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Assessing Evaluation of eHealth Interventions in Uganda: Practices, Challenges and Insights

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Background and Purpose: Electronic health (eHealth) is the use of information and communication technology (ICT) to support healthcare. It is becoming more popular in healthcare management with expectations of improved effectiveness, access, quality, and efficiency of the healthcare systems. The increased investment and implementation of eHealth across the world calls for its evaluation to evidence its value. This study thus aimed at investigating the practices, challenges, and suggestions for optimising evaluation of eHealth interventions in Uganda.
Methods: A cross-sectional survey was used to conduct the investigation among key eHealth implementing institutions in Uganda. Primary data provided by 22 participants from 18 institutions was used to establish an understanding of the institutions' perspectives with respect to eHealth evaluation practices and challenges faced, as well as to derive insights from these perspectives in relation to the World Health Organization (WHO) understanding of digital health evaluation.
Results: The study revealed that various eHealth interventions are implemented in Uganda; however, very little of their evaluation is undertaken, as it is not a key activity with most of the eHealth implementers. Focus is put on monitoring the eHealth initiatives' functionality and adoption rather than their outcome and impact. Limited skills/capacity and unavailability of national guidelines on eHealth evaluation were reported as key limitations.
Conclusions: Accordingly, the study recommends the need for an evaluation framework to elucidate and guide on the notion of evaluation, its characteristics, and measurement indicators regards the outcome and impact of eHealth interventions in healthcare and service delivery for Uganda's health system.

Keywords: eHealth, evaluation, monitoring, results-based management

1 Introduction

Across the world, healthcare systems are facing pressures to guarantee simultaneously accessible, quality, and affordable care. Healthcare administrators and policymakers are expected to implement interventions that increase the quality and efficiency of services, care, and support high performance of health systems [1] [2] [3]. eHealth, the use of information and communication technologies (ICT) for health [4] is becoming more popular in healthcare management and has proved to improve the effectiveness, access, quality and efficiency of the healthcare systems [5] [6] [7] [8]. The definition of eHealth by [4] accommodates a variety of medicine and public health applications including patient and public health data management (electronic health records), provision of remote health care services (telemedicine/teleHealth), health information and services through mobile telephone technology (mHealth), health knowledge management and distant learning for health workers (eLearning), connection of medical devices (internet of things), and other areas like improved planning, organization, and management of health services, and more recently the management of large public health data [9]. eHealth applications allow communication between healthcare providers and their clients, and sharing of information and knowledge among healthcare providers [10]. The Internet has also been used for communication and it has contributed to better disease management [11] [12].

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Learning from the developed world, sub-Saharan African and other developing countries are implementing ICT solutions as a means to improve accessibility to quality and equitable healthcare for poor and vulnerable communities [13]. In sub-Saharan Africa, the early use of ICTs in health was evidenced in the use of various mobile health solutions in multiple countries [14] and telemedicine in West Africa [15]. Currently, there is an increase in eHealth implementation on the continent and leading implementations including mHealth, eLearning, and telehealth. Social media, electronic health records and implementation of digital medical devices are also gaining popularity on the continent [16] [17]. There is much interest internationally in exploiting the potential of ICTs to improve healthcare [16] [18] [19] [20] because the proper use of ICTs in healthcare enable more efficiency in information processing and impact on access and quality of care [21] [22] [23]. WHO [16] further notes that the application of eHealth is necessary if universal health coverage is to be realised.

The increasing investment in eHealth has called for its evaluation to generate evidence that there are benefits realised from eHealth applications. Such evidence helps to establish the return on investment and guides future eHealth investment and adoption decisions. Evaluation for eHealth interventions helps to generate data used to assess whether observed changes in behaviour; processes or health outcomes can be attributed to the interventions [24] [25]. The concept of evaluation can be defined as a systematic and objective assessment of an intervention that aims to determine the fulfilment of objectives, efficiency, effectiveness, impact, and sustainability [26]. WHO [25] further defines evaluation, as measures taken and analysis performed in order to assess the interaction of users or a health system with the digital health intervention strategy, or changes attributable to the digital health intervention. Related to evaluation is monitoring, in which monitoring and evaluation are sometimes used interchangeably, yet the two concepts are different in the context of measuring performance and impact of eHealth interventions. [25] emphasizes that monitoring is the routine collection, review, and analysis of data intended to measure implementation progress for an eHealth initiative, and results into adjustments in intervention activities necessary to maintain or improve the quality and consistency of the eHealth deployment. In contrast, evaluation measures changes in health outcome and impact that are attributed to the eHealth initiative.

Notwithstanding the challenges, eHealth evaluation efforts are worth undertaking [27]. Implementers and countries that have evaluated their eHealth implementations have benefited from the knowledge about results of the implementations in the respective programmes [24] and this knowledge base helps to inform decisions on policies, practices, and research [28]. In Europe, the topic of impact assessment as well as evaluations for eHealth had gained considerable momentum by 2011 to an extent that half of the countries had designated a specific body/institution that was responsible for eHealth evaluation activities. Various Canadian eHealth evaluation studies evidenced positive benefits from the implementation of electronic medical records and drug information systems [29] [30] [31], and such helped to answer questions concerning whether there was sufficient value for money on Canadian electronic health records investments which were earlier raised in 2009-2010 performance audit reports by the Auditor General of Canada and six provincial auditors offices [32]. In 2010 Canada's International Development Research Centre (IDRC) conducted an evaluation of its 25 eHealth projects funded between years of 2005 and 2010 in 28 countries in Africa, Asia and Latin America and the Caribbean (LAC). The projects (50% from Africa, 28% from LAC, and 16% from Asia) focused on contributing evidence and knowledge about how to use technology to help solve health challenges through either the use of eHealth tools to tackle one or more specific challenges, or general health systems strengthening. The evaluation results showed contributions of the projects in the regions and informed IDRC's future programming in eHealth research [33]. Evaluation done for the United Kingdom's implementation and adoption of the nationwide electronic health records system indicated limited visible benefits for clinicians and patients, and it guided the eventual closedown of the initiative [34] [35]. An assessment that sought to find out the successes and challenges of eHealth in Africa and developing countries [36] indicated that most of the initiatives lacked documentation and proper evaluation hence their overall success was uncertain, but led to recommendations that would guide future implementations to do well. All the above cases communicate how eHealth evaluation has been given attention in some countries and how the evaluation results have been useful to inform decisions.

Evaluation of eHealth implementations is a challenging undertaking [24] [37] [38] and there are a few published evaluations on eHealth implementations [7] [39] [40] [41] [42] [43] especially in the developing countries [38] including Uganda [44]. The difficulty is because such evaluation does not focus on technology only but often needs to consider how the technology components interact with other processes

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in the eHealth implementation [45], which in turn broadens the scope of the evaluation [46] [47]. Secondly, the evaluation takes place in a complex healthcare setting that involves multiple stakeholder categories (such as patients, clinicians, administrators, IT specialists, funders) on top of legislation, social, political and economic environments [48]. This poses challenges to the evaluation since different stakeholders present different expectations and perspectives of a successful eHealth implementation, which may lead to conflicting evaluation criteria, and require multiple study designs and evaluation methods [37] [49] [50]. eHealth evaluations are also resource-intensive and are always hampered by insufficiency of resources like time, funding, human resources, and subject participants [37]. Due to various eHealth evaluation complexities, various literature recommend the use of frameworks or some other type of organizing schemes to help in guiding the evaluation process but also making sense of eHealth systems and evaluation findings [24], [25].

Uganda, like most developing countries, has employed eHealth applications to improve healthcare delivery and public health [13]. Its National eHealth Policy and Strategy [51] were also developed to guide the development and implementation of eHealth in the country. The National eHealth Strategy (2017) further stipulates the need to evaluate digital health interventions and keep track of their results in terms of outcomes and impact; however, most eHealth processes are not systematically documented and lack ongoing monitoring or measurement mechanisms [44]. To this end, this study sought to investigate and document the extent to which Uganda's eHealth interventions are evaluated, the practices and challenges faced, as well as propose suggestions for improvement in evaluation of eHealth interventions in Uganda.

2 Materials and methods

The cross-sectional survey was used to collect data because it was found to be more suitable in describing the current situation on evaluation of eHealth interventions in Uganda. Cross-sectional survey is a method that is used to collect data at a particular point in time [52]. Particularly, we used the survey questionnaires to investigate the practices and challenges in evaluation of eHealth interventions. The authors through consensus developed the questionnaire with both closed and open-ended questions on the following topics; organization and respondent information, the use of eHealth in organisation activities; organisation practices, motivations and challenges in eHealth evaluation; performance indicators for eHealth evaluation; existing tools and resources for supporting eHealth evaluation, and their suggestions on ways to improve eHealth evaluation.

Primary data was collected from twenty-two (22) key informants from eighteen (18) key eHealth implementing institutions in Uganda through face-to-face semi-structured interviews with each informant following the developed questionnaire. Face-to-face sessions allowed an opportunity for probing more information and seeking clarification where necessary. Informants from the same institution belonged to different departments with differing practices regarding eHealth implementation and evaluation. Among the institutions included the Ministry of Health and its international development partners, national implementing partners, research/academic institutions, and health facilities; with each institution having the possibility of belonging to more than one category.

The institutions were selected using a combination of purposive and convenience sampling. Initially, the Ministry of Health (MoH) Division of Health Information (DHI), which is the custodian of eHealth and health information management in Uganda, was contacted to recommend the key eHealth implementing institutions to participate in the study. Out of the twenty-five (25) recommended institutions, three (3) were not contacted due to limitations to access their offices and contact details in the data collection period. Entry contacts to twenty-two (22) institutions were contacted, where we explained the study objectives and asked them to nominate their most appropriate staff that were involved in eHealth implementation or evaluation to participate in the study data collection exercise. Of the twenty-two (22), eighteen (18) institutions responded positively and each nominated staff confirmed to the researchers their respective interview appointments. Four (4) institutions did not respond and did not participate. Verbal consent to participate in the study was obtained from participants, and face-to-face interviews were conducted on separate days at scheduled time at each participant's institution.

The first author (JA) conducted the interviews in English, each lasting between 60 to 90 minutes. Participants' responses were recorded verbatim as written extensive notes. Responses on each question

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were reviewed with each of the participants to ensure that no wrong data was carried over; and more field notes were also written immediately after each interview. Notes taking was used rather than voice recording to eliminate prospective participants' fears that their recorded experiences and opinions might be listened to and evaluated or judged, and this facilitated a relaxed active engagement between the researcher and each participant.

The analysis of the interviews notes was done using the thematic content analysis approach [53] where both authors/researchers (JA and JN) read all the notes to familiarise themselves with the text, then identified codes, and categorised the codes and developed themes from the collected data. Quantitative information about the resultant codes and other quantitative responses were analysed using SPSS (Statistical Package for the Social Sciences) software. Descriptive statistics were generated to produce summary tables and graphs. Feedback on the field findings was then shared with the MoH DHI for review and identification of any obvious outliers in the collected data. The DHI did not identify any outliers and validated the findings to be reflecting the true practices in eHealth implementation and evaluation in the country.

3 Results

3.1 Characteristics of Respondents

Out of the 22 respondents, 17 (77.3%) were males and 5 (22.7%) were females. Most of the respondents 12 (54.5%) were in the age bracket of 31-40 followed by 6 (27.3%) in the age bracket of 18-30 and 3 (13.6%) in the age bracket of 41-50. The respondents included a diverse range of cadres including programme managers, monitoring and evaluation officers, health informatics specialists, software developers, statisticians, and IT systems administrators.

3.2 The Use of eHealth

All participants mentioned that their organisations use eHealth in their health-related activities. With 'great extent' meaning very high rate, 'certain extent' meaning medium rate and 'very small extent' meaning very low rate, 91% of the respondents indicated to be using eHealth to a great extent while only 9% indicated to be using eHealth to a certain extent in their activities. Data collection and reporting (41%) was the most common area of eHealth application followed by data analysis (18%) and others as shown in Figure 1. In addition, DHIS2 (54.5%), mTrac (41%) and Family Connect 5 (22.7%) were reported as the most used eHealth software (Figure 2). Below are some of the participants' responses (quoted verbatim);

> *"We use information systems in basically all of our services provision; stores, general clinic, laboratory, finance and procurement, etc..." (Participant 22)*

> *"eHealth is used to a great extent, for example with the use of DHIS2 to support reporting of routine health services from districts, use of MTrac based on rapid sms for surveillance and medicines management, use of HRIS to manage human resources for health." (Participant 12)*

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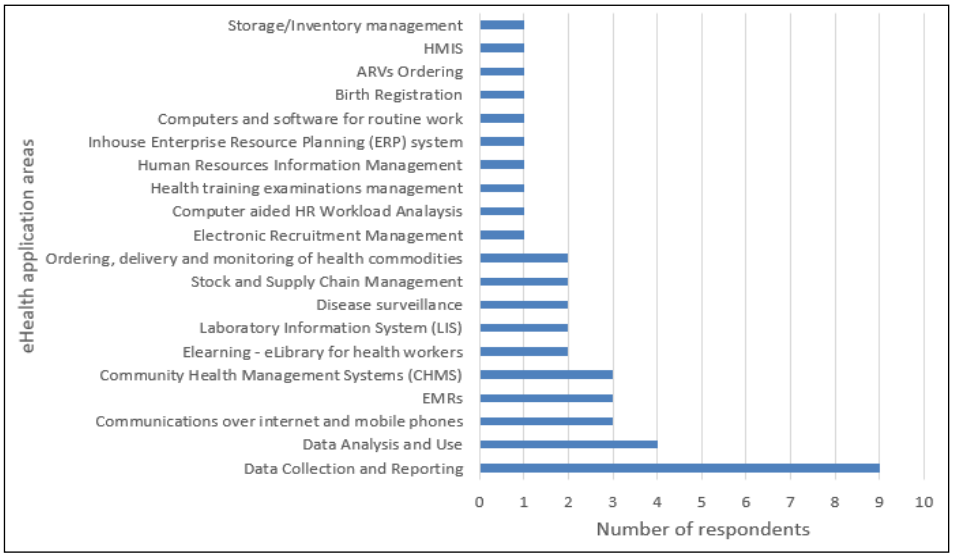

Figure 1: Areas of eHealth Application

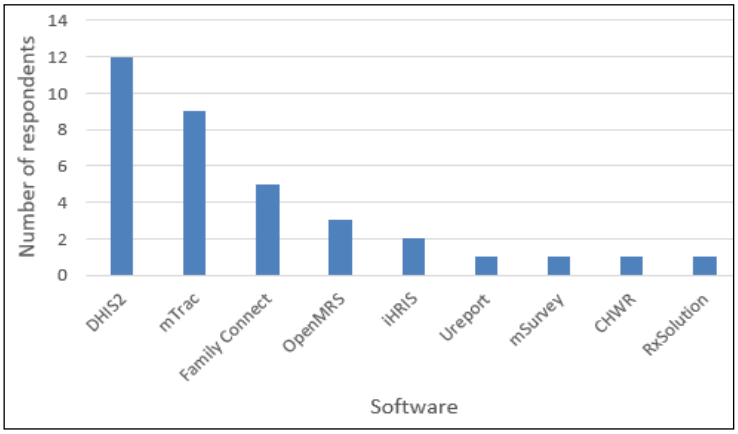

Figure 2: eHealth software in use

3.3 Practices and motivations for eHealth evaluation

Most participants reported that their institutions put efforts to evaluate the performance of eHealth and some organisations do not. 50% of the participants indicated that their organisations put efforts to a great extent, 18% to a certain extent, 23% to a very small extent and 9% not at all into the evaluation of eHealth interventions (Table 1). In addition, 59% of the participants indicated that their organisations use or follow guidance of in-house evaluation tools or adopted evaluation guidelines respectively in conducting their evaluations while 41% do not use or follow any tools and guidelines. For participants who use evaluation tools and guidelines, the reported tools and guidelines included extracts from international standards like principles of digital development (14%), Uganda eHealth policy and strategy (9%), and assessment criteria including indicators and checklists (9%).

On the reasons for conducting the evaluations, checking functionality of the eHealth initiatives was the most reported reason by many participants (32%). Participants reported that institutions also conducted evaluation of eHealth because it was a requirement by funders, to keep track of changes in user requirements, to identify gaps in system functionality, and to streamline partners' approaches to eHealth implementation (Figure 3). Below are some of the participants' responses (quoted verbatim);

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"... I think to a great extent, because we conduct these evaluations throughout the implementation of the systems. We conduct the evaluation because one, it is a requirement from our donors, secondly, evaluations help to quickly document achievements, and also capture user feedback. Internal evaluations contribute to our marketing strategy for the systems." (Participant 2)

".. to a very small extent because we do not normally conduct performance evaluations, but we sometimes want to ensure proper flow of system functionality to meet user requirements." (Participant 17)

Table 1: Extent of eHealth evaluation

Extent of eHealth evaluation	Frequency	Percent
To a great extent	11	50.0
To a certain extent	4	18.2
To a very small extent	5	22.7
Not at all	2	9.1
Total	22	100.0

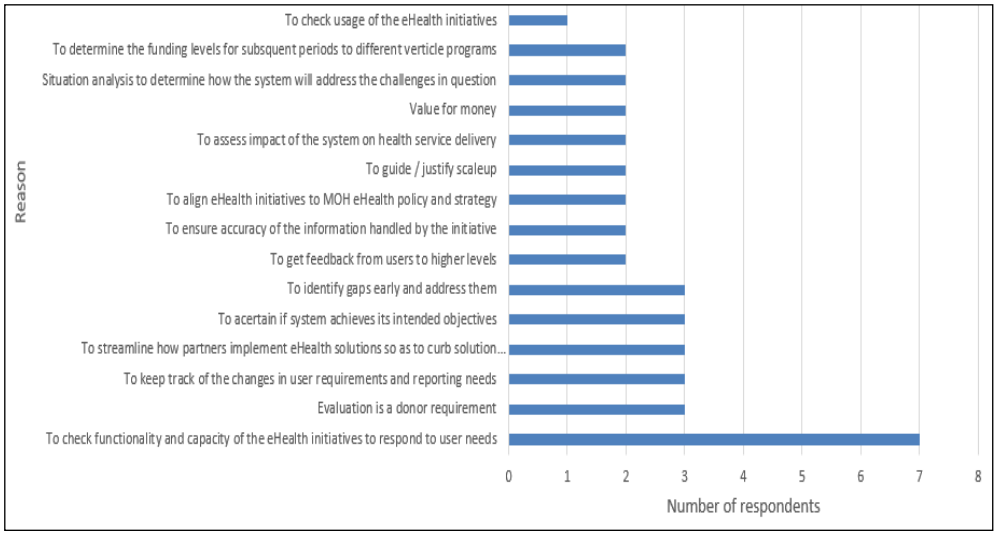

Figure 3: Reasons for evaluating eHealth Interventions

3.4 Indicators monitored during eHealth evaluation

Participants reported various indicators that are currently considered during evaluations, most reported indicators being system availability, system response speed, interoperability, usability, scalability, and availability of human resources to implement the eHealth initiatives (Table 2). Among the participants, 9 (41%) did not mention any indicators because their organisations did not conduct evaluations or they did not have a practice of using indicators for evaluation. Below are some of the participants' responses (quoted verbatim);

"We normally evaluate functional and non-functional requirements of the system. Functional requirements are evaluated through checking the functionality of the system and then validation rules on the data. Then some of the non-functional requirements evaluated are system's

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interoperability capacity with other systems, cost implications for implementing the system, security, scalability, and sustainability of the system." (Participant 6)

"… we only developed the electronic database and dashboard and trained health facility trained staff, and the project even ended but we did not evaluate implementation of the initiative…" (Participant 15)

Table 2: Indicators measured during eHealth evaluation

Indicator	Count	Indicator	Count
System Availability	4	Confidentiality of data	1
System response speed	4	Implementation of data validation rules	1
System interoperability	3	Cost implication on implementing program	1
System functionality	3	Extracts from national and international standards	1
Scalability	3	Ability to support collaboration of end users, partners, Gov't	1
Usability	3	Skills capacity of health workers	1
Staffing levels / (HR Availability)	3	Timeliness of reporting	1
Usage of the system / System use	2	ICT infrastructure	1
Data accuracy	2	USAID Measure tools	1
System security	2	WHO eHealth pillars	1
Sustainability plan	2	Training needs	1
Support for data use	2	Both qualitative and Quantitative	1
Availability of enabling ICT infrastructure	2	Up datedness of the initiative version	1
Number of users of the system	2	Data backup status	1
Data quality	2	Updatedness of data in the system	1
Availability of a champion to lead implementation of the initiative at the implementation site	1	Indicators are always specific to function being evaluated	1
Availability of Audit trail of data changes	1	Work places policies apply to guide on indicators	1
User satisfaction/acceptance	1	Results of performance / quality audit reports	1
Data completeness	1	Quantity of complains from users	1
System accessibility	1		

3.5 Challenges in eHealth evaluation

Respondents reported a wide range of challenges they face during evaluation of eHealth interventions. The most reported challenges and limitations included limited skills/capacity among the evaluation teams, lack of standard procedures on eHealth implementation and evaluation, limited documentation about the eHealth interventions, limited resources in terms of time and money, unharmonised interpretation of eHealth performance indicators and stakeholders' negative attitudes (Figure 4). Below are some of the participants' responses (quoted verbatim);

"We have challenges related to interpretation of evaluation indicators because we do not have them categorised and made more specific, so different stakeholders understand and interpret some indicators differently…." (Participant 2)

".. there is no enough documentation of these initiatives, so trouble comes when individuals leading their implementation leave the organisations where the initiatives are being implemented … evaluating an initiative without enough background information is difficult …" (Participant 3)

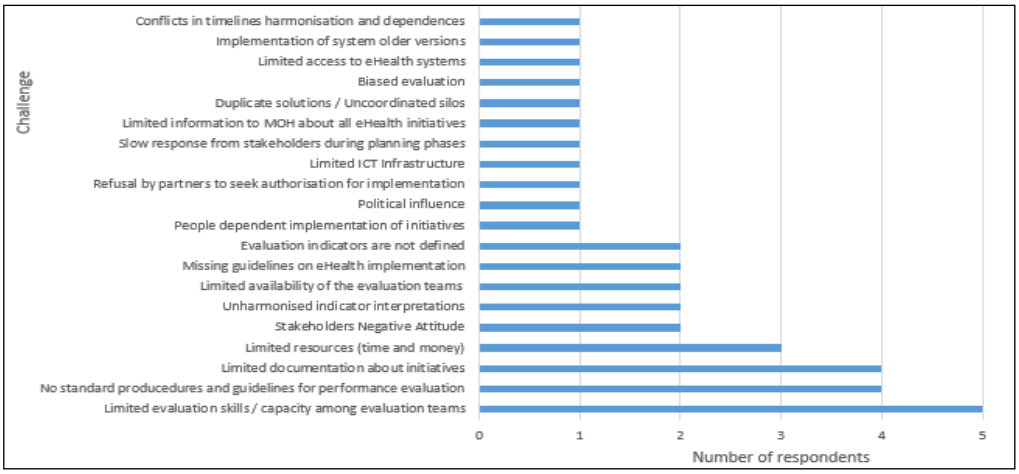

Figure 4: Challenges in eHealth evaluation

4 Discussion

eHealth use and evaluation practices – Results indicated that all the institutions apply eHealth in some ways in the country which is in agreement with [54] [55]. In addition, results indicated various areas of eHealth application although fewer institutions use each; in other words, eHealth implementation in Uganda is not integrated but operated in silos [55]. Regards conducting eHealth evaluation, the results showed that only 50% of the respondents conduct eHealth evaluation to a great extent, while the rest 50% conduct it to a small extent or not at all, implying that there is no concerted culture of eHealth evaluation in Uganda. Looking into the reasons why evaluations are conducted (Figure 3), most of the reasons are related to ensuring proper functionality of the eHealth initiatives. This is also reflected in the indicators measured in Table 2, where system availability, response speed, interoperability, usability, scalability, and availability of human resources to implement the eHealth initiatives are the most measured indicators. The World Health Organization [25] and WHO & ITU [56] categorise such indicators as process and output indicators that provide information and insight on the adoption of an eHealth initiative, are more suitable for monitoring eHealth initiative implementation, and do not necessarily evaluate the performance of the eHealth initiative. This implies that even though more respondents reported to be conducting evaluations on their eHealth implementations, they majorly monitor eHealth deployment, functionality, and adoption rather than measuring the outcome and impact that result from the eHealth implementations. Uganda is not the only country suffering the challenge of having weak eHealth evaluation mechanisms. According to the World Health Organization's observations in its Global Observatory Survey on eHealth of 2016 [4] in which 112 WHO member states participated, though there was a reported rapid growth in implementation of eHealth initiatives in the member states (109, 87%), very few member states (16, 14%) conducted the evaluation of their initiatives. The Eastern Mediterranean region and the South-East Asia region had the highest percentages of countries that conducted evaluations; while in terms of the World Bank income groupings, the high-income countries reported the highest percentage of countries that conducted evaluation of the initiatives [16].

eHealth evaluation challenges – Most respondents reported limited skills/capacity among the evaluation teams, lack of standard procedures on eHealth implementation and evaluation, limited documentation about

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the eHealth initiatives [36], and un-harmonised interpretation of eHealth performance indicators [24]. Other challenges reported by more than one respondent included limited resources (finances and time) to promote eHealth evaluation activities, unavailability of the definition of impact evaluation indicators [38] and stakeholders' attitude about the evaluation [57]. The challenges faced by implementers in conducting an evaluation of eHealth initiatives are more attributed to the fact that the country had no guidelines for eHealth evaluation and implementers had not yet put efforts to building capacity that is relevant for the evaluation of eHealth implementations [37]. Though the country's National eHealth Policy and Strategy [51] was developed and launched in 2017, there were no guidance for all existing eHealth initiatives implemented before 2017. In addition, even when the National eHealth Strategy indicated the need for a monitoring and evaluation framework that focuses on assessing the outcomes and health impact caused by the eHealth initiatives, such a detailed framework and guidelines for evaluating eHealth initiatives in the country were not yet existent.

Insights learned from eHealth implementations evaluation – From this study, we learned that implementers in Uganda undertake more of "monitoring" activities for their eHealth implementations as compared to their evaluation. That is, the implementers understood that such monitoring activities and efforts could also be used to evaluate the impact and contribution of the eHealth implementations to the main programme objectives. This coincides with observations by [58] where only very few cases had their impact evaluation done out of the twelve eHealth cases studied across sixteen African countries. In their study, only Ethiopia's FrontLineSMS and Malawi's CommTrack were evaluated for impact; while for Uganda, both its RapidSMS and MTrac FM were not evaluated. Following guidance by WHO & ITU [56], activities and efforts for eHeath evaluation should consider observations and measurements beyond the process and output indicators to also consider outcome and impact indicators for each of the eHealth implementation/initiative in question. In order to improve the practice of eHealth evaluation in Uganda, efforts are needed to support changing implementers' perspectives on eHealth evaluation; the key effort being the development of an eHealth evaluation framework that will define the notion of "evaluation", its characteristics, and the indicators that should be measured with regards to the performance and impact of eHealth implementations in healthcare and service delivery for Uganda's health system.

5 Conclusion

The researchers investigated the practices and challenges regarding eHealth evaluation in Uganda, and practical weaknesses, challenges and areas of improvement were identified. The study findings can play a vital role in terms of providing the baseline situation on which health leaders and policymakers as well as the eHealth implementers can set improvement targets and action plans for strengthening and sustaining eHealth in Uganda. Accordingly, following the guidance of the national eHealth policy and strategy, there is need for the development of an eHealth evaluation framework, evaluation indicators and guidelines for using such a framework, which then can be used to evaluate the outcome and impact of eHealth interventions in the country. Additionally, we advocate for the creation of awareness of the need to plan for eHealth evaluation in addition to monitoring activities during the planning of eHealth implementation programmes. The authors/researchers are already using insights from this study to inform the development an eHealth evaluation framework that will guide comprehensive evaluation of eHealth interventions in Uganda. We recommend future work to include an investigation about other important attributes related to eHealth evaluation activities such as who are the evaluators / offices responsible for conducting eHealth evaluation, and their required skills, the process of agreeing on evaluation data collection tools, among others.

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