Barriers and Facilitators of eHealth Adoption Among Patients in Uganda – A Quantitative Study

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Abstract. The adoption of eHealth has not made great strides in Uganda especially among patients despite its potential in improving patient outcomes through access to care, patient engagement and its ability to reduce unnecessary hospital visits. Previous studies have focused on barriers and facilitators of eHealth in general. None has examined the adoption of eHealth among patients in Uganda, which was the focus of this study. A cross-sectional survey was conducted in four districts across the country. Two hundred ninety two patients of 18 years and above participated in the study and their selection was through simple random sampling. The bivariate analysis results revealed that education level ($\chi^2 = 14.9$, $\rho < 0.05$), gender ($\chi^2 = 4.95$, $\rho < 0.05$) and location ($\chi^2 = 85.9$, $\rho < 0.05$) have a statistical significant relationship with eHealth adoption. The logistic regression model further revealed that male patients (OR = 2.662), those with master's degree and above (OR = 2.2797) and those residing in Kampala (OR = .012) were more likely to use eHealth systems than their counterparts. The success of eHealth requires players in the health sector to ardently focus on the socio-demographic factors of the users, technological and hospital conditions if eHealth adoption is to ensue.

Keywords: Barriers · Facilitators · eHealth · Adoption · Patients

1 Introduction

Communities constantly face health-related issues yet healthcare is still a huge public health concern in developing countries. With majority of the population affected by all sorts of illnesses (communicable and non-communicable), coupled with accessibility challenges especially in the rural communities, the adoption of information and communication technologies (ICT's) has been seen as an alternative to realize efficiency and effectiveness in healthcare service provision [1]. ICT's in the health sector are generally termed as eHealth or digital health technologies. eHealth is an umbrella term that covers a wide range of health and care services delivered through information and communication technologies, such as electronic health records (EHRs), health information systems, remote monitoring and consultation services (e.g. telehealth, telemedicine, telecare), tools for self-management, and health data analytics [3]. eHealth tools [mobile and fixed

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phones, voice over internet protocol, text and multimedia messaging] encourage communication between healthcare providers and their clients, sharing of information and knowledge among healthcare providers and establishing better healthcare for patients [4].

Digital health technologies facilitate the electronic capture, processing, storage, and exchange of health data and have the potential to address many of the challenges that healthcare systems are currently facing [5]. With the fast growing internet connectivity in Uganda, coupled with good infrastructure and government support, several challenges that patients face such as poor information management and inaccessibility of health services can be alleviated with effective eHealth systems. The WHO recognizes eHealth as a major player in healthcare today and it is evidenced at the core of responsive health systems. The day to day routine of health relies heavily on information and communication and more specifically the technologies that enable it at the different levels of service delivery [6].

This study is aligned to UN's Sustainable Development Goals (SDGs) specifically Goal 9, which aims at building resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation [7]. One of the outcomes of this goal is to significantly increase access to information and communications technology and strive to provide universal and affordable access to the internet in least developed countries. Exploring the barriers and facilitators of eHealth perfectly fits within this goal because the study provided pointers to improve access and usage. Working with patients to elucidate the key challenges barring eHealth adoption, to a certain extent, also contributes to SDG 3, which aims at ensuring healthy lives and promoting well-being for all at all ages [7].

eHealth Adoption in Uganda

Uganda recognizes and appreciates the significant role of eHealth in improving health service delivery through advocating healthcare providers to use DHIS-2 aimed at strengthening routine health data reporting from the district level to the national headquarters at the ministry [6]. The government of Uganda together with donors have commissioned several eHealth innovations. Such systems include Text-to-Change and U-Reporting, SMS-based platforms aimed at scaling up HIV/AIDS awareness and generate a national procurement plan respectively [8, 9]. Similarly, Magpi has been used to collect data of children suffering from nodding syndrome diseases in rural northern Uganda [10]; RxSolution used for pharmaceutical stock management and dispensing [11]; and pharmaceutical information portal, a data warehouse and business intelligence system [12]; the NeMo system that was used by nursing mothers to assess signs of illnesses in their newborns [13]. Lastly, the Eastern, Central and Southern Africa health community TB supply chain portal for sharing information and mitigating risks of stock outs, overstock and expiries [11]. However, most of these eHealth initiatives are skewed towards healthcare providers and provision of healthcare services in general with less focus on patient systems. The lack of such systems plays a lot in delayed uptake among patients and can partially explain why adoption is very low. A few systems that are patient-centred like Antenatal Care Studio [14]; and WinSenga [15] lack breadth and are not widely known because of lack of funds to market and scale them, hence, even their acceptability is equally low.

Worldwide, patient-centred eHealth systems are not generally adopted because of usability issues, lack of clear advantage and divergent knowledge and beliefs [16–18]. A study that was conducted in Bangladesh revealed that perceived ease of use, usefulness, subjective norm and gender influenced patient adoption to eHealth [18]. Similarly, another study conducted in the Netherlands found out that the ease of use and the benefits of eHealth systems greatly influenced adoption among patients [17]. No such study has been conducted in Uganda, however, a few that have tried to investigate eHealth adoption have identified the following challenges; lack of ownership, limited content of health issues in local content, lack of funding, lack of skilled HR i.e. health workforce and health ICT workforce, lack of a sustainability plan [6, 16, 19–22]. Similarly, the attitude of users, culture, inadequate training and skill, technophobia, organizational barriers, interoperability issues and lack of readiness have greatly affected the adoption of eHealth [6, 13, 21, 23–26]. Also, the lack of awareness, lack of ICT policies, inadequate ICT infrastructure, poor internet connectivity, scarcity of computers and inadequate power supply [10, 21, 24, 25, 27–33] pose great challenges on eHealth adoption.

Despite all the tremendous investments in the ICT infrastructure by the Government of Uganda and the private sector to support eHealth [6], use of digital technologies is still very low especially among patients. Thus, the aim of this study was to investigate the barriers and facilitators of eHealth adoption among patients in Uganda, and to the best of our knowledge, this is the first of its kind. This study is an extension to a study that was conducted by Namatovu et al. [34] that recommended an investigation into the barriers and facilitators of eHealth adoption among patients in order to holistically understand the eHealth ecosystem for better adoption outcomes.

2 Methods and Materials

2.1 Study Setting

The study was conducted in central, southwestern, eastern and northern Uganda. Data was collected from health facilities located in; Kampala central division, Mbarara municipal council, Jinja central division and Mbale municipality. The study aimed at investigating the barriers and facilitators of ehealth adoption among patients in Uganda. The choice of these districts was because they rank in the top twenty largest districts by population size, have moderate levels of internet penetration and have a good mix of urban and peri-urban population [35, 36]. Inclusion criteria included i) recovering patients and outpatients ii) those above 18 years of age iii) with minimum education of an ordinary certificate and iv) those who sought medical services from national and regional referral hospitals, health centre II, III, IV, and clinics. Sixty-eight health facilities were visited (Table 1).

Table 1. Health facilities in the Four Selected Regions

Type of Health Facility	Population
National Referral Hospital	1
Regional Referral Hospital	3
Health centre II	74
Health centre III	26
Health centre IV	6
Clinic	99
Total	*209*

Adopted from Ministry of Health 2018 report on national health facilities [37].

2.2 Study Design

A cross-sectional study design was employed using a quantitative data collection approach covering a period of October 2020 – January 2021. The survey questionnaire used to collect data was structured and formulated in English with three main themes (demographic data, barriers and facilitators). Barriers and facilitators used in the questionnaire were drawn from existing studies [6, 19, 23, 28, 38]–[10, 16, 20–22, 27, 29, 30, 32, 33, 40–43]. All authors designed the questionnaire; however, it was specifically tailored to fit the scope of this study. A thorough scrutiny of the barriers and facilitators was done where patterns were identified and factors clustered into three major themes (hospital, technological and individual factors). To ensure consistency and clarity, two independent researchers validated the questionnaire. A pre-test was conducted in October 2020 with 20 outpatients at Corsu Rehabilitation hospital, Entebbe and Rubaga Hospital. The responses on the questionnaires were measured using a five point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). However, at the advent of the CoVID-19 pandemic, there was a mandatory requirement to observe the Ministry of Health CoVID-19 standard operating procedures especially when in public. Thus, data collection was done using the Open Data Kit (ODK) and a physical questionnaire. Respondents were free to choose any one method of their convenience. For those that chose to fill a google form, a consent form was sent through email, and once filled, a google link was subsequently sent. For participants who opted for the ODK tool and physical questionnaires, the research team first sought written consent from them before collecting data.

2.3 Sampling and Data Collection

Three hundred and twenty patients from 68 health facilities located across the four districts received questionnaires, and 292 were successfully returned, translating to 91.2% response rate. The number of health facilities were determined using Yamane's formula of determining sample size [44]. Using this formula, $\frac{N}{1+N(e)^2}$ where n is the sample size, N is the population size and e is the level of precision (assumed to be 10% for this study),

we were able to determine our sample (68 health facilities) using a population of 209 health facilities. After determining our sample size, we then purposively selected the health facilities. At the health facilities, study participants were randomly selected using simple random sampling and this exercise lasted approximately four months. Study participants were recruited from the eye and dental clinics, cancer and heart institute, maternity and orthopedic wards, and others were selected while entering or exiting the hospital gates. For all selected participants (patients), telephone contacts were exchanged and follow-up was done to ensure that the questionnaire was filled and appointment to have it picked set. Ten research assistants (RA's) who were graduate students were used in the distribution of questionnaires. They were trained about the research expectations and the data collection tool.

2.4 Analysis

IBM SPSS Statistics Version 25 (New York, USA) was used to code and analyze the data. Phase one of the analysis started with a descriptive bivariate analysis to understand the demographic composition of the study participants. This was achieved using the mean and standard deviation, to ascertain how spread out the responses were; Pearson's Chi-square test (χ^2) to test variable independence; and cross tabulation to summarize the relationships between different variables. Phase two involved using multivariate analysis achieved through using logistic regression because of its ability to estimate the probability that a patient will use eHealth systems and determining which socio-demographic or socio-economic factor significantly influences eHealth adoption among patients. The logistic regression model used "eHealth system use" as the dependent variable. The independent variables were education level, age, gender, type of patient, location, employment status and type of health facility.

2.5 Ethical Approval

A multi-layered approval process was adopted in this research. First, approval was sought from the ethical review committee of school of public health (SPH-2021-42), Makerere University, which was followed by Uganda National Council of Science and Technology under registration number SS945ES. Subsequent approval was sought from district health officers, health facilities and from the patients. Consent was both verbal and written, however respondents were first asked for their verbal approval, followed by a written one. All human subjects consented and were informed of their rights to withdraw at any point of the study.

3 Results

Results from Table 2 are a result of cross tabulation indicating that Kampala district received the highest number of participants 144(49%) in both categories of patients i.e. recovering 49(34%) and outpatients 95(66%). This was followed by Mbale district 86(30%). Jinja received the lowest number of participants 30(10%). Majority of the participants were degree holders 153(52%); Kampala having 81(56%), Mbale 43(50%), Mbarara 16(50%) and Jinja 13(43%). Those in the category 'others' 8(3%) were either masters or PhD holders. Majority of the patients who participated in this study 103(36%) were in the age range 31–40 years, 101(36%) between 18–30 years, 76(27%) between 41–50 years and only 3(1%) above 51 years. The distribution of participants by gender was, males 161(55%) and females 131(45%). Majority of the participants 100(34%) were from HC II's. More than half of the participants 158(54%) were unemployed. A big number 219(76%) of participants had never used any form of eHealth system, specifically none from Mbarara and Mbale, whereas there was only 1(3%) from Jinja. Participants that had used eHealth systems predominantly used desktop applications 51(75%).

Table 2. Demographics Data of the Study Participants

Number that participated and returned questionnaires	Number/Percent of Patients N = 292				
	Kampala	Jinja	Mbale	Mbarara	Total
Number of Respondents	144(49%)	30(10%)	86(30%)	32(11%)	292(100%)
Types of patients					
Recovering patients	49(34%)	9(30%)	27(31%)	11(34%)	96(33%)
Out-patients	95(66%)	21(70%)	59(69%)	21(67%)	196(67%)
Education Level					
Ordinary certificate	31(22%)	2(7%)	19(22%)	4(13%)	56(19%)
Diploma	28(19%)	14(47%)	23(27%)	10(31%)	75(26%)
Bachelors	81(56%)	13(43%)	43(50%)	16(50%)	153(52%)
Masters and above	4(3%)	1(3.3%)	1(1.2%)	2(6%)	8(3%)
Age					
18–30 years	80(59%)	3(10%)	12(14%)	6(19%)	101(36%)
31–40 years	44(33%)	14(47%)	29(34%)	16(50%)	103(36%)
41–50 years	11(8%)	12(40%)	44(51%)	9(28%)	76(27%)
Above 51 years	0(0%)	1(3%)	1(1%)	1(3%)	3(1%)

(*continued*)

Table 2. (*continued*)

Number that participated and returned questionnaires	Number/Percent of Patients N = 292				
	Kampala	Jinja	Mbale	Mbarara	Total
Gender					
Male	83(58%)	18(60%)	44(51%)	16(50%)	161(55%)
Female	60(42%)	12(40%)	42(49%)	17(50%)	131(45%)
Types of Health Facility					
National Referral Hospital	12(8%)	1(3%)	2(2%)	1(3%)	16(6%)
Regional Referral Hospital	13(9%)	7(23%)	24(28%)	8(25%)	52(18%)
Health Centre II	37(26%)	17(58%)	30(35%)	16(50%)	100(34%)
Health Centre III	20(14%)	3(10%)	20(23%)	3(9%)	46(16%)
Health Centre IV	24(17%)	0(0%)	2(2%)	1(3%)	27(9%)
Clinics	38(26%)	2(7%)	8(9%)	3(9%)	51(18%)
Employment status					
Employed	64(44%)	15(50%)	42(49%)	13(41%)	134(46%)
Unemployed	80(56%)	15(50%)	44(51%)	19(59%)	158(54%)
Used a eHealth system/device					
Yes	67(47%)	1(3%)	0(0%)	0(0%)	68(24%)
No	75(53%)	28(97%)	85(100%)	31(100%)	219(76%)
Types of eHealth systems used					
Mobile		17(25%)			
Desktop		51(75%)			

Table 3. Test of independence of eHealth adoption

Variable	*df*	χ^2	Sig
Education level	3	14.9	.002
Age	3	13.6	.003
Gender	1	4.95	.026
Type of patient	1	.194	.660
Location	3	85.9	.000
Employment status	1	.873	.350
Type of facility	7	89.1	.000

Using a .05 criterion of statistical significance, results of Pearson's Chi-square in Table 3 indicate that education level ($\chi^2 = 14.9$, $\rho < 0.05$), age ($\chi^2 = 13.6$, $\rho < 0.05$), gender ($\chi^2 = 4.95$, $\rho < 0.05$), location ($\chi^2 = 85.9$, $\rho < 0.05$) and type of health facility ($\chi^2 = 89.1$, $\rho < 0.05$) have a statistical significant relationship with eHealth use.

Table 4. Facilitators of eHealth Adoption

Hospital Facilitators	Mean	Std. Dev
Training patients to use the technology is important to accelerate eHealth adoption	4.00	1.022
In my opinion, communicating eHealth benefits to patients is crucial in successful adoption	4.00	.885
The size of the health facility will determine the successful adoption of eHealth systems	3.47	1.263
Hospital readiness (strategy, structure, process) is critical to eHealth adoption	3.77	.953
eHealth adoption necessitates change and if change is not properly infused with patient expectations, eHealth adoption will not ensue (proper change management)	3.55	1.136
In my opinion, if digital health technologies are cost-effectiveness, uptake will be easy	3.88	1.225
In my opinion, once the ehealth system improves my communication with the health provider, I will gladly use it	3.81	1.156
My involvement in the preliminary implementation of ehealth services is critical for adoption	3.89	.952
In my opinion, the role of local champions to promote the service and motivate users is vital for successful eHealth adoption	3.74	1.068
In my opinion, if the policies for using generated data for research are flexible and transparent, using eHealth systems will be embraced	3.77	.952
The popularity of the eHealth system accelerates adoption	3.62	1.242
If there are supporting laws and regulations for eHealth use, adoption becomes easy	3.66	1.213
Technological Facilitators	**Mean**	**Std. Dev**
Ehealth systems that cut across different functions (finance, drug dispensing, e-consultation) will be widely adopted	3.69	1.140
If the eHealth system is easy to use with an effective interface between the human and machine, it fosters adoption	3.97	.843
In my opinion, if the quality of the system is good and data readily available, uptake is inevitable	3.85	1.117

(*continued*)

Table 4. (*continued*)

Hospital Facilitators	Mean	Std. Dev
Embedding eHealth systems in existing health care infrastructure can spearhead adoption	3.94	.862
In my opinion, security of patient data drives eHealth adoption	4.12	.869
If appropriate technical support for the installation and maintenance of the system is provided, adoption will come with ease	3.80	1.167
Reliability of the eHealth systems is important to influence uptake	3.82	1.349
When there is multiple channels (online, offline, mobile apps, web apps) to exchange information, people will be motivated to use the eHealth system (multi-channel access)	3.92	1.020
High quality evaluation with users during the development process increases adoption	3.71	1.266
A well- designed system that reflects the user's needs will most likely be adopted (patient outcomes)	3.89	1.042
Individual Facilitators	**Mean**	**Std. Dev**
Perceived usefulness of eHealth systems in personal healthcare drives adoption	4.21	.734
Personal attitude towards change in my opinion will influence eHealth use	3.82	.936
The need for fast execution of processes will motivate users to use eHealth systems	3.77	1.115
If the users of the system trust the service, they will be obliged to use it	3.59	.980
In my opinion, if the system facilitates research and development, adoption will increase	3.66	.975
The lack of ownership by users bars adoption of eHealth systems	3.70	.839

Results in Table 4 indicate hospital, technological and individual facilitators of eHealth adoption. With hospital facilitators, participants expressed strong opinions on training ($\mu = 4.00 \pm 1.022$), communicating eHealth benefits ($\mu = 4.00 \pm .885$), involving users in the preliminary implementation phase ($\mu = 3.89 \pm .952$), cost effectiveness of eHealth systems ($\mu = 3.88 \pm 1.225$) and the capability of eHealth systems to improve communication with healthcare providers ($\mu = 3.81 \pm 1.156$) as factors that influence their adoption of eHealth.

For technological facilitators, security of patient data ($\mu = 4.12 \pm 0.869$), ease of use ($\mu = 3.97 \pm .843$), embedding eHealth systems in existing health infrastructure ($\mu = 3.94 \pm .862$) and having multiple channels to exchange information ($\mu = 3.92 \pm 1.020$) received relatively higher scores, although the difference in the scores in relation to other factors was small.

Although, perceived usefulness of eHealth systems ($\mu = 4.21 \pm .734$) and personal attitude towards change ($\mu = 3.82 \pm .936$) received the highest mean scores, the variance in the means with other factors in the same category was very minimal.

Table 5. Barriers of eHealth adoption

	Mean	Std. Dev
Hospital Barriers		
The lack of compatibility of the ehealth system hinders users to adapt them	3.36	1.245
The lack of appropriate ICT infrastructure impede adoption of ehealth systems	3.78	1.029
Missing standards for patient data and data exchange creates fear to use ehealth systems	3.74	1.152
Several ehealth systems modules operate in isolation which delays the execution of tasks (silo systems)	3.42	1.302
It may not be cost-effective to provide ehealth services	3.87	1.935
In my opinion, the unclear benefits of the eHealth systems reduces uptake	3.50	1.199
The lack of incentives to use ehealth systems hinders some patients from using ehealth systems	3.69	1.168
Technological Barriers		
The lack of developer support affects eHealth adoption	3.48	1.210
The unreliable eHealth systems slow the adoption because users are not certain of the availability of the data or the system (unreliability)	3.59	.985
eHealth systems that are not secure may hinder uptake (security)	3.55	1.250
The lack of proof of effectiveness and efficiency of ehealth systems in my opinion slows uptake	3.56	1.301
In my opinion, ehealth systems design that do not meet patient's needs, impede adoption (usefulness)	3.75	1.186
The interfaces of some ehealth systems are not user-friendly and hard to navigate (usability issues)	3.48	1.146
Unreliable broadband connectivity does not motivate users to use technology	3.53	.949
In my opinion, limited local content of health information slows adoption	3.53	1.021
Individual Barriers	**Mean**	**Std. Dev**
The issue of confidentiality of ehealth data hinders patients to use ehealth systems	3.78	1.051
The capability to learn is very low among patients which bars them from embracing new technology	3.59	1.119
Bad information about existing eHealth systems influences patients not to use digital systems	3.78	1.209
The lack of trust in several eHealth systems demotivates use of digital technologies	3.71	1.188

(*continued*)

Table 5. (*continued*)

	Mean	Std. Dev
The lack of system's acceptance among users limits eHealth adoption	3.92	1.123
In my opinion, the technophobic nature among users slows adoption	3.90	2.812
Patient barriers like users with disabilities or physical impairments like blindness bars adoption	3.62	1.267
Digital illiteracy among patients impedes the use of ehealth systems	3.90	.855

Analysis in Table 5 reveals that missing data standards for patient data ($\mu = 3.74 \pm 1.152$), lack of appropriate ICT infrastructure ($\mu = 3.78 \pm 1.029$) and the cost that might be associated to health systems ($\mu = 3.87 \pm 1.938$) are hospital barriers which hinder adoption.

For technological barriers, it was pointed out that unreliable eHealth systems ($\mu = 3.59 \pm .985$), eHealth systems designs that do not meet the patient's needs ($\mu = 3.75 \pm 1.186$) and the lack of proof of effectiveness and efficiency of ehealth systems ($\mu = 3.56 \pm 1.301$) were negative contributors of eHealth adoption.

Consequently, the participant's opinions on the individual barriers of eHealth were strongly inclined to the lack of acceptance among users ($\mu = 3.92 \pm 1.123$), the technophobia ($\mu = 3.90 \pm 2.812$) and the digital illiteracy ($\mu = 3.90 \pm .855$).

Logistic Regression Analysis

The odds of whether or not to use eHealth technologies is computed using the formulae,

$$\ln(ODDS) = \ln\left(\frac{\hat{Y}}{1-\hat{Y}}\right) = a + bX$$

where $\hat{Y}$ is the predicted probability coded with 1 (use of eHealth technologies) rather than 0 (do not use eHealth technologies), 1-$\hat{Y}$ is the predicted probability of the other decision, and X is the predictor variable, gender. Given the results in Table 4 (A), 76% did not use eHealth systems.

The intercept-only model is,

$$\ln(\text{odds}) = -1.169$$

To exponentiate both sides of the model gives the predicted odds of using eHealth systems of [Exp (B)] = .311 demonstrated in Table 6. Adding gender as a predictor, the omnibus test of coefficients gives us a chi-square of 4.795, on 1*df,* with no statistical significance ($p > .001$), χ^2 (1, N = 288) = 4.795, $p = .029$ (see Table 7A). The model with the intercept only has a −2 Log-Likelihood statistic of 318.779 (313.984 + 4.795). The model summary in Table 6A shows a −2 Log-Likelihood statistic of 168.293. Adding the gender variable reduced the −2 Log-Likelihood by 4.795, which is the χ^2 statistic in Table 7A, which implies a better model in predicting the patient's likelihood of using eHealth technologies. After adding the seven variables to the model, there was a drop in the −2 Log-Likelihood statistic to 168.293 (see Table 6B), indicating that the

expanded model does a better job of predicting the likelihood of eHealth use than was the one-predictor model. The R^2 statistics also increased from .025 to .585 in Table 6. Hence, a test of the full model versus a model with intercept only χ^2 (1, N = 292) = 4.795, $p = .029$ showed a significant improvement in the model χ^2 (7, N = 292) = 150.486, $p < .001$ with the overall success rate in classification improving from 76% to 86% (see Table 6B, 7A & 7B). The non-significant chi-square in the Hosmer and Lemeshow statistic χ^2 (6, N = 288) = 4.578, $p = .801$ (see Table 7C) indicates that the data fit the model very well.

Table 6. Model Summary

(A) For Gender				
Step	-2 Log Likelihood	Cox & Snell R Square	Nagelkerke R Square	Success Rate
1	318.779	.016	.025	76%
(B) For all the seven variables				
1	168.293	.388	.585	86%

Table 7. Omnibus Test for Model Coefficients

(A) Gender			
	Chi-square	df	Sig
1 step	4.795	1	.029
Block	4.795	1	.029
Model	4.795	1	.029
(B) **For all the Variables**			
1 step	150.486	7	.000
Block	150.486	7	.000
Model	150.486	7	.000
(C) **Hosmer and Lemeshow Test**			
1 step	4.587	8	.801

The variables in the equation output in Table 8 shows that the regression equation is;

$$\ln(ODDS) = -1.537 + .621Gender$$

This model predicted the odds that a subject of a given gender will use eHealth technologies to access health services. The odds prediction equation is;

$$ODDS = e^{a+bX}$$

If the patient is a woman (gender = 0), then they are only 0.21 as likely to use eHealth technologies as she is not to use them. If a patient is a man (gender = 1), they are only 0.4 times more likely to use eHealth technologies than not to.

Table 8. Variable in the Equation

Predictor	*B*	Wald χ^2	*p*	Exp(B)
Intercept only	−1.169	71.882	.000	.311
Gender	.621	4.632	.031	1.861
Constant	−1.537	44.741	.000	.215

Converting the odds to probabilities, using the formulae below, the model predicts that 17% of women and 29% of men will use eHealth technologies.

$$\hat{Y} = \frac{ODDS}{1 + ODDS}$$

The odds ratio predicted by the model in Table 8, using the formulae $e^{.621}$, implies that the model predicts that the odds of using eHealth technologies are 1.861 times higher for men than they are for women.

The variables were denoted as follows.

Use of eHealth systems/devices with the highest value of 1 (have ever used) and 0 (have never used any eHealth).

Gender was a variable denoting the sex of the patients, with 1 for males and 0 for females.

Education was the education attainment level of the patients, with 1 representing those with completed masters degrees and above, 2 representing those with completed bachelor's degree, 3 diploma and 4 ordinary certificate.

Location was the districts of residence of the patients, with 1 representing Kampala, 2 representing Jinja, 3 Mbale and 4 Mbarara.

Type of patient was denoted with 1 for outpatients and 0 for recovering patients.

Employment status with 1 representing those employed and 0 the unemployed.

For Age, 1 represented 18–30, 2 represented 31–40, 3 was 41–50, 4 represented 51 years and above.

Table 9 shows a logistic regression coefficient, Wald test and the odds ratio for each predictor variable. Applying a .05 criterion of statistical significance, location, gender and education are statistically significant. The odds ratio for gender (OR = 2.662) indicates that, if other factors are held constant, the odds of using eHealth technologies are 2.662 times higher for men than women. The odds ratio for education (OR = 2.697) reveal that patients with a higher level of education (masters and above) are 2.697 times more likely to use eHealth systems than those with low education. Similarly, the odds for location (OR = 0.12) indicate that patients residing in Kampala have a .012 times chance of using eHealth systems than the patients in other regions.

Both models (Pearson Chi-Square model and the logistic regression model) indicate that education level, gender and location of the patients are strong determinants of eHealth adoption.

Table 9. Predictors of eHealth adoption

Predictors	*B*	Wald χ^2	*P*	Exp(B)
Location	−4.433	15.049	.000	.012
Gender	.979	6.147	.013	2.662
Type of patient	−.015	.001	.971	.985
Education	.832	12.250	.000	2.297
Employment Status	−.640	2.731	.098	.528
Age	.554	3.144	.076	1.739
Type of health facility	−.133	2.354	.125	.876
Constant	1.999	2.140	.144	7.385

4 Discussion

The study revealed that training patients to use the technology, communicating the benefits of eHealth to users, securing patient data and the ease associated with using eHealth systems facilitate adoption. On the other hand, digital illiteracy, technophobic nature of users, lack of system's acceptance among users and system's that do not meet the needs of the users negatively affect adoption. Further analysis revealed that education level (master's degree and above), location (residing in Kampala) and gender (being male) significantly influenced eHealth adoption.

This study revealed that training was a facilitator of eHealth adoption. Training has been identified cited as a key success factor in technology acceptance. Commensurate to our findings, receiving necessary training prior to using the system has been encouraged in several other studies [6, 19, 21, 28, 30, 33, 39, 41, 45]. Training equips users with the knowledge of the system [20], gives a chance to acclimate to the new processes and in the long run boosts confidence to use the system. Effective user training will ensure that users have an optimal starting point for working with the new information system [46], facilitate optimal IT use and acceptance [47] and ensure users with differing levels of IT skills become comfortable with the software [48]. With inadequate training, the system operates, but does not fulfill its desired expectations whilst non-trained users will resist the change [48]. Although some studies emphasize that usability eliminates the need for training [49], many studies have underscored training and support in improving acceptance of eHealth systems [50, 51]. In some studies, training boosted peer and management support, which was a catalyst for system learning and use [33]. Some studies, however stress that training can only be effective if systematic processes are properly followed [47].

Communicating the benefits of eHealth systems to the users ranked second in this study. Systems are as good as the users knowing their benefits, and training has been found to fulfill this. Reminding users of the usefulness of the systems increases the chances of adoption as alluded in several other studies [30, 41]. In some studies, communicating anticipated benefits was reported to increase user acceptance of the eHealth system [5, 52, 53]. Communication tightens the loose ends between the patients and

the healthcare providers, but most importantly, makes the users aware of the system. User resistance and low adoption of eHealth has largely been attributed to the lack of awareness of the potential benefits of these systems. In some studies, naïve optimism, as a result of lack of communication, has created pockets of resistance even before implementation [54].

This study also revealed that securing patient data is very crucial in accelerating adoption of eHealth. Securing patient data involves protecting confidential medical information and once security is compromised, it creates a sense of fear and resistance among users. Similar to this study, concerns over privacy and security being compromised have been raised in several other studies [6, 10, 39, 40, 45, 55] as barriers of eHealth adoption. In a study conducted by Chang [43], participants expressed concerns about the confidentiality and the security of patient data with smartphones, with specific concern on multimedia capabilities that were perceived as having the potential of abuse. When patients exude fear in the system, its use and adoption becomes far from being attained. The more robust and secure the system is, the less likelihood of attack, hence adoption.

The ease associated with using systems was a factor revealed in this study that was critical for successful adoption of eHealth among patients. There has been wide debate on whether ease of use can be ascribed to technology acceptance. But Kassim [56] study stresses that the ease of use is associated with increase in user satisfaction and trust in the system. In a study conducted in Ghana [57], ease of use and perceived usefulness had the strongest influence on eHealth adoption than any other factors. Likewise, other studies Riana et al. [58] have emphasized the relative importance of ease of use in influencing eHealth adoption.

This study revealed that digital illiteracy is a barrier to eHealth adoption among patients. This can largely be attributed to lack of training and no user involvement at the time of design and implementation. Lacking digital skills to operate a system can be aggravated by the little or no formal education. As reported in other studies [20, 24, 38, 41] the lack of ICT skills to operate digital technologies was a very big impediment to adoption. Whereas a study conducted in Finland indicated that digital literacy does not have a direct impact on adoption [59], research conducted in Uganda, found out that expectant mothers did not use digital health technologies in their routine antenatal care practices because they lacked technical skills to operate the internet, computers and smartphones [29]. Because of this problem, many users become technophobic – the fear to use technology. This study revealed a strong correlation between digital illiteracy and technophobia. This technology fear exhibited by users is partly due to little or no exposure to technology or digital tools and the fear to be ridiculed [60], and as a result, many shun using eHealth systems as reported in other similar studies [19, 45]. If not dealt with at an early stage, it may result into one being cyberphobic [60] which is an abnormal fear detrimental to users.

Lack of system's acceptance among users was another barrier of eHealth adoption cited in this study. System's acceptance among users could be caused by the lack of user involvement [33], when the system does not address the needs of the users [61], not communicating the benefits of the system [41] and to a smaller extent, attitude towards technology [23]. Like this study, several other studies [13, 24, 26, 62] reported user acceptability of the systems to be a very big challenge to eHealth adoption. In a

study conducted by Konduri et al., [63], they recommended ensuring user acceptance to fully realize the potential of digital health technologies. In another study that was conducted in Iganga district hospital involving nursing mothers, the NeMo system was successful because of acceptability among mothers [13]. When users do not have a sense of ownership of the system, acceptance will be hard which increases system rejection.

The study further revealed that once the system does not address the needs of the users, then ehealth adoption cannot ensue. Usefulness is the knowledge the users have of the system and the benefits that accrues from its use. Many scholars [23, 28, 30, 39, 13, 61, 64] have equally reported on perceived usefulness in facilitating or impeding the successful adoption of systems in general. Once users do not perceive the system as useful, acceptability will be very low. However, some studies have recommended training users [6] and active user participation in the system evaluation process [14, 55] to enhance user's knowledge of the system. Behind a successful eHealth systems is the ability to satisfy the needs of the users [58, 65].

This study revealed that education level, location and gender could influence eHealth adoption. Both models indicated that the gender of the patient can influence adoption, however the logistic regression model further revealed that male patients were 2.662 times more likely to use eHealth systems than the females. The findings in this study can be corroborated with [18, 57], who equally reported gender to be a determinant of eHealth adoption, although, in their study, females were more likely to adopt than the males. However, other studies have equally reported the males enjoying higher levels of eHealth adoption than the females [18, 66, 67]. Conversely, the study revealed that a patient with a master's degree or higher was 2.297 times more likely to use eHealth technologies than the rest of the participants. Education influences eHealth adoption and many scholars have equally stressed the importance of education in accelerating eHealth technology acceptance and adoption [19, 31, 42, 68]. In a study conducted in Ghana, it was revealed that participants having a higher education used eHealth devices more often than their counterparts [57]. Education shapes attitude and perception, and it has been reported to improve self-efficacy [69, 70]. Lastly, this study revealed that location as a factor strongly influences eHealth adoption. Specifically, the odds were in favor of the participants residing in Kampala than the rest of the districts. Unlike Kampala, these locations have poor network coverage, intermittent internet connectivity and poor telecommunication infrastructure, which, most times disrupts connectivity [10, 16, 22]. There's little literature to support location as a determinant of eHealth adoption, however, in some study, though not necessarily related to eHealth adoption, it was reported that location affected the adoption of commercial internet [71]. Similarly, a study by Melesse [72] found a correlation between technology adoption and geographical distance.

5 Conclusion and Recommendations

This study showed that gender, education and location have a significant impact on eHealth adoption. The study also revealed that hospital, technological and individual characteristics had a positive influence on eHealth. Specifically, in order of score, it was revealed that training patients, communicating eHealth benefits to the users, user involvement in the preliminary implementation phase were hospital factors that influenced eHealth adoption among patients. Subsequently, technological factors like security

of patient data and ease of use had an uphill influence on eHealth adoption. Lastly, the study revealed that individual factors like the lack of acceptance among users, technophobia, digital illiteracy and eHealth systems designs that do not meet the patient's needs had a negative influence on eHealth adoption. Whereas the other factors under hospital, technological and individual barriers/facilitators showed influence of eHealth, their average score was relatively low. The success of eHealth requires players in the health sector to ardently focus on the socio-demographic factors of the users, technological and hospital conditions if eHealth adoption is to ensue. Future research should investigate the maturity level of eHealth systems to ascertain digital health penetration in health facilities.

Limitation of the Study

The limitations of this study that were both in breadth and accessibility of study sites. At a hospital level, there were many restrictions to access study participants because of the COVID-19 pandemic. Some facilities that had initially approved our study later backed out in a bid to curb the COVID-19 virus spread. At a country level, the two nation-wide lockdowns affected both public and private transport. Inter and intra-district movements were limited, at a certain point, the study had to be halted because it was no longer possible to get travel permits from the relevant government organs. At the participant level, patients were very jittery to interact with our research assistants because at that time, Uganda was at the peak of the second wave, hence many participants declined to participate. Another limitation of the study was that no data was collected on the level of exposure and effectiveness of eHealth technologies as a selection criterion, which could have affected the perception of the participants. Rather, the objective of the study was to get empirical data on the barriers and facilitators, which will inform a more rigorous study.

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