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Factors influencing adoption of eHealth technologies in Ghana

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Abstract

This study covers factors influencing the adoption of electronic health (eHealth) technologies in Ghana. The study was designed as a quantitative survey with questionnaire as the main method of data gathering. A total of 1640 questionnaires were administered to users and potential users of eHealth technologies in both public and private healthcare centres in Ghana. The study concludes that institutional characteristics and healthcare manager characteristics have a high influence on eHealth adoption. However, factors related to performance expectancy and effort expectancy only have low influence on the adoption of eHealth devices and systems. Accordingly, the study makes recommendations to policymakers for improving eHealth adoption in the health sector.

Keywords

eHealth, ICT4D, Ghana, health informatics, technology adoption.

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Introduction

Information communication technology (ICT) is fast altering how business, social interactions and medical science are conducted globally. The deployment of ICT in an economy leads to the creation of effective macroeconomic and public-sector management, promotion of private enterprise development and the integration of local, regional and national economies into the global economy of trade and finance as well as the promotion of education and health control.[1] Since its introduction there has been a tremendous growth in eHealth adoption and usage in several jurisdictions mainly in developed countries.[2] This is because of the benefits it offers for improving healthcare and supporting a good quality of life. The Rockefeller Foundation observed that eHealth represents an effective means of ensuring quality healthcare globally and narrowing health disparities through appropriate equipping of health care providers.[3]

Ganesh noted that eHealth is driven by consumer preferences, technical capabilities, health system policy and economic considerations.[4] Ganesh,[4] unlike Sun et al.,[5] does not classify competition in the health care industry as a major facilitator of eHealth adoption. The increased number of healthcare institutions has led to the need to differentiate one's product from another's as well as to gain speed in service provision. This need is one major facilitator in eHealth adoption.[5,6] It is apparent, therefore, from the views of these authors that several factors drive eHealth adoption. Studies within the context of Ghana have looked at the rise of mobile technology in the health sector.[7] Arguably, little study has been done in Ghana to highlight the factors that drive eHealth adoption, hence the need for this study.[8,9]

The next section discusses eHealth and its current state in Ghana, followed by the methodology of the study, then analysis of findings, followed by a discussion of the results, and conclusions.

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Literature review

Several eHealth definitions have been adopted by researchers, academic institutions, professional bodies and funding organisations. eHealth is making headway in the treatment of mental disorders,[10,11] self-health monitoring,[12] disease diagnosis,[13] physical activity intervention for the medically challenged and survivors,[14,15] and many other health-related scenarios. With regards to the definition of eHealth, researchers have found it difficult to reach a consensus.[16] Also with the evolving technological innovation landscape, it is difficult to adopt a single definition for a concept as broad as eHealth. Whilst some authors have focused on the technology side of the definition, others have focused on commerce and/or health care elements. It is not uncommon for researchers to define concepts in a way that represent their objectives. For this study, we adopt the definition by Cunningham et al. of eHealth as the use of technologies, education and data to support point-of-care clinical services operated by health care teams, or by the patient themselves in order to support their own self-management.[16] The definition recognizes the importance of ICT in the health sector. Based on this definition, adoption of eHealth technologies can be at both the micro/individual level and the meso/institutional level. Individual adoption of eHealth involves the acceptance of the technologies as part of the professional work of the individual, whilst institutional adoption refers to the acceptance of the technologies with institutions to support healthcare processes.[6,17] Shaw et al. described the overlapping nature of eHealth technologies with respect to functions as: enabling data storage, retrieval, and transmission; the support of clinical decision making; and facilitating remote care.[18]

eHealth is the most efficient means of ensuring information capture, data mining, and concomitant access by multiple stakeholders.[19] It promotes the partnering of providers, insurers and clients, to bring about transparency and co-operation among healthcare providers, and breaks down barriers between independent professional roles.[20] Sun et al. observe that the adoption of eHealth is determined by five key factors: performance expectancy, effort expectancy, social influence, facilitating conditions and threat appraisals.[5] Their study, however, did not mention the influence of customers, as well as technical and operational issues that might dictate that the health institution either adapts to the efficient eHealth platform or goes bankrupt. Furthermore, they do not rank these characteristics to indicate those that are the most important influencers and those that are secondary.

It has been aptly demonstrated that eHealth is leading to a progressive blossoming of automation in the health sector.[19] However, there are several constraints, such as the high cost of information technology (IT) infrastructure and low level of human capacity to adopt eHealth globally.[21] A study conducted by Busagala and Kawono to identify the challenges on the adoption of eHealth in Tanzania reveals that the adoption of eHealth in that country is constrained by inadequate ICT skills, high cost of ICT in relation to economic status of community members, less developed infrastructure including lack of imaging equipment, small proportion of internet users and lack of information about suitable ICT solutions.[22]

Similarly, Anderson notes that eHealth has the potential to positively influence the quality of care, and improve healthcare service efficiencies.[23] However, it is hindered by a number of factors such as high cost of acquisition, especially at the initial stage, security, privacy and confidentiality concerns, and lack of technical skills. Moniz noted that resistance to change on the part of healthcare professionals hinders eHealth adoption,[21] while DeNardis points out that the major barrier to eHealth adoption is the inability of healthcare information systems (HIS) to interoperate to share information and the huge number of available eHealth standards, with many of them competing and overlapping, and some even contradicting one another.[24] Furthermore, Vishwanath and Scamurra attributed the low adoption rate of eHealth to both macro-level factors (e.g. supportive policies) from the perspective of the public, health care organisation and system, and micro-level barriers from the perspective of health care providers (e.g. physicians' perception about technological complexity).[25]

Although eHealth has the ability to positively influence the quality of healthcare and improve health services, there are a number of challenges to its adoption. The World Heath Organisation (WHO) indicates that constraints to the adoption of eHealth in Africa include the low ICT budgets, poor infrastructure in support of health services, erratic electricity supply and inadequate human resource capacity.[26] Busagala and Kawono, however, argue that the high cost of acquisition of IT facilities, particularly at the initial stage, resistance to change on the part of healthcare professionals, and lack of technical skills are the main constraints to the adoption of eHealth technologies.[22] WHO again noted that the major barrier to eHealth adoption is the inability of HIS to interoperate in order to share information.[27]

Acheampong also mentions that poor leadership, governance, and multi-sector involvement in eHealth hinder its adoption.[28] In this instance, there is no provision of directives and coordination for eHealth initiatives at the national level and, therefore, health goals in the country are poorly aligned with eHealth strategies.

Cardellino and Finch add that inadequate human resource capacity remains a crucial threat to the adoption of eHealth in general.[29] They observe that the development of effective health professionals with the requisite technical expertise in ICT with high capability of designing, building and running eHealth services greatly improve the performance of eHealth in Ghana.

A study conducted by Adebesin et al. on barriers and challenges to the adoption of eHealth in Africa using 200 survey questionnaires reveals that African countries' active participation in eHealth standards development is limited to the requirements of the International Organization for Standardization (ISO).[30] As much as this is hailed, Adebesin et al. observed that there is no substantiation of active involvement in this and other international standards' development initiatives in West Africa.[30] Accordingly, Adebesin et al. enumerates factors that contribute to the poor adoption of eHealth by West African countries using eHealth interoperability and adoption model developed by Wager et al.[30,31] These factors have been summarised into constraints identified in the general environment and constraints identified in the ICT environment. Apparently, the interplay of the enabling and the ICT environment ensures the appropriate adoption of eHealth. However, Adebesin et al. overlooked other factors that were equally important, especially constraints that lie outside the influence of the organization.[30]

Lack of understanding of the importance of eHealth, limited participation in eHealth standards development, lack of foundational ICT infrastructures, and limited human resource capacity for eHealth standard development pose great hindrances to eHealth adoption.[32,33] Some measures to control this include transformation of the eHealth standards development process at an international level and the adoption of a user-centered eHealth development approach. In addition, governments have to give precedence to investment in basic ICT infrastructure and the development of human resource capacity and as well as play an active role in eHealth adoption through implementation of appropriate national policies and guidelines.[34]

The Ministry of Health (MoH) has identified several challenges in eHealth implementation in Ghana, and has outlined quite a number of these challenges, not least among them challenges relating to integrity, confidentiality, authenticity and data protection.[35] The ministry notes, however, that by far the most potent challenge to the deployment of the programme is training of practitioners, as well as lack of ICT support systems and weak linkages of the various components in its deployment.

Developing countries like Ghana provide a different context for the analysis of adoption of technologies. Although Ghana has been recognized as an African regional leader in ICT penetration since the first internet connection was set up in 1989, and is judged to have one of the highest ICT penetration rates in sub-Saharan Africa,[28] there is little ICT impact in health management administration and, ultimately, health outcomes. According to Ghana's MoH,[35] the sector is characterised by a high number of different and independent management units working and generating large amount of information held in separate silos. Thus, creating difficulties in information sharing, with a ripple effect on the management of common, chronic, communicable and lifestyle diseases between hospitals, as well as among various departments in the same hospital. Poor communication has been implicated in many instances of inefficiencies in the health sector, with even well-rehearsed procedures to combat emergencies and epidemics suffering major hiccups due to the general lack of good communication among health practitioners. These challenges can, however, be minimized through eHealth, the implementation of which is presently largely uncoordinated, not based on existing standards and focused on small components of healthcare delivery, rather than being system- or organisation-wide.

The adoption of eHealth in Ghana has been slower than expected, compared with the fast adoption of ICT in other important areas of business and social life. eHealth is still at the neophyte stage, with most hospitals only partially electronic.[28] The low adoption of eHealth in Ghana has been judged to have had dire consequences on health provision in this modern era. First the apparent lack of co-ordinated information makes the operation of the National Health Insurance Scheme (NHIS) difficult. The NHIS was introduced by the government in 2003 to improve access to healthcare in the country. With poverty as a critical factor affecting access of healthcare provision, the NHIS contributed immensely to sustainable development goals by providing the opportunity for poor citizens to access quality healthcare at very little or no cost. However, after increased participation by citizens, the National Health Insurance Authority (NHIA) has had a daunting task to validate huge claims submitted by healthcare providers for payments.[36] Without transparent health record systems in the majority of healthcare institutions, fraudulent claims have become the norm and this has gradually crippled the overall efficiency of the scheme.

Second, the poor use of IT also affects the quality of the healthcare provided to patients. The majority of health providers continue to use ordinary paper folders for patients.[37] Patients are required to locate their

folders at the records office before they are attended to. With the large numbers of records in major hospitals in the Greater Accra Region such as Korle-Bu Teaching Hospital and Tema General Hospital, patients spend a considerable amount of time on this exercise. In several cases, loathsome queues are formed in front of the records office, and this delays healthcare delivery.[38] There are several instances were emergency patients have died as a result of this practice. This makes the adoption of eHealth critical to the continued improvement of healthcare in Ghana.

Third, in 2010 the MoH launched an eHealth strategy to chart a clear path for e-health adoption in the country. The report outlined four key strategies that will ensure the full implementation of eHealth:

1. Streamlining the regulatory framework for health data and information management;
2. Building sector capacity for wider application of eHealth solutions in the health sector;
3. Increasing access and bridging equity gap in the health sector through the use of ICT; and
4. Building a paperless records and reporting system.[35]

These strategies will see the light if eHealth is fully embraced and used by health care providers and professionals. With several inhibiting factors, eHealth adoption will not increase as envisaged. This makes the study of adoption factors critical to the national strategy and efforts.

Theoretical background

Empirical studies on eHealth have focused mostly on developing standards as well as the security, privacy and confidentiality concerns associated with eHealth adoption.[30] This focus has invariably shifted attention away from core issues pertaining to the level of adoption, and the possible factors that drive adoption of eHealth in Ghana.

The objective of this study was to examine the factors driving the adoption of eHealth technologies in health centres and institutions in the Greater Accra Region.

The study's theoretical roots are derived from the Diffusion of Innovation Theory, which was propounded by Everett Rogers to explain the uptake of innovation in general (and technology in particular) by individuals and institutions in Ghana.[39] The Diffusion of Innovation Theory is recommended in health informatics studies.[40] Zhang et al. recommended the theory as useful for conceptualising the adoption of technology within the context of eHealth[41]; hence, it was adopted as the underpinning theory in this study. Rogers (p. 5) defines innovation as 'an idea, practice, or object that is perceived as new by an individual or another unit of adoption' and diffusion as 'the process by which an innovation is communicated through certain channels over time among the members of a social system'.[42] Therefore, the Innovation Diffusion Theory argues that 'potential users make decisions to adopt or reject an innovation based on beliefs that they form about the innovation' (Agarwal, 2000,[43] cited in Lee et al.,[44] p. 9). Thus, individual and institutions' adoption of technology is based on innovation decision model, which Rogers defined as 'the process through which an individual or any decision-making unit passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making decision to adopt or reject, to implementation of the new idea and to the confirmation of this decision[45] (Shea et al., 2006;[46] cited in Tagoe,[39] p. 58).

Robinson and Tagoe describe the variables in the theory as follows:

1. **Relative advantage:** According to Robinson,[47] the greater the extent to which an innovation is perceived to be better than an existing one, the more rapidly it is adopted.
2. **Compatibility:** This is the degree to which an innovation is perceived as being consistent with the values, past experiences, and needs of potential adopters.[39]
3. **Observability:** Robinson suggests that the more individuals, groups or institutions can envision or describe an innovation, the more likely they are to adopt it.[47]
4. **Trialability:** According to Rogers,[45] 'trialability' represents the extent to which an innovation could be experimented on within a shorter time frame.
5. **Complexity:** This is the degree to which an innovation is perceived as difficult to understand and use.[39]

Citing Rogers,[45] Robinson asserts that these five qualities determine between 49% and 87% of the variation in the adoption of new technology.[47] The next section discusses the research method.

Methodology

The study adopts the quantitative survey approach as its research design. The research population for this study was health professionals and managers in the Greater Accra Region who are users and potential users of eHealth technologies. According to the Ghana Health Services, there were 456 health institutions in the Greater Accra Region at the time pf the study.

For this study, only those health institutions that fall under Private, Government and Quasi-Government designation, as well as those that offer direct health care, were considered in the study population. In other words, district and regional health directorates were not considered, since they do not offer direct health care to patients. The respondents in the study were therefore selected from the following broad categories: (a) Community Health Improvement Services (CHIPS); (b) clinics; (c) health centres; (d) maternity homes; (e) hospitals; (f) teaching/university hospitals; (g) polyclinics; and (h) psychiatric hospitals. The study sample (82 institutions) was therefore selected from a population total of 456 health institutions (as seen in Table 1).

The study sample was selected using Yamane's formulation to determine sample size. This formula is given as $n = N/1+N\ (e)^2$ where N is the total number of households and e is the margin of error (assumed to be 10% for this study). With a population of 456 health institutions, 82 institutions were considered representative based on Yamane's formula. Thus, the sample for the study consisted of 82 health institutions, representing approximately 18% of the targeted healthcare institutions in Table 1.

Researchers administered 20 questionnaires to each of the 82 institutions, bringing the total sample size of responses to 1640. A sample size of 20 responses per health institution was considered adequate due to the fact that 20 responses was best fit to represent the views of all health staff in each institution with respect to our study, which is not generalized to a larger population. With the sample size representing approximately 19% of the total population size, we determined 20 responses per 82 institutions to be a satisfactory size. According to Martínez-Mesa et al.,[48] a very large sample has the potential of complicating the study, and its associated costs, thereby making research and analysis unfeasible. Thus, the purposive sampling method was the main non-probability sampling method used, while the cluster and the simple random sampling method were the probability sampling methods used in the selection of health institutions and two categories of healthcare workers – doctors and nurses. The study used questionnaire as its main data-gathering instrument. The questionnaire was designed to fit the scope of this particular study by gathering quantitative data. The questionnaire was designed by all authors of the study in consultation with a health service research expert as well as observing eHealth research surveys focused on other countries so as to specifically tailor questions to the Ghanaian context, while capturing the core focuses of internationally accepted eHealth technology features. The data gathering instrument (questionnaire) was pre-tested at Tema General Hospital in February 2014, and finally printed and distributed in person as well as by email (in document format to those who found this format convenient) to doctors and nurses within the Greater Accra Region. Since the questionnaires used the purposive sampling technique, and were handed over to each health centre's administration to be given to 20 respondents, it is impossible to determine the response rate. The core areas covered by the questionnaire include questions on assessing the health workers' level of knowledge within the domain of eHealth and the use of such technologies in their place of work, the relative advantages of eHealth, complexity of eHealth usage, just to name a few.

Table 1. Population and selected sample size.

Type	Health Institutions in Greater Accra	Research Sample Size (Selected)
CHIPS (Community Health Improvement Services)	5	1
Clinics	276	50
Health Centre	23	4
Maternity Homes	50	9
Hospital/Teaching and University Hospitals/ Psychiatric Hospitals	94	17
Polyclinics	8	1
Total Number of Health Institutions	456	82

Source: Ghana Health Services – 2017.
CHIPS, Community Health Improvement Services.

Data obtained from the questionnaires were analysed using the Statistical Package for Service Solutions (SPSS) software, version 21. Phase one of the analysis involved descriptive univariate analysis, where frequencies and percentages were derived to describe the social and demographic characteristics of the respondents as well as those of the health institution. The author wrote a computer programme using the SPSS syntax commands in undertaking advanced analysis of the data.

A standard multiple regression and a logistic regression analysis were undertaken to determine health centre/firm characteristics, and socio-economic characteristics of responding health managers and professionals that significantly influence the adoption of eHealth devices. Dewsburys describes eHealth devices as devices developed to promote health by using prompts,

aiding in the storage of health activities and also provide information on users' healthy lifestyles.[49] The multiple regression and the logistic regression models used various classifications of adoption of eHealth technologies as the dependent variable. The independent variables were as follows:

1. Specialization of the health institution – gynaecology/obstetrics, surgery and paediatrics;
2. Practice level of the health institution – primary, secondary or tertiary health care institution;
3. Ownership of health institution – private, government or quasi-government;
4. Gender of health care manager/professional;
5. Age of health care manager/professional;
6. Educational status of healthcare manager/professional;
7. Years of practice of the health care manager/professional.

According to Ahiadeke,[50] the logistic regression model can be used to predict a dependent variable given either a continuous and/or categorical explanatory variable. The analysis can also give an indication of the relative significance of independent variables relative to the dependent variable under investigation.

The probability of health managers or professionals adopting eHealth devices or systems is related to their personal characteristics as well as those of the institution. Adopting the Pindyck and Rubinfield (1981)[51] cumulative logistic probability model, the extent of adoption (P_i), where P_i is the probability that an individual has ever used an eHealth device or system, is represented as follows:

$$\log(P_i/1–P_i) = \alpha + \beta_1 x_1 + \beta_2 x_{2+\cdots+}\beta_k x_k \quad \text{(Equation 1.0)}$$

As explained above, the probability of health managers or professionals adopting eHealth devices or systems is related to their personal characteristics as well as those of the institution.

Analysis of findings

The results were analysed in two strands: using individual characteristics and using institutional characteristics. Both analyses were done because adoption of different factors influence adoption at these levels. The respondents' socio-economic information entails their gender, age, educational status, and the institutional place of work.

The majority of the respondents in study were aged between 25 and 30 years, and males were more represented – males constituted 50.22% while females constituted 49.78% of respondents. Slightly above 50% of respondents had been working in their respective institutions for 1–3 years. The largest group of respondents (47.7%) were degree holders. The second largest group were medical doctors, comprising 29.8% of respondents. The majority of respondents worked in private practice, i.e. private clinics and maternity homes, followed by those who worked in private hospitals, which constituted 54.4% of the respondent's places of work. For further information, see Table 2.

A multiple regression analysis was undertaken to determine health centre or firm characteristics and socio-economic characteristics of health managers and professionals that significantly influenced the adoption of eHealth devices. The multiple regression model used for the study was as follows:

$$\begin{aligned}\text{EXTENTOFADOPTIONOFDEVICES} &= \text{B0} + \text{B1 GYNECOLOGY} + \text{B2 PEDIATRICS} \\ &+ \text{B3 TERTIARYPRACTICE} + \text{B4 PRIVATE} \\ &+ \text{B5 GENDER} + \text{B6 AGE} + \text{B7 EDUCATION} \\ &+ \text{B8 YEARS} + \text{U}\end{aligned}$$

where:

EXTENTOFADOPTIONOFDEVICES was the average scoring index of adoption of the seven eHealth devices using a 0–5 Likert scale with the highest value of 5 being the maximum value of adoption of a eHealth device and 0 representing total lack of use of the device;

GYNECOLOGY was a dummy variable for health centres that had gynaecological services, with 1 representing presence of these services and 0 absence of these services;

PEDIATRICS was a dummy variable for health centres that had paediatrics services, with 1 representing presence of these services and 0 absence of these services;

TERTIARYPRACTICE was a dummy variable, with 1 representing health centres, which were referral, service institutions such as the university hospitals and zero otherwise;

PRIVATE was a dummy variable with a value of 1 for privately owned and managed health centres and 0 for publicly owned health centres;

GENDER was a dummy variable denoting the sex of the responding health manager/professional, with 1 for males and 0 for females;

Table 2. Summary of socio-economic characteristics of responding healthcare managers and professionals.

Item/group	Percentage
Age group	
25–30	42.0
31–35	16.8
36–40	0.0
41–45	33.0
46–50	0.0
51 years and above	8.2
Years in Practice	
1–3 years	50.3
4–6 years	35.7
7–9 years	14.0
Educational Level	
Diploma	9.6
Bachelor degree	47.7
Master degree	14.2
Medical Doctor	28.5
Current Place of Work	
Hospitals Private practice	27.3
Health Centres/Polyclinics	18.1
Government hospital/Teaching Hospitals	18.7
Quasi-Public Hospitals/Clinics	7.8
Private Clinics/Maternity Homes	28.1

Source: Derived from survey data, 2014.

AGE was the age group that the responding health manager/professional belonged to. This variable took five values from 1 to 6, representing increasing average age of respondents;

EDUCATION was the educational attainment level of the responding health manager/professional, with 1 representing diploma holders, 2 representing those with completed Bachelor degrees, 3 representing those with completed Master degrees and 4 denoting those who were classified as medical doctors and/or had doctorate degrees;

YEARS was a variable denoting the number of years that the responding health manager/professional had worked at the health centre or organisation; and

U was the error term initially assumed to have a zero mean and constant variance.

The results of multiple regression analysis of factors influencing the level and degree of adoption of eHealth devices showed that the overall power of the model was very high, as measured by the 67.2% R^2 and the 66.4% adjusted R^2 and the statistical significance of the whole model at the 0.000 levels (Table 3). The variance inflation factor (VIF) of all eight independent variables was low, and all were below the critical value of 10.0 as suggested by Gujarati (p. 362),[52] which indicates the absence of the problem of significant multicollinearity.

The results of the analysis indicate that institutional factors, such as being a tertiary or referral practicing institution and being a private health practice, were significant at positively influencing the adoption of eHealth devices among health managers and professionals. These results could be explained from the resources available to tertiary practice or referral institutions, such as Korle-Bu, the Ridge Hospital, Nyaho Clinic, and similar institutions relative to primary or secondary health institutions. The relatively high resource availability, as a result of their referral or specialised status, influences their decision to adopt eHealth in their operations. Similar arguments could be made for either being a private or public health institution. Private health institutions generate all their income from patients, and therefore have the incentive to institute eHealth to be more efficient and have a shorter turnaround time in order to be more profitable. Public health institutions, on the other hand, generate most of their income from government subventions and are not quite motivated to employ eHealth devices to be more efficient since those subventions are not tied to delivery or efficiency. In addition, the decision on whether to adopt the eHealth devices or not has to go through a bureaucratic process in public institutions, which might delay such decisions whereas similar hindrance would be low in private health centres.

Other results of the analysis indicate that individual factors, such as being female, being young, having a higher education and having spent more years in the professional role were statistically significant in influencing the adoption of eHealth devices among health professionals or managers. These suggest that the characteristics of the health practitioners are pertinent to the adoption of eHealth in various health

Table 3. Results of the multiple regression analysis of factors influencing the adoption of eHealth devices based on both firm characteristics and those of the responding manager/professional or manager.

Explanatory Variable	Parameter estimate (B)	Standardized parameter estimates (BETA)	Student t value	Probability level of significance	VIF
Constant	−1.550	0.000	−5.671	0.000*	0.000
Gynaecology	−0.032	−0.015	−0.472	0.637	1.073
Paediatrics	0.135	0.066	1.578	0.116	1.738
Tertiary practice	1.589	0.774	18.015	0.000*	1.855
Private	2.428	1.346	15.514	0.000*	7.568
Gender	−0.650	−0.375	−7.172	0.000*	2.746
Age	−0.298	−0.480	−7.028	0.000*	4.691
Education	0.938	1.313	15.078	0.000*	7.623
Years	0.103	0.110	2.132	0.034*	2.657

Notes: Sample size was 338.
The real value (R2) whole the adjusted R2 value was 66.4%.
*Parameter was statistically significant at the 5% confidence level used for the study.
Source: Derived from survey data, 2014.

institutions. If health practitioners are not prepared to use a particular tool, every investment made in such an instrument constitutes a wasted effort. It was obvious that the area of specialization of the health institution, whether gynaecology, paediatrics or surgery, was not statistically significant at influencing the adoption of eHealth devices and systems.

Overall, the five factors that has the most influence the adoption of eHealth devices, ranked in ascending order, were:

1. Being private;
2. Higher education;
3. Being a tertiary practice institution;
4. Age, i.e. being young; and
5. Gender, i.e. being female.

This affirms that any policy intervention intended to increase eHealth adoption among health institutions in Ghana should focus on these factors first before considering others. The other factors, in ascending order, were years in practice, and specialist status, i.e. paediatrics or gynaecology.

A multiple regression analysis was undertaken to determine health centre or firm characteristics, and socio-economic characteristics of health managers and professionals that significantly influenced the adoption of eHealth systems. The multiple regression model used for the study was as follows.

$$\begin{aligned}\text{EXTENT OF ADOPTION OF SYSTEMS} &= \text{B0} + \text{B1 GYNECOLOGY} + \text{B2 PEDIATRICS} \\ &\quad + \text{B3 TERTIARY PRACTICE} + \text{B4 PRIVATE} \\ &\quad + \text{B5 GENDER} + \text{B6 AGE} + \text{B7 EDUCATION} \\ &\quad + \text{B8 YEARS} + \text{U};\end{aligned}$$

where

EXTENTOFADOPTIONOFSYSTEMS was the average scoring index of use of the 13 eHealth systems using the 0–5 Likert scale, with the highest value of 5.0 being the maximum value of use of an eHealth device and 0 representing total lack of use of the device;

GYNECOLOGY was a dummy variable for health centres that had gynaecological services, with 1 representing presence of these services and 0 absence of these services;

PEDIATRICS was a dummy variable for health centres that had paediatrics services, with 1 representing presence of these services and 0 absence of these services;

TERTIARYPRACTICE was a dummy variable, with 1 representing health centres that were referral, service institutions such as university hospitals and zero otherwise;

PRIVATE was a dummy variable, with a value of 1 for privately owned and managed health centres and 0 for publicly owned health centres;

GENDER was a dummy variable denoting the sex of the health manager/professional, with 1 for males and 0 for females;

AGE was the age group that the responding health manager/professional, with 1 for males and 0 for females. This variable took five values from 1 to 6, representing increasing average age of respondents;

EDUCATION was the educational attainment level of the responding health manager/professional, with 1 representing diploma holders, 2 representing those with completed Bachelor degrees, 3 representing those with completed Master degrees and 4 denoting those who were classified as medical doctors or had doctorate degrees;

YEARS was a variable denoting the number of years that the responding health manager/professional had worked at the health centre or organisation; and

U was the error term initially assumed to have a zero mean and constant variance.

The results of multiple regression analysis of factors influencing the level and degree of adoption of eHealth devices showed that the overall power of the model was moderately high, as measured by the 39.6% R^2 and the 37.8% adjusted R^2 and the overall statistical significance of the model (Table 4). The VIF of all eight independent variables was very low (all <3.0) and were all below the critical value of 10.0 suggested by Gujarati (p. 362)[52] for the absence of the problem of significant multicollinearity.

The results of the analysis indicate that institutional factors such as specialisation of the health institution (being in paediatrics or not) and being a private health practice were significant at 5% confidence level in influencing the adoption of eHealth systems among health manager and professionals. Paediatrics covers childcare, and the handling of delicate and vulnerable children motivates professionals to have the option of eHealth systems to aid in their diagnosis and treatments. Moreover, as explained earlier, private health care institutions have a higher motivation to employ eHealth systems in their health care operations than their public counterparts. Again, it must be emphasised that the decision-making process in a private health set up is shorter and relatively easier and more flexible relative to the bureaucratised public health set up.

The results of the logistic regression analysis of factors that influence the overall adoption of eHealth devices and systems where the overall power of the model was high based on the 83.5 count and R^2 representing the proportion of correct classification using the model. The results of the analysis indicate that institutional

Table 4. Results of the multiple regression analysis of factors influencing the adoption of eHealth systems based on both firm characteristics and those of the responding professional or manager.

Explanatory Variable	Parameter estimate (B)	Standardized parameter estimates (BETA)	Student *t* value	Probability level of significance	VIF
Constant	2.968	0.000	4.913	0.000*	0.000
Gynaecology	0.110	0.032	0.586	0.558	1.121
Paediatrics	1.579	0.392	5.771	0.000*	1.753
Private	−1.832	−0.500	−6.320	0.000*	2.384
Gender	−0.815	−0.259	−3.450	0.001*	2.142
Age	−0.186	−0.208	−2.404	0.017*	2.855
Education	0.537	0.276	3.402	0.001*	2.504
Years	0.116	0.076	1.115	0.266	1.777

Notes: Sample size was 237.
*Parameter was statistically significant at the 5% confidence level used for the study.
Source: Derived from survey data, 2014.

factors such as specializing in paediatrics, being a tertiary or referral practicing institution and being a private health practice were significant in influencing the adoption of eHealth devices among health professionals or managers. The results of the analysis indicated that other factors such as being male, being young and having a higher education, and having spent several years in the professional role were significant in influencing the adoption of eHealth devices among health professionals or managers.

Discussion

Lehman et al.[53] argued that if health care providers resist change, or do not possess attributes necessary for change (e.g. adaptability and growth-orientation), the change process is less likely to proceed. This makes it imperative to investigate the attributes or the characteristics of the healthcare provider that positively or negatively influence the adoption of eHealth. Most of the professional characteristics that influence eHealth adoption had a low-to-moderate influence on eHealth adoption. The human resource challenge in the deployment of eHealth has been noted by the MoH in Ghana.[35] The ministry emphasised that one of the biggest challenges to eHealth implementation borders on capacity issues, as most health institutions lack qualified, trained health care professionals at all levels.

The study assessed how professional factors such as gender, age and education, and years of experience play in the adoption of eHealth devices and systems among health professionals or managers. The study revealed that:

1. Professional factors such as:
   a. Being female;
   b. Being young;
   c. Having a higher education; and
   d. Having spent several years in the professional role were significant and positively influence the adoption of eHealth technologies among health professionals or managers (see Table 3).

2. Rank wise, the multiple regression performed under the adoption of eHealth devices and systems both confirmed that:
   a. Being a private practitioner,
   b. Having a higher education,
   c. Being young, and
   d. Feminine gender were factors that affected adoption most, when considered in an ascending order.

Thus, any policy targeted at integrating eHealth should take the indicated professional characteristics into consideration to increase its likelihood of adoption (see Table 4).

Table 5. Results of the logistic regression analysis of factors influencing the overall adoption of eHealth technologies based on both firm characteristics and those of the responding managers and professionals.

Explanatory Variable	Parameter Estimate (B)	Student *t* value	Probability level of significance
Constant	−8.391	105.843	0.000*
Gynaecology	−0.475	2.418	0.120
Paediatrics	−1.120	10.802	0.001*
Tertiary practice	3.657	82.885	0.000*
Private	2.941	69.865	0.000*
Gender	1.500	21.017	0.000*
Age	0.460	14.877	0.000*
Education	0.800	32.478	0.000*
Years	0.743	25.167	0.000*

Notes: Sample size was 533.
*Parameter was statistically significant at the 5% confidence level used for the study.
The proportion of correct classification of choice was 83.5% (Count R^2).
Source: Derived from survey data, 2014.

Besides the location of the health institutions, this only had a low influence on the adoption of eHealth, other factors such as:

1. Patient age range;
2. Single/multi-specialisation;
3. Practice levels;
4. Availability of ICT infrastructure;
5. Practice size;
6. Management commitment in supporting change;
7. Financial constraints and IT support influence the adoption of eHealth (Table 5).

It is apparent from the responses that respondents regard the institutional characteristics pertinent in the adoption of eHealth relative to their own characteristics. This is worth noting because, notwithstanding how savvy one might be with ICT, if the institution does not encourage its use, it will be of no relevance. However, if an ICT system has already been set up and running, employees have no choice than to fall in line in using it. The institutional role notwithstanding, Anderson observed that eHealth implementation at

that level is challenged by high cost of acquisition, especially at the initial stage, security, privacy and confidentiality concerns and lack of technical skills.[23]

Vishwanath and Scamurra synthesised the relationship between the personal characteristics and the medical practice characteristics when they attributed the low adoption rate of eHealth to both macro-level factors (e.g. supportive policies) from the perspective of the public, health care organization, and system, and micro-level barriers from the perspective of health care providers (e.g., physicians' perception about technological complexity).[25] In essence, they argued that just addressing one of the characteristics without adequate attention paid to the other does not sustainable eHealth implementation.[54]

Other factors that influence eHealth adoption, as identified by Li et al., [6] include performance expectancy, effort expectancy and other facilitating or inhibiting conditions. With respect to the performance expectancy variables, it was observed that only perceived usefulness and need had an influence of eHealth adoption while the rest – computer self-efficacy, job fit (designed to simplify my work), cost saving – had a low effect on the adoption of eHealth. Similar observations were made with respect to the variables that fell under efforts expectancy, where only perceived ease of use had an influence of eHealth adoption while all the other factors had a low influence on adoption. It is therefore apparent the various healthcare professionals consider the perceived usefulness and ease of use of the eHealth platform – particularly in Ghana and developing economies – important in the adoption of eHealth.

Among the other factors, end user involvement in the design of eHealth devices and tools, interoperability (the ability to make systems and organisations work together) and professional autonomy had moderate influences on eHealth adoption while patient privacy concerns, legal concerns, and time cost had low influence. In fact, interoperability has been observed by the MoH,[35] Wager et al.,[35] WHO,[27] and the Rockefeller Foundation,[3] as one of the major factors that influence eHealth adoption as well as being the ultimate objective of eHealth adoption. DeNardis points out that interoperability could also be a major barrier to eHealth adoption.[24] This refers to the fact that the inability of healthcare information systems to interoperate to share information, and the huge number of available eHealth standards, with many of them competing and overlapping, and some even contradicting one another, hinders the effectiveness of any eHealth device or system adopted.

Findings in this study contribute to the insufficient literature on factors that drive eHealth adoption in Ghana as well as sub-Saharan Africa. In addition, this study recommends the private sector's involvement in spearheading an eHealth revolution within the sub-region so as to be an immense benefit to alleviating the burden on governments and their inadequacy.

Conclusions

In concluding the study, we first disclose limitations to this research, which is primarily the restriction of coverage to only the Greater Accra region where the capital is situated. Hence, for further studies, an extension into all 10 regions of Ghana is highly recommended.

In this study, Rogers' theory of innovation diffusion has been beneficial in analysing the diffusion of eHealth technologies in Ghana.[42,45] In line with the theory, the findings of the study reiterated the postulation that a lower socio-economic profile has a negative influence on the adoption of eHealth technologies in Ghana.

Multiple and logistic regression analysis showed that gender, age and education, and years of experience of medical practitioners/managers within the institution have a significant influence on the adoption of eHealth devices and systems. The study also found that most of the medical practice characteristics had a moderate uphill influence in the adoption of eHealth systems and eHealth devices in health institutions in the region. This was confirmed by both multiple and logistic regression analysis, which established that institutional factors such as being a tertiary of referral practicing institution and being a private health practice significantly influences the adoption of eHealth devices while the specialization of the health institution (being in paediatrics or not) and being a private health practice significantly influences the adoption of systems.

The study further observed that performance expectancy variables and effort expectancy variables had a moderate-to-low association of eHealth adoption while the other factors had a low association on eHealth adoption among the health institutions. When ranked together, it is apparent that the medical practice characteristics and other inhibiting/influencing characteristics have a high association with eHealth adoption in that order. The other three characteristics, i.e., health care manager characteristic, performance expectancy and effort expectancy only have low association with the adoption of eHealth devices and systems.

The study concludes that the medical practice or health institution characteristics, health care manager characteristics and other inhibiting/influencing characteristics have a high association with eHealth adoption, while the factors related to performance expectancy and effort expectancy have only low levels of association with the adoption of eHealth devices and systems.

With respect to implications for practice, this study recommends that the MoH of the Republic of Ghana

employ an efficient approach to roll out eHealth system adopting programmes into health institutions. This is feasible through proper budgetary allocation, leveraging on favourable professional factors to institute eHealth in the sector. Also, by embarking on programmes that integrate software into a singular operational entity that will ensure that information is not held in silos or stand-alone departments. One final recommendation to policymakers within the health service sector is the inclusion of ICT programs in the academic syllabus of tertiary health education with real-world practical applications.

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