springer;* 2017. p. 152-162.

22 Schleyer R, Burch C, Schoessler M. Defining and Integrating Informatics Competencies Into a Hospital Nursing Department. CIN: *Computers, Informatics, Nursing* 2011 Mar;29(3):167-173.

23 Ross J, Stevenson F, Lau R, Murray E. Factors that influence the implementation of e-health: a systematic review of systematic reviews (an update). *Implementation science: IS* 2016 Oct 26;11(1):146-12.

24 Sukums F, Mensah N, Mpembeni R, Kaltschmidt J, Haefeli WE, Blank A. Health workers' knowledge of and attitudes towards computer applications in rural African health facilities. *Glob Health Action* 2014 Oct 27; 7:24534.

25 Mohammed E, Andargie G, Meseret S, Girma E. Knowledge and utilization of computer among health workers in Addis Ababa hospitals, Ethiopia: computer literacy in the health sector. *BMC Res Notes* 2013 Mar 20; 6:106.

26 Biruk S, Yilma T, Andualem M, Tilahun B. Health Professionals' readiness to implement electronic medical record system at three hospitals in Ethiopia: a cross sectional study. *BMC Medical Informatics and Decision Making* 2014;14(115):1-8.

27 Alwan K, Awoke T, Tilahun B. Knowledge and Utilization of Computers Among Health Professionals in a Developing Country: A Cross-Sectional Study. *JMIR Hum Factors* 2015 Mar 26;2(1): e4.

28 Habibi-Koolaee M, Safdari R, Bouraghi H. Nurses readiness and electronic health records. *Acta Inform Med* 2015 Apr;23(2):105-107.

29 GürdaşTopkaya S, Kaya N. Nurses' computer literacy and attitudes towards the use of computers in health care. *Journal of Nursing Interventions* 2015 May;21(S2):141-149.

30 Adeleke IT, Lawal AH, Adio RA, Adebisi AA. Information technology skills and training needs of health information management professionals in Nigeria: a nationwide study. *Health Information Management Journal* 2015;44(1):30-38.

31 Olok GT, Yagos WO, Ovuga E. Knowledge and attitudes of doctors towards e-health use in healthcare delivery in government and private hospitals in Northern Uganda: a cross-sectional study. *BMC Medical Informatics and Decision Making*2015; 15:87.

32 Nicol E, Bradshaw D, Phillips T, Dudley L. Human factors affecting the quality of routinely collected data in South Africa. *Stud Health Technol Inform*2013; 192:788-792.

33 Luna D, Almerares A, Mayan JC, González Bernaldo de Quirós, Fernán, Otero C. Health Informatics in Developing Countries: Going beyond Pilot Practices to Sustainable Implementations: A Review of the Current Challenges. *Healthcare Informatics Research* 2014 Jan 1;20(1):3-10.

34 Feroz A, Kadir MM, Saleem S. Health systems readiness for adopting mhealth interventions for addressing non-communicable diseases in low- and middle-income countries: a current debate. *Global Health Action* 2018;11(1):1496887.

35 Gholamhosseini L, Ayatollahi H. The design and application of an e-health readiness assessment tool. *HIM J* 2017;46(1):32-41.

36 Cresswell K, Sheikh A. Organizational issues in the implementation and adoption of health information technology innovations: An interpretative review. *International Journal of Medical Informatics* 2013;82(5): e86.

37 Li J, Talaei-Khoei A, Seale H, Ray P, MacIntyre CR. Health Care Provider Adoption of eHealth: Systematic Literature Review. *Interact J Med Res* 2013 -4-16;2(1).

38 Karsh B, Weinger MB, Abbott PA, Wears RL. Health information technology: fallacies and sober realities. *J Am Med Inform Assoc* 2010 Jan 1;17(6):617-623.

39 Staggers N, Gassert CA, Curran C. A Delphi study to determine informatics competencies for nurses at four levels of practice. *Nurs Res* 2002 Nov-Dec;51(6):383-390.

40 Chang J, Poynton MR, Gassert CA, Staggers N. Nursing informatics competencies required of nurses in Taiwan. *International Journal of Medical Informatics* 2011;80(5):332-340.

41 Gill R, Borycki EM. The Use of Case Studies in Systems Implementations Within Health Care Settings: A Scoping Review. *Stud Health Technol Inform*2017; 234:142-149.

42 Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology* 2006;3(2):77-101.

43 Saleh S, Khodor R, Alameddine M, Baroud M. Readiness of healthcare providers for eHealth: the case from primary healthcare centers in Lebanon. *BMC Health Services Research* 2016 Nov 10;16(1):644.

44 Nilseng J, Gustafsson LL, Nungu A, Bastholm-Rahmner P, Mazali D, Pehrson B. A cross-sectional pilot study assessing needs and attitudes to implementation of Information and Communication Technology for rational use of medicines among healthcare staff in rural Tanzania. *BMC Med Inform DecisMak* 2014; 14:78.

45 Adedeji P, Irinoye O, Ikono R, Komolafe A. Factors influencing the use of electronic health records among nurses in a teaching hospital in Nigeria. *Journal of Health Informatics in Developing Countries*2018; 12:2

46 Lam MK, Nguyen M, Lowe R, Nagarajan SV, Lincoln M. "I can do it": does confidence and perceived ability in learning new ICT skills predict pre-service health professionals' attitude towards engaging in e-healthcare? *Stud Health Technol Inform* 2014; 204:60-66.

47 Yagos WO, TaboOlok G, Ovuga E. Use of information and communication technology and retention of health workers in rural post-war conflict Northern Uganda: findings from a qualitative study. *BMC Medical Informatics and Decision Making* 2017;17(1):6.

48 Khairat S, Sandefer R, Marc D, Pyles L. A review of biomedical and health informatics education: A workforce training framework. *Journal of Hospital Administration* 2016 Jul 3;5(5):10-20.

49 Kimaro HC, Titlestad OH. Challenges of user participation in the design of a computer based system: the possibility of participatory customisation in low income countries.*Journal of Health Informatics in DevelopingCountries*2008; 2:1.