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An Evaluation of a Framework for Supporting E-health Service Delivery in a Ugandan Rural Setting

Ali Mwase[1]*, Keefa Bwiino[2], Abdnoor Kyambadde[3]

Department of Marketing and Management, Makerere University Business School, Kampala, Uganda

Research Article

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***For Correspondence:**
Ali Mwase, Department of Marketing and Management, Makerere University Business School, Uganda

E-mail: amwase@mubs.ac.ug

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ABSTRACT

E-health is an emerging field in the intersection of medical informatics, public health, business, and clinical practices. It can be applied to meet the rising global demand for cost-effective and reliable services in the health sector. As a result, E-health has been put forward on the planning agendas of different organizations. Consequently, this study aims at evaluating a designed framework for supporting E-health service delivery in a rural setting of Uganda taking the case of the district of Iganga. A quantitative research approach was adopted and the framework was evaluated using the Delphi technique amongst 13 E-health experts. The evaluation criterion consisted of three parameters; functionality, usability, and traceability. SPSSv20 was used for data analysis and descriptive statistics were generated. The results revealed that the framework was usable, understandable, and applicable in addressing the major challenges hindering E-health service delivery in a rural setting. The study, therefore, provides a baseline survey to help the health practitioners and the government that would wish to implement E-health services in rural areas.

INTRODUCTION

In developing countries, especially where a large proportion of the population still resides in rural areas, healthcare access and delivery are often poor, and can potentially benefit from innovative service models and supporting technologies [1]. Health perspectives differ between rural and urban communities. The health perceptions of rural

and urban residents significantly reflect their health-promotion behaviours, health maintenance, and illness treatment.

Health service delivery to rural communities has always been challenged with specialized services and infrastructure is usually less available [2]. It is argued that rural communities are confronted with the out-migration of working-age adults from rural to urban areas and the in-migration of former urban dwellers, often at retirement age. This affects the quality of life and health in rural communities. Nonetheless-Health services are seen as a solution to these concerns. This is because E-Health has diverse web portals and encompasses both core healthcare services and social innovation. Electronic health (E-health) is the application of ICT across a whole range of functions that affect the healthcare industry when it comes to matters relating to health through the various solutions that exist.

E-health initiatives present the ability to tackle challenges that exist within the healthcare industry especially for the rural community [3-6]. These initiatives are artifacts in form of models, frameworks, web-based and mobile-based applications or platforms. However, it is argued that a designed artifact ought to be verified for quality, effectiveness, and efficiency using well-grounded assessment approaches. Offermann moreover adds that a designed artifact can be evaluated in terms of completeness, accuracy, functionality, reliability, consistency, traceability, understandability, usability among others. In another related study, it is asserted that researchers rigorously evaluate designed artifacts and this should be done through evaluation methods like observational, analytical, experimental, testing, and descriptive; further argue that artifact evaluation is done through laboratory experiments, pilot applications, simulation procedures, expert reviews, and field experiments. This paper, therefore, is aimed at evaluating a designed framework for supporting E-health Service Delivery in Iganga district, a rural setting of Uganda using the expert judgment evaluation method [6-10]. The rest of the paper is organized as follows, Section 2 presents the literature review, section 3, methodology, in section 4 results are presented and in section 5, the conclusion and recommendations are presented.

Literature review

Healthcare in rural areas: While the urban localities have healthcare options from five-star medical colleges to small private dispensaries run by trained doctors, the rural areas often are left with the only option of untrained private practitioners. The quality of healthcare in rural areas is constrained. In these rural areas, the challenges of healthcare quality are many, ranging from poor infrastructure, low literacy, poverty, to inadequate monitoring of patients with chronic or serious diseases [11-14]. Patients in rural areas incur heavy expenditure in traveling long distances spending a lot of time to consult Specialists in cities due to the lack of Specialists in their areas. The myriad of challenges requires innovative solutions that are affordable, robust, and sustainable over time.

Evaluation of artifacts: It is argued that evaluation is a core activity in conducting design science research and artifact construction. This is because the novel IT artifact must demonstrate measurable improvements to illustrate technology evolution, advancement, and thus acceptance [15-19].

According to Venable, evaluations provide evidence that a new technology developed in Design Science Research (DSR) works or achieves the purpose for which it was designed. Without evaluation, outcomes of DSR are unsubstantiated assertions that the designed artifacts, if implemented and deployed in practice, will achieve their purpose. Further posit that to rigorously reveal the quality of a designed artifact, design science requires proper artifact evaluation [20-23]. This presents a formal procedure to determine whether the artifact is completing, effective, and applicable. It is suggested that evaluation of a designed artifact may be performed at two levels: the

abstract artifact is either assessed directly or through one or several instantiations. Additionally, evaluation criteria are classified along system dimensions and may be decomposed into several levels, forming a hierarchy. The same criterion may be assessed by several generic evaluation methods. Generic evaluation methods vary along with four fundamental characteristics, namely the form of evaluation, secondary participant, level of evaluation, and the relativeness of evaluation [24-27].

The structure of artifacts can be assessed by completeness, simplicity, clarity, style, homomorphism, level of detail, and consistency.

MATERIALS AND METHODS

Parameters for the evaluation criterion

A designed artifact can be evaluated in terms of functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization, and other relevant quality attributes. Evaluation of artifacts takes too much time mainly because it involves a lot of parameters and at the same time some parameters are difficult to apply [28-32]. Due to time constraints, the study adopted three parameters for the evaluation criterion of the FSEHSD. In addition, it was considered more important to determine whether the framework performs its functions (functionality), is easy to use (usability), and has traceability. Each of the evaluation parameters is explained below;

Usability is the degree to which a product can be used by specified users to realize intended objectives with efficiency, effectiveness, and satisfaction in a specified context of use. The purpose of this parameter was to identify areas of confusion and ambiguity for the users which, when improved increases the efficiency and quality of a users' experience with the framework.

Traceability is defined as the ability to chronologically interrelate the uniquely identifiable entities in a way that matters. This parameter was used to measure how well the framework steps and guidelines/principles can be traced in the designed framework. It looks at how the framework requirements can be traced from the origin through the interconnections and interdependencies [33-37].

This functionality of an entity is defined as its intended behavior, interpretation of its behavior under a goal, a kind of hierarchical abstraction, or effects on the environment of the entity. This parameter was used to measure whether the framework addresses all the major challenges hindering Ehealth service delivery in Iganga District.

Delphi technique

The Delphi technique is a group process used to survey and collect the opinions of experts on a particular subject. The Delphi technique is applied whenever policies, plans, or ideas have to be based on informed judgment. This technique is useful where the opinions and judgments of experts and practitioners are needed. It is observed that the Delphi technique uses a series of judges as experts to define or evaluate components of a theoretical issue.

According to Giannarou and Zervas, there are two important factors when conducting the Delphi technique namely; the panel size and the response rate. In both cases, there are no strict rules. It is preferred that the group size is highly related to the purpose of the investigation and the response rate may be ranging between the different disciplines, according to the participants' research interest. It is proposed that the sample ranges from 7 to 30. Additionally, it is claimed that the panel's size selection is determined by the homogeneity since in this case a sample of between 10 to 15 people can yield sufficient results and assures validity [38]. There are various research methodologies such as; Action research methodology, mixed research methodology, participatory research methodology, design science research methodology, and participatory action research methodology. this study adopted the design science research methodology. Design science methodology attempts to create things that

serve human purposes and it is technology-oriented, and is a paradigm in information system science for understanding, executing, and evaluating research that aims at designing new and novel artifacts intended to solve identified organizational problems [39]. The artefacts can be defined as constructs, models, methods, or instantiations. A quantitative research approach was adopted and used in the evaluation exercise. Avison and Heje argue that quantitative research enables researchers to answer scholarly and practical questions about the interaction of humans and artifacts such as computer systems and applications. According to Skulmoski, when applying the Delphi technique, a sample of between 10 to 15 people yields sufficient results. In this study, therefore 13 E-health experts were purposively selected from the 5 health facilities around two divisions (Central and Northern division) of Iganga District. A five-point Likert scale questionnaire was administered for data collection. SPSSv20 software was used for data analysis and descriptive statistics were generated.

This study adopted the expert judgment (Delphi technique approach) evaluation method to evaluate the FSEHSD. This is because the expert judgment relies on a group of experienced scientists with a good understanding of environmental problems and who are the most knowledgeable and capable members of society to judge the relative significance of interventions. The expert judgment further plays a vital role in risk management, uncertainty analysis, and decision-making. The results are of the study are presented throughout section 4 of this paper [40].

Study participants

A total of 13 participants were purposively selected to participate in the evaluation exercise. These participants included 2 database administrators, 2 IT/ARE managers and 2 IT/ARE experts from the 5 health facilities, and 3 E-health experts (Table 1).

Table 1: Breakdown of participants involved in the evaluation of the FSEHSD.

Participants	Health facilities	No
Database administrators, IT/IS managers, IT/IS experts	Iganga Nakavule Hospital (Database administrator 1, IT/IS expert 1)	2
	Mercy Health Centre (Database administrator 1, IT/IS expert 1)	2
	Iganga Municipal Council HC (Database administrator 1, IT/IS manager 1)	2
	PeakPoint HC (Database administrator 1, IT/IS manager 1)	2
	Iganga Islamic Medical Centre (Database administrator 1, IT/IS manager 1)	2
E-health experts	-	1
		1
		1
Total	5	13

Framework usability (ease of use)

The results presented in Table 2 below indicate that majority (72.7%) of the respondents agreed that the framework is easy to understand. In addition, 63.6% of the respondents indicated that the framework requires little or no training to be used. It was also observed that 63.6% of the respondents reported that the framework is easy to learn and use.

Table 2: Evaluation results of the FSEHSD from 5 health facilities based on the parameter of usability.

		SD	D	NS	A	SA
1.0	Usability (ease of use) of the framework					
1.1	Is the framework easy to learn and use?	0%	9.10%	9.10%	18.20%	63.60%
1.2	The framework requires little or no training to be used.	0%	0%	9.10%	27.30%	63.60%
1.3	Is the framework easy to understand?	0%	0%	18.20%	9.10%	72.70%

Framework traceability

The results presented in table 3 below indicate that majority (81.8%) of the respondents indicated that the various components of the framework are interdependent. In addition, 72.7%% of the respondents indicated that guidelines/principles of the framework are interrelated. It was also observed that 54.5% of the respondents indicated that the factors/variables leading to supporting E-health were logically arranged.

Table 3: Evaluation results of the FSEHSD from 5 health facilities based on the parameter of traceability.

		SD	D	NS	A	SA
2.0 Traceability of the framework						
2.1	Are the various components of the framework are interdependent on each other?	0%	0%	0%	18.20%	81.80%
2.2	The guidelines/principles of the framework are interrelated.	0%	0%	9.10%	18.20%	72.70%
2.3	Are the factors/variables leading to supporting Ehealth logically arranged?	9.10%	18.20%	9.10%	9.10%	54.50%

Framework functionality

Regarding the functionality evaluation parameter, the results indicate that majority (54.5%) of the respondents agreed that the framework addresses all the major challenges hindering E-health service delivery in the Iganga district in Table 4 below. In addition, 72.7% of the respondents agreed that the framework simplifies the process of supporting Ehealth service delivery by providing guidelines or principles to be followed. Lastly, it was also observed that 63.6% of the respondents indicated that the framework contributes to the support of E-health service delivery in the Iganga district.

Table 4: FSEHSD evaluation results based on the parameter of functionality.

		SD	D	NS	A	SA
3.0 Functionality of the framework						
3.1	The framework addresses all the major challenges hindering Ehealth service delivery in the Iganga district.	18.20%	9.10%	9.10%	9.10%	54.50%
3.2	The framework simplifies the process of supporting Ehealth service delivery by providing guidelines or principles to be followed.	0%	0%	9.10%	18.20%	72.70%
3. 3	Does the framework contribute to the support of Ehealth service delivery in the Iganga district?	0%	0%	18.20%	18.20%	63.60%

RESULTS FROM THE EHEALTH EXPERTS

Framework usability

The results in Table 5 below indicate that all the experts indicated that the framework was easy to learn and use, and further the majority (66.7%) agreed that the framework is easy to understand. In addition, 33.3% of the experts indicated that the framework requires little or no training to be used.

Table 5: Evaluation results from Ehealth experts based on the parameter of usability.

		SD	D	NS	A	SA
1.0 Usability (ease of use) of the framework						
1.1	Is the framework easy to learn and use?	0%	0%	0%	0%	100%
1.2	The framework requires little or no training to be used.	0%	33.30%	0%	33.30%	33.30%
1.3	Is the framework easy to understand?	0%	33.30%	0%	0%	66.70%

Framework traceability

The results in Table 6 below indicate that 33.3% of respondents reported that the various components of the framework are interdependent, 66.7% of the respondents reported that the guidelines/principles of the framework are interrelated and 33.3% of respondents disagreed that the factors/variables leading to supporting of Ehealth logically arranged.

Table 6: Ehealth experts opinions based on the parameter of traceability.

		SD	D	NS	A	SA
2.0 Traceability of the framework						
2.1	Are the various components of the framework are interdependent?	33.30%	0%	33.30%	33.30%	33.30%
2.2	The guidelines/principles of the framework are interrelated.	0%	0%	0%	66.70%	33.30%
2.3	Are the factors/variables leading to supporting Ehealth logically arranged?	33.30%	33.30%	0%	0%	33.30%

Framework functionality

E-health experts' evaluation opinions regarding the parameter of traceability indicate that majority (66.7%) of the experts agreed that the framework addresses all the major challenges hindering Ehealth service delivery in the Iganga district. In addition, 33.3% of the respondents indicated that the framework simplifies the process of supporting E-health service delivery by providing guidelines or principles to be followed in Table 7 below. Lastly, it was also observed that 66.7% of the respondents indicated that the framework contributes to the support of E-health service delivery in the Iganga district [41].

Table 7: Ehealth experts opinions based on the parameter of functionality.

		SD	D	NS	A	SA
3.0 Functionality of the framework						
3.1	The framework addresses all the major challenges hindering Ehealth service delivery in the Iganga district.	0%	33.30%	0%	0%	66.70%
3.2	The framework simplifies the process of supporting Ehealth service delivery by providing guidelines or principles to be followed.	0%	33.30%	0%	33.30%	33.30%
3.3	Does the framework contribute to the support of Ehealth service delivery in the Iganga district?	0%	33.30%	0%	0%	66.70%

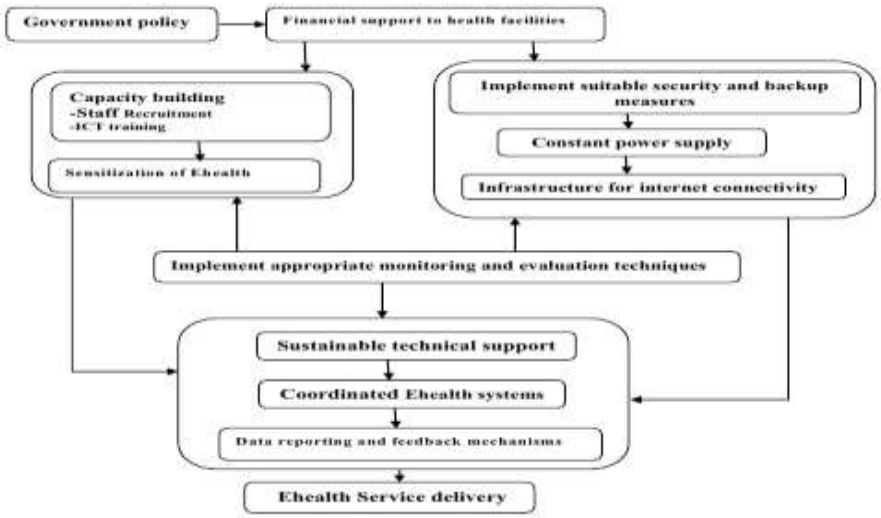
General expert's recommendations for an improved FSEHSD

Through face-to-face interactions with the experts, the experts recommended government consideration as one of the constructs of the framework. Additionally, the experts suggested that the variables for the FSEHSD be rearranged to get a uniform flow such as a bottom-up approach, top-bottom, or left to right. This issue was given attention by the researchers and hence the FSEHSD variables were rearranged to the new top-bottom flow as seen in Figure 1, section 4.5.5 of this paper. Another expert suggested the need to consider integration and interoperability of information from different Ehealth systems. But with the existence of the ICT training to staff and Human resource recruitment and capacity building constructs as part of the FSEHSD, the staff shall be equipped with skills to develop interoperable Ehealth systems that integrate information from different Ehealth systems. Therefore the FSEHSD was fine-tuned and thus improved to incorporate the suggestions from the experts [42].

The evaluated framework (FSEHSD)

In this study, the artifact is the designed Framework for Supporting Ehealth Service delivery in a rural setting of Uganda (FSEHSD). This is presented in Figure 1 below and subsequently explained in section 4.5.5.1.

Figure 1: The Framework for Supporting Ehealth Service delivery in Iganga District, Uganda (FSEHSD).



Explanation of the framework for supporting E-health service delivery in a Ugandan rural setting

A favourable government policy should provide a legal framework to support the E-health budget and this will lead to the availability of funds for supporting E-health in terms of setting up the infrastructure which includes implementations of suitable secure backing up of data in a secondary device or location and power backups like standby generators and solar power. Hence constant power supply leads to internet connectivity. In so doing Ehealth service delivery is supported.

DISCUSSION

Availability of funds will also aid capacity building that will see that there is the recruitment of qualified staff and ICT personnel, ICT trainings being conducted as well as sensitization of E-health to the public. Once the staff is trained, they can develop, operate and provide sustainable technical support for coordinated E-health systems. E-health systems should provide data reporting and a feedback mechanism inform of SMS alerts, emails to service recipients as well as stakeholders. Finally, appropriate monitoring and evaluation techniques should be implemented across all chains to ensure effectiveness and comprehensiveness. Hence supported E-health service delivery. Thus the FSEHSD can be used to support E-health service delivery in a Ugandan rural setting since the majority of the challenges concerning E-health service delivery have been addressed. Moreover, the experts opinions have also been incorporated.

CONCLUSION

In this digital age, the potential for effective use of E-health initiatives in healthcare in rural settings is promising. This study looked at the concept of evaluating a designed Framework for Supporting E-Health Service Delivery (FSEHSD) in a rural setting to ensure that health facilities seamlessly deliver services and exchange information amongst health workers and patients. The FSEHSD was evaluated using the Delphi technique and the findings revealed that the framework was useful and the framework layout was understandable and applicable. This affirms that the FSEHSD can support E-health service delivery in a Ugandan rural setting

RECOMMENDATIONS

Therefore, this study recommends that Health service providers use the developed framework (FSEHSD) when planning and implementing electronic services. Future research should focus on developing a framework for enhancing the diffusion of Ehealth technologies in rural areas.

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