Article, Review

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. Therefore, this study set out to investigate the barriers and facilitators of eHealth adoption among patients in Uganda. A cross-sectional survey was conducted in four districts across the country. A total of 292 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. World Health Organization defines eHealth as the cost-effective and secure use of ICT in support of health and health-related fields, including health care services, health surveillance, health literature, health education, knowledge and research [2]. 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 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 of 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 baring 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, i) 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, and ii) developing an eHealth policy to guide the development and implementation of eHealth in the country [6]. The government of Uganda together with donors have commissioned several eHealth innovations. Such systems include Text-to-Change and U-Reporting are 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], [19], [20], [21], [16], [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 [23], [21], [24], [25], [13], [26], [6]. Also, the lack of awareness, lack of ICT policies, inadequate ICT infrastructure, poor internet connectivity, scarcity of computers and inadequate power supply [27], [10], [28], [25], [24], [29], [21], [30], [31], [32], [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. Previous studies have focused on barriers and facilitators of eHealth in general. None has examined the adoption of eHealth among patients in Uganda, and to the best of our knowledge, this is the first of its kind.

This paper will contribute to understanding the factors that influence the successful adoption of eHealth among patients for those seeking to implement patient-centered systems, and will be a pedestal in enhancing the national eHealth strategy of Uganda. Investigating barriers and facilitators for successful eHealth adoption among patients is vital for informing policy and relevant stakeholders investing in the sector.

2. Materials and Methods

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 [34], [35]. Inclusion criteria included i) recovering patients and outpatients above 18 years of age who sought medical services from national and regional referral hospitals, health centre II, III, IV, and clinics. Sixty-eight health facilities were visited.

| Type of Health Facility       | Health Facilities in the Four Selected Regions |
|------------------------------|-----------------------------------------------|
| National Referral Hospital    | 1                                             |
| Regional Referral Hospital    | 3                                             |
| Health centre II             | 74                                            |
| Health centre III            | 26                                            |
| Health centre IV             | 6                                             |
| Clinic                       | 99                                            |
| **Total**                    | **209**                                       |
Study Design

The study employed a cross-sectional design using a quantitative data collection approach covering a period of October 2020 – January 2021. A structured survey questionnaire formulated in English with three main themes (demographic data, barriers and facilitators) was used to collect data. Barriers and facilitators used in the questionnaire were drawn from existing studies [6], [19], [23], [28], [37]–[39], [21], [27], [29], [16], [22], [32], [30], [40], [41], [20], [33], [42], [10]. 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 was collected in three different ways, i) using the Open Data Kit (ODK), ii) a google form, and iii) 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.

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, contributing 91.2% to the response rate. The number of health facilities were determined using Yamane’s formula of determining sample size [43]. 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) together with the authors participated in the distribution of the questionnaires. All RA’s were graduate students who, despite their experience in data collection had to first be trained on the primary objective of the research, research ethics, code of conduct and communication skills.

Data Analysis

All data was coded, processed and analyzed using IBM SPSS Statistics Version 21 (New York, USA). Phase one of the analysis started with a descriptive bivariate analysis
to understand the demographic composition of the study participants and provide basic information about the dataset. This was achieved using the mean and standard deviation, to ascertain how spread out the responses were; Pearson’s Chi-square test ($\chi^2$) to test the independence between different variables; 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.

**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, Makerere University, which was followed by Uganda National Council of Science and Technology under registration number SS945ES. Subsequent approval was sought from health facilities and from study participants. Consent was both verbal and written, however respondents were first asked for their verbal approval, which was later accompanied by a written one. All human subjects consented and were informed of their rights to withdraw at any point of the study.

3. Results

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%) |
| Gender                                              |         |       |       |         |
| Male                                                | 83(58%) | 18(60%) | 44(51%) | 16(50%) | 161(55%) |
| Female                                              | 60(42%) | 12(40%) | 42(49%) | 16(50%) | 130(45%) |
Results from table 2 indicate 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 130(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 prior to the study, 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 3: Test of independence of eHealth adoption

| Variable               | df | \( \chi^2 \) | 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 |
Employing a .05 criterion of statistical significance, results of Pearson’s Chi-square in table 3 indicate that education level ($\chi^2 = 14.9, \ p<0.05$), age ($\chi^2 = 13.6, \ p<0.05$), gender ($\chi^2 = 4.95, \ p<0.05$), location ($\chi^2 = 85.9, \ p<0.05$) and type of health facility ($\chi^2 = 89.1, \ p<0.05$) 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    |
| 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    |
Results in table 4 indicate hospital, technological and individual facilitators of eHealth adoption. Concerning hospital facilitators, participants expressed strong opinions on training (µ=4.00±1.022), communicating eHealth benefits (µ=4.00±.885), involving users in the preliminary implementation phase (µ=3.89±.952), cost effectiveness of eHealth systems (µ=3.88±1.225) and the capability of eHealth systems to improve communication with healthcare providers (µ=3.81±1.156) as factors that influence their adoption of eHealth.

For technological facilitators, security of patient data (µ=4.12±0.869), ease of use (µ=3.97±.843), embedding eHealth systems in existing health infrastructure (µ=3.94±.862) and having multiple channels to exchange information (µ=3.92±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 (µ=4.21±.734) and personal attitude towards change (µ=3.82±.936) received the highest mean scores, the variance in the means with other factors in the same category was very minimal.
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
Missing standards for patient data and data exchange creates fear to use eHealth systems 3.74 1.152
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
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
Several eHealth systems modules operate in isolation which delays the execution of tasks (silo systems) 3.42 1.302
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

| Individual Barriers | Mean  | Std. Dev |
|---------------------|-------|----------|
| In my opinion, limited content of health issues in local content slows adoption | 3.53  | 1.021    |
| 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    |
| In my opinion, the unclear benefits of the eHealth systems reduces uptake | 3.50  | 1.199    |
| 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    |
| 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    |
| The lack of incentives to use eHealth systems hinders some patients from using eHealth systems | 3.69  | 1.168    |
| It may not be cost-effective to provide eHealth services | 3.87  | 1.935    |
| 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 (μ=3.74±1.152), lack of appropriate ICT infrastructure (μ=3.78±1.029) and eHealth systems designs that do not meet the patient’s needs (μ=3.75±1.186) were technological barriers that patients felt strongly about.

Consequently, the participant’s opinions on the individual barriers of eHealth were strongly inclined to the lack of acceptance among users (μ=3.92±1.123), the technophobia (μ=3.90±2.812) and the digital illiteracy (μ=3.90±.855).
Logistic Regression Analysis

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

\[ \ln(\text{Odds}) = \ln \left( \frac{\hat{Y}}{1-\hat{Y}} \right) = a + bX \]

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,

\[ \ln(\text{odds}) = -1.169 \]

Exponentiating both sides of the model gives the predicted odds of using eHealth systems of \( \text{Exp} (B) = .311 \) demonstrated in table 6. Adding gender as a predictor, the omnibus test of coefficients gives us a chi-square of 4.795, on 1df, with no statistical significance \( (p>.001) \), \( \chi^2 (1, N=288) = 4.795, \ p=.029 \) (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, the \( \chi^2 \) 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 \( \chi^2 (1, N=288) = 4.795, \ p=.029 \) showed a significant improvement in the model \( \chi^2 (7, N=288) = 150.486, \ p<.001 \) 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 \( \chi^2 (6, N=288) = 4.578, \ p=.801 \) (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

|  | 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 |
The variables in the equation output in Table 8 shows that the regression equation is; 
\[ \ln(ODDS) = -1.537 + 0.621 \times Gender \]

Table 8: Variable in the Equation

| Predictor       | B  | Wald  | \( \chi^2 \) | \( p \)  | Exp(B) |
|-----------------|----|-------|--------------|--------|--------|
| Intercept only  | -1.169 | 71.882 | .000        | .311   |
| Gender          | .621 | 4.632 | .031        | 1.861  |
| Constant        | -1.537 | 44.741 | .000        | .215   |

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.

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 \( e^{0.621} \), 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: Predictors of eHealth adoption

| Predictors               | B    | Wald  $\chi^2$ | 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 |

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 2.297 times more likely to use eHealth systems than their counterparts. 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.

4. Discussion

The study revealed that training patients to use the technology, communicating the benefits of eHealth to users, security of 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 as one of the key success factors in technology acceptance. Commensurate to our findings, receiving necessary training prior to using the system has been encouraged in several other studies [6], [38], [44], [19], [28], [21], [40], [30], [33]. 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 [45], facilitate optimal IT use and acceptance [46] and ensure users with differing levels of IT skills become comfortable with the software [47]. With inadequate training, the system operates, but does not fulfill its desired expectations whilst non-trained users
will resist the change [47]. Although some studies emphasize that usability eliminates the need for training [48], many studies have referred to training and support in relation to acceptance of eHealth systems [49], [50]. 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 [46].

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 by several other studies [40], [30]. In some studies, communicating anticipated benefits was reported to increase user acceptance of the eHealth system [51], [5], [52]. 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 [53].

This study also revealed that the security of 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], [44], [39], [38], [10], [54] as barriers of eHealth adoption. In a study conducted by Chang [42], 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 will be 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 [55] 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 [56], ease of use and perceived usefulness had the strongest influence on eHealth adoption than any other factors. Likewise, other studies [57] have underscored 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], [37], [40] 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 [58], 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 [59], and as a result, many shun using eHealth systems as reported in other similar studies [19], [44]. If not dealt with at an early stage, it may result into one being cyberphobic [59] 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 no user involvement [33], when the system does not address the needs of the users [60], not communicating the benefits of the system [40] and to a smaller extent, attitude towards technology [23]. Like this study, several other studies [13], [26], [24], [61] reported user acceptability of the systems to be a very big challenge to eHealth adoption. In a study conducted by [62], 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 accrue from its use. Many scholars [38], [28], [23], [30] [13], [60], [63] 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 [54], [14] to enhance user’s knowledge of the system. Behind a successful eHealth systems is the ability to satisfy the needs of the users [57], [64].

This study revealed that demographic factors such as 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 [56], [18], 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 [65], [66], [18]. 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 underscored the importance of education in accelerating eHealth technology acceptance and adoption [19], [41], [31], [67]. In a study conducted in Ghana, it was revealed that participants having a higher education used eHealth devices more often than their counterparts [56]. Education shapes attitude and perception, and it has been reported to improve self-efficacy [68], [69]. 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 [22], [10], [16]. 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 [70]. Similarly, a study by [71] found a correlation between technology adoption and geographical distance.
Limitations 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 due to 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.

5. Conclusion

This study showed that gender, education and location have a significant influence 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 such as security of patient data and ease of use had an uphill influence on eHealth adoption. Lastly, the study revealed that individual factors such as 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.

With respect to implications, the findings of this study should be used by Ministry of Health of the Republic of Uganda to enforce technology inclusion at every point of care in health facilities, and embark on advocacy and training programs to enhance digital skills of patients.

Similarly, this study divulges key barriers and determinants of eHealth adoption among patients, which, when ardently addressed by the ministry or other partnering agencies, can change the face of eHealth adoption.

The key success factor of any technology is having stakeholders work collaboratively; hence, players in the sector should embark on programs that create synergy between patients and the healthcare providers in order to accelerate eHealth adoption.

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