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Factors Affecting the Successful Adoption of e-Health Cloud Based Health System From Healthcare Consumers' Perspective

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ABSTRACT Cloud computing in healthcare has witnessed a major development in recent years due to its remote access capabilities among others. Studies have shown that it has attracted great attention in the field of healthcare. However, research studies show a number of healthcare consumers are yet to accept the technology, especially in developing countries due to reasons, such as the data security and the improper utilization of available information and communication technologies (ICTs) in healthcare. This paper therefore aims to identify factors affecting healthcare consumers' attitude toward the adoption of the cloud-based health center. Questionnaires were administered to 465 respondents in four locations in Benue, Nigeria with 76.9% response rate. The analysis of the data was conducted with statistical package for social science (20.0), factor analysis, and LISREL (9.30), was used to determine the structural path model. Using the social technical design approach, we developed the cloud-based health center which will provide access to healthcare services remotely to rural communities and reduce the cost/time of medical healthcare delivery when implemented into the Nigerian healthcare system. The results show that performance expectancy ($\beta = 0.31$ and $t = 5.80$), effort expectancy ($\beta = 0.19$ and $t = 3.90$), social influence ($\beta = 0.21$ and $t = 3.95$), facilitating conditions ($\beta = 0.22$ and $t = 4.82$), data security ($\beta = 0.15$ and $t = 3.07$), and information sharing ($\beta = 0.11$ and $t = 2.53$) had a significant impact on the behavioral intention of healthcare consumers. However, cloud-based health knowledge ($\beta = 0.09$ and $t = 1.49$) was found to be statistically not significant. With these findings, healthcare policy makers must think carefully before the implementation of cloud-based health center. Otherwise, the integration will continue to create a challenge.

INDEX TERMS Behavioral intention, cloud, e-health, Nigeria, remote access.

I. INTRODUCTION

The worldwide human population has shown an enormous growth in the last decade, while the pace of global economic development is maintained, great advances have been made in the production of food, in the provision of heat, light and shelter, and healthcare services. On the other hand, there have been challenges of inadequate health institutions and shortage of healthcare professionals in some countries [1]. In line with these needs, realizing effective ways to handle these issues has become a crucial objective. These developments are greatly missing in some of the developing countries as many healthcare service providers prefer to practice in the urban developed cities rather than in the rural areas. Accordingly, healthcare services are scarce in rural, remote villages due to the fact that providing health care to rural communities is exhausting and challenging because of the distance [2]. In addition, because the rural community dwellers lack basic education, they often prefer traditional medicine/healers (which has no specific dosage) instead of going to a proper health institution where they can be treated promptly. Therefore, the death rate among rural community dwellers is very high compared to those who live in urban cities since they have a quicker access to better health care services. Since most health institutions are situated in the urban regions, the rural community dwellers have to travel for a very long distance to urban regions to get treated for any health little challenge: a situation which results in medical tourism. If this issue must be curtailed, then special attention

must be given to primary health centers since they are closer to the rural populace and pivotal to the administration of healthcare for remote communities [3].

The Federal Republic of Nigeria is a fast developing country with an estimated population of over 180 million and a growth rate of 2.8% [4]. Therefore, prompt access to health care services is not easy since the percentage of the general population is higher than the available capacity of service providers and facilities. At the moment, the Nigerian health care system is divided into three separate categories, all operating on a different system, making referrals and prompt access to patient data nearly impossible. These categories include: the primary health care (PHC) made up of primary healthcare centers, the secondary health care (SHC) made up of the general hospitals and state hospitals, and finally, the tertiary health care (THC) made up of the federal medical centers and the national hospitals. They are all tasked with the provision of appropriate health care services for the people. While the federal government sets the health care policies, it ensures that the policies are maintained by the PHC, SHC and THC. The THCs are furnished with adequate healthcare facilities along with a good supply of electricity and internet, whereas, the PHCs and the SHCs on the other hand, have little or no access to required health care infrastructure and the internet. Electricity supply is even epileptic. These, notwithstanding, the speedy availability/affordability of smart phones and alternative source of power supply (e.g. power generator) has enhanced people to no longer rely on the public source of power and internet, having the option to individually subscribe to internet services from an internet service provider (e.g. MTN, Glo-mobile network, Etisalat, Airtel etc.) who are readily available. There is a need for an effective, efficient and robust healthcare system which will be beneficial to both stakeholders, service providers and consumers. It is also crucial for the system to be remotely accessible so that the above mentioned problems could be minimized or totally eliminated.

Better utilization of information and communication technologies (ICTs) in healthcare offers a good solution to the health services issue [5]. ICTs, which is seen in developing countries as a catalyst for rapid socio economic development, could be a viable tool in health care transformation. These technologies could meet the needs of patients, service providers and stakeholders. Cloud computing in healthcare has seen a major development in recent years [6] owing to its remote access capability, software on demand and high storage functionality among others. According to [7], the cloud technology, which provides access to services on the go is an interconnection of computers with software running and accessed from a central server. As a result of the over demand of healthcare services, it is ideal that cloud computing through the adequate utilization of ICTs could ease the pressure on the available health facilities and healthcare professionals. However, it is an important process to verify the acceptance of this technology by healthcare consumers, which is a revolutionary advancement for the healthcare sector. Why is the acceptance of this technology by healthcare consumer necessary? It is necessary because the success or failure of cloud based health center technologies depends on the acceptance of this technology by consumers [8].

Over the years, research in this field has shown that the successful adoption of a technology and its subsequent use depend on the behavior of consumers as noted in [9]. According to [10], technology acceptance model (TAM) was developed by Davis in 1989 to describe the acceptance of an information system by users. He postulates that an acceptance of technology by users is grounded on two things: perceived usefulness of the technology and its ease of use. It is also likely that the technology will not be accepted due to reasons such as data security [11], information sharing [12] and so on.

There has been great improvement in the utilization and use of modern technologies in the health care systems. Studies by [13]–[15] have all shown the advantages of cloud based health systems (CBHS) in health. However, quite a large number of consumers are yet to really understand and accept the technology, especially those in developing countries such as Nigeria. This acceptance is determined by either the results of data security [16], IT infrastructure availability [17], the utilization of available ICTs in healthcare and perhaps the awareness of the technology.

The aim of this research is to determine the factors that affect the acceptance of cloud based health systems (CBHS) by healthcare consumers in Nigeria as well as propose a system model which will enhance remote access to healthcare facilities, and which will also prevent unnecessary delay in the delivery of health care services. We believe that the proposed system can provide solutions to the aforementioned issues. These factors are examined in order to measure the intention of healthcare consumers by using a questionnaire in the context of cloud based systems using the unified theory of acceptance and use of technology extended by integrating some new constructs: cloud based health knowledge, data security, and information sharing, which are specific to our study. To this end, the following research questions have been developed:

a. What are the factors that influence the acceptance of CBHS by healthcare consumers?
b. Is there any correlation between data security and information sharing? If there is a relationship between data security and information sharing, does the relationship influence the behavioral intention of health care consumers in the use of the CBHS?
c. How can healthcare delivery be accessed remotely in Nigeria?

Our major contribution therefore, is to determine significant factors driving from our findings that can be of positive values to healthcare managers and policy makers in developing/third world countries. In addition, the purpose of the study is to develop a suitable framework by building on related theoretical foundations of previous studies (Unified Theory of Acceptance and use of Technology 2 - UTAUT2) and extending these constructs to specific areas crucial to this study.

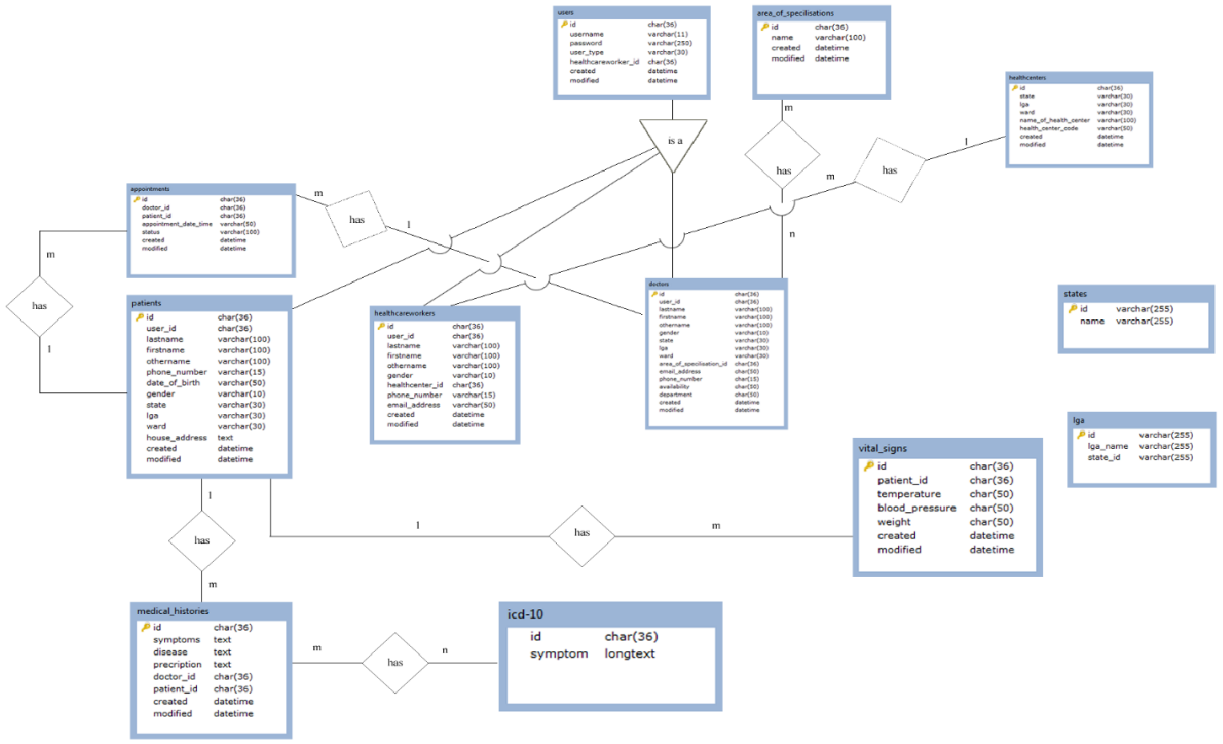

FIGURE 1. Proposed CBHS ERD diagram.

As a result, contribute to the existing literature on the factors of CBHS acceptance. Moreover, our study, which is a relatively new concept, will reveal the dynamics of healthcare cloud implementation in Nigeria health care system. By doing this will help the government, management, service providers and authorized institutions to strategically make adequate and efficient plans on efficient healthcare service delivery. This will also bring about real and on time healthcare service delivery, adequate resource distribution and enhance the working capacity of healthcare professionals and self-Medicare. This research has implications for the future healthcare service delivery in Nigeria.

II. ACCEPTANCE OF CLOUD BASED HEALTH TECHNOLOGY

Different models are considered in various studies in order to realize the technology acceptance, such as TAM, the Theory of Reason Action (TRA), UTAUT [18] & [19] and Theory of Planned Behavior (TPB) [20].

TAM is a well-known model to identify the factors which have a positive effect on the acceptance of information system technology. Perceived usefulness (PU) and perceived ease of use (PEoU) are considered as the two main factors that are related to the acceptance of information technology (IT). In addition, social influence to use IT, facilitating conditions and motivation has also been included as predictors of acceptance in the literature [21]. However, it was discussed in [22] that classic TAM is not suitable for healthcare IT acceptance determination due to the inconsistencies between the operation of TAM constructs and the unique nature of healthcare.

While behavioral attitude and subjective norm are considered in TRA, performance expectancy, effort expectancy, social influence, and facilitating conditions are included in UTAUT studies to identify the factors for the motivation of users using information IT.

Several research studies are conducted in the literature for the application of cloud based system in the healthcare sector. For instance, cloud based health clinics are developed in [15], [21], and [23] for the identification, treatment and monitoring of non-communicable diseases in remote communities. On the other hand, a cloud based blood pressure system, for physicians, is proposed in [24] to improve the health conditions of hypertensive patients in Taiwan.

Sailunaz [25] proposed a cloud based health care system by using speech recognition of the users in Japanese language with a tested 97.30% accuracy. Enhanced cloud-based privacy scenario is utilized in [17] to overcome security and privacy concerns by authorizing users to configure their own privacy details before uploading their data to the cloud.

A. PROPOSED CLOUD BASED HEALTH SYSTEM MODEL

CBHS model is proposed as depicted in Figure 1 that could be remotely accessible in real time while eliminating the need of medical tourism, undue pressure on healthcare professionals, patient waiting time and reduced death rate.

We believe that the proposed system could be able to address the issues of people and process according to [26] in the design/development of health information technology (HIT). The socio technical design approach is deemed adequate in the design of healthcare information system (HIS) as such, we adopted the study of [27] which list socio technical IS design science approach into four basic phases: (1) problem identification scope and desired result (2) reviews of theories and data (3) refining/proposing design theories (4) design theory testing.

CBHS is a database driven application that works off a client-server architecture. It uses a MySQL database to store data, and implement PHP and other associated technologies (JQuery, HTML, CSS, and Ajax) as its server side and frontend scripting language. Access to the application is via a single login form for all the users. The application automatically directs different type of users to their respective interface according to the functionalities. The major players in the application include the community healthcare workers (HCW), the doctors and the patients. The HCW is the intermediary authority between the doctors and the patients. They are stationed at the community health centers (CHC). Setup, configuration and application parameters are maintained centrally by an IT service support staff (system administrators). The administrator registers doctors (based on availability) and HCWs on the platform. HCW uses internet enabled devices, such as, laptop or mobile phones to access the CBHS services. Proposed application could be introduced to the community to register new patients on the platform. Upon successful registration, the application dynamically and automatically generates a unique username and a default password which is assigned to the patients registered newly to the system. The patients could have a pre-registration by the HCWs at the comfort of their homes or offices using an internet enabled devices, logins into the application using the dynamically generated password and username.

The CBHS is developed to properly identify, diagnose and treat communicable diseases without the intervention of a doctor except when the patient is not satisfied with the outcome of the system diagnosis. Then, such patient can schedule an appointment with the doctor. The application uses the symptoms provided by the user to identify the likely disease(s) the patient is suffering from and displays a description and suggest a possible treatment of the disease(s). With respect to the symptoms provided by the patients, the application matches a doctor who has expertise in that specific field and schedules an appointment with the patient. The patient and doctor could meet up through a HCW using Telepresence (video conferencing) remote one to one communication.

B. RESEARCH HYPOTHESIZED MODEL

The UTAUT is a combination of eight different models, namely: Theory of Planned Behavior (TPB), Theory of Reason Action (TRA), Innovation diffusion Theory (IDT), TAM, Social Cognitive Theory (SCT), Motivational Model (MM), PC Utilization Model (PCUM) and Combined Acceptance of Technology Model and Theory of Planned Behavior. It was modeled with variables which are catalysts to behavioral intention to use a particular technology [28]. In 2012, UTAUT is extended by adding three additional constructs [20]. The constructs in UTAUT2 include: performance expectancy (the degree of benefits gotten from using a particular technology in the performance of named activities by a user), effort expectancy (the degree of effortlessness related with the use of a particular technology by a user), social influence (the level to which a user believes relatives, friends and colleagues influence their use of a particular technology), facilitating conditions (the believe of user's to have the resources and support needed for the use of a particular technology), hedonic motivation (the enjoyment derived from using a certain technology), price value (the burden of cost incurred from the use of a certain technology by the user) and habit (the degree to which behavior is performed automatically). The UTAUT2 also have some moderators such as age, gender and experience.

Based on the above discussions, an extended UTAUT2 is proposed in this research in accordance with the related studies [29] and [30]. Our study did not consider hedonic motivation, price-value, habit and moderating variables. Instead, we introduced new constructs specific to health care information technology adoption and to the research scope; since according to Venkatesh *et al.* [20], it is necessary to extend the UTAUT2 model by adding new constructs, relationships and moderators in circumstances where technology is subjective by defined factors. These new constructs include:

a. Cloud based health knowledge (CBHK): is a motivating factor for the constructs effort expectancy and regarded as a basic necessity for the use of cloud based systems. Studies have shown that developing countries have a higher rate of poor awareness of cloud based applications in health [12]. Therefore, knowledge is necessary for the smooth operation of health care IT.
b. Data security: when it comes to personal information, the security of data is a key concern in cloud based systems since unauthorized access can lead to grave damage. Therefore, there is a need for adequate guidelines and precautionary measures. Research has shown the existence of the strong relationship between data security and user's intention to use the cloud based systems [31].
c. Information sharing: cloud based health system is known to provide remote access to data. Hence, an important construct to consider is information sharing. Information could be shared either internally or externally. However information sharing occurs, the unrestricted flow of information in the cloud based health system, brings about its effectiveness [32].

Proposed model has higher potentials to realize behavioral intentions of users for using HITs. It validates with the other UTAUT2 results from related health care contexts which affirms that UTAUT2 extended is capable of predicting the

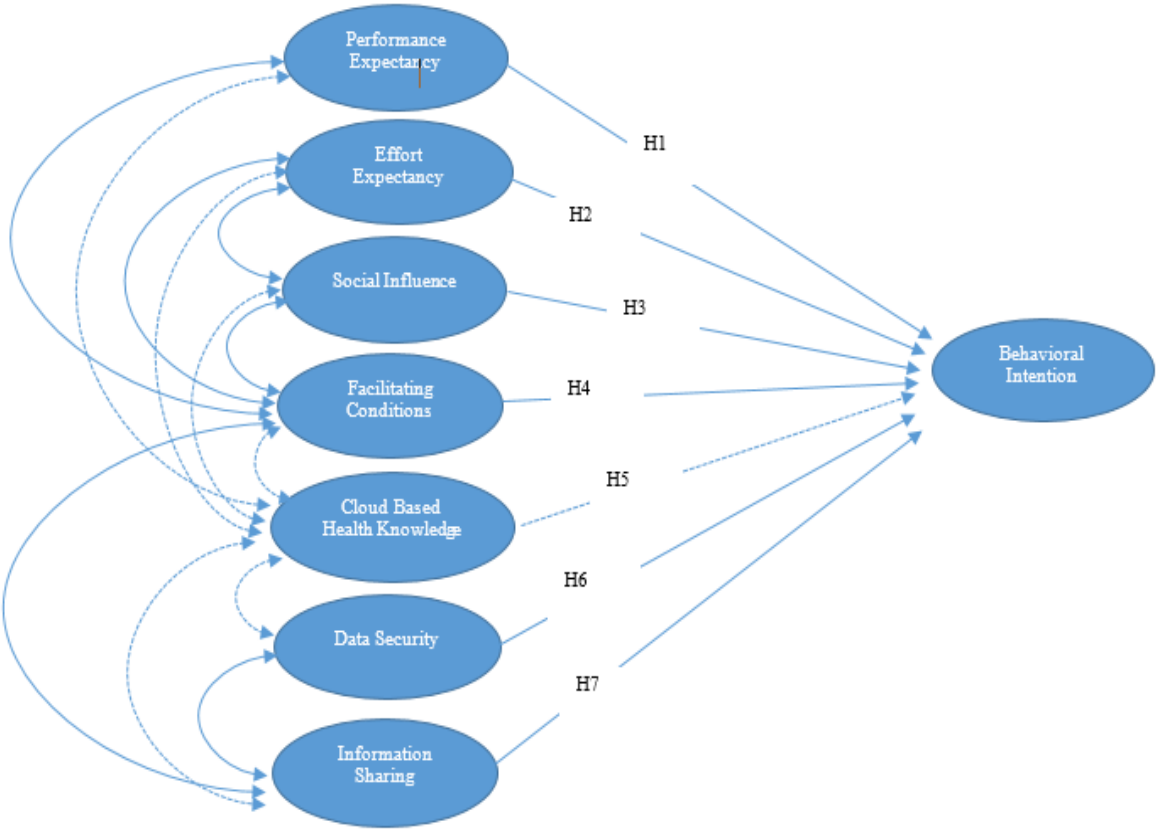

FIGURE 2. Hypothesized research model.

influencers of CBHS acceptance by healthcare consumers in Nigeria. With that in mind, the following hypothesis are proposed and the hypothesized model of the research is illustrated in Figure 2 accordingly.

Hypothesis (H1): Performance expectancy has a positive impact on healthcare consumer's behavioral intention to use the cloud based health system.

Hypothesis (H2): Effort expectancy has a positive impact on healthcare consumer's behavioral intention to use the cloud based health system.

Hypothesis (H3): Social influence has a positive impact on healthcare consumer's behavioral intention to use the cloud based health system.

Hypothesis (H4): Facilitating conditions have a positive impact on healthcare consumer's behavioral intention to use the cloud based health system.

Hypothesis (H5): Cloud based health knowledge have a positive impact on healthcare consumer's behavioral intention to use the cloud based health system.

Hypothesis (H6): Data security has a positive impact on healthcare consumer's behavioral intention to use the cloud based health system.

Hypothesis (H7): Information sharing has a positive impact on healthcare consumer's behavioral intention to use cloud based health system.

III. METHODS

A. QUESTIONNAIRE DESIGN

A structured questionnaire is developed in order to measure the intention of health care consumers for using CBHS. Seven points Likert scale is used for the questionnaire measuring from 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = agree, and 7 = strongly agree. The questionnaire is sectioned into two: the first section collects respondent's data (age, gender and experience) and the second section measures UTAUT2 extended constructs such as performance expectancy, effort expectancy, social influence, facilitating conditions, cloud based health knowledge, data security, and information sharing. The study considered seven independent constructs and one dependent construct, comprising of 31 items in total. Use behavior which was considered in the original UTAUT2 was not measured in our study because the proposed technology, is an envisaged technology, which has not been implemented. We adapted the survey items to ensure reliability and validity and modified them to suit our research context.

B. DATA COLLECTION

Cross sectional study was used to examine, classify and evaluate the factors that affect health care consumers' willingness

to accept the cloud based health system in Nigeria. Data collection was carried out in four locations in Benue State, Nigeria. According to previous studies [33] and [34], early adopters and users of healthcare technologies are those who have some levels of higher education. For this reason, our target participants were selected from educational institutions and healthcare institutions (patients of general hospital Alaide, general hospital Otukpo, students of Benue State University teaching hospital, and staffs of Oju healthcare management board). The questionnaire was administered to people whose ages are between 18 and 45 years and had at least a minimal level of education after seeking their consent. Adequate care was taken to ensure that the participants are eligible to partake in the study. Prior to the administration of the questionnaire, one of the authors introduced the concepts of cloud based health system to the target participants, as well as the objectives of the survey in order to ensure that all the participants have a clear understanding of what the study entails. 465 questionnaires were distributed in a face-to-face meeting, but only 358 were returned. All completed questionnaires were returned same day by the participants. At the end of careful sorting, 58 were found to be either improperly filled or not filled at all. A questionnaire is deemed invalid if all questions were not answered. So that, only 300 questionnaire was later used for the research analysis with a feedback rate of 76.9%. Data collection was carried out from 1st April to 30th May 2017 after an ethical permission was received from the federal government of Nigeria with reference no MOH/STA/204/VOL 1/28.

C. DATA ANALYSIS

SPSS (20.0) is used to conduct the factor analysis and Structural Equation Modeling (SEM) approach with LISREL (9.30) was indulged to test the structural path model and hypothesis. SEM approach is appropriate for the evaluation of the goodness of fit [35]. In addition, LISREL is known for flexibility in conducting simultaneously structural and measurement components. The model could be used for larger sample sizes [36], unlike Partial Least Square (PLS) [37], and this is required due to the large sampling size of the research study. In contrast to other SEM approaches, the LISREL structural path model requires three kinds of evaluation methods to obtain an absolute fit model [38]. These are: Chi-square, Root Mean Square Error Approximation (RMSEA) and Goodness of Fit Index (GFI).

IV. RESULTS

Measurement model testing was done by estimating the internal consistency reliability and convergent as well as discriminant validity of all items used. As an indicator of appropriate internal reliability, all the reliability measures were far above the required recommended value of 0.70 which signify a good internal consistency [39] as any item which is not up to this is disregarded and not used. According to [40], convergent validity is appropriate when constructs are seen to have an Average Variance Extracted (AVE) of a minimum of 0.5 (>0.5) and all proposed constructs show a very good convergent and discriminant validity as can be seen in Table 1.

Discriminant validity of the constructs is illustrated in Table 2. The Table presents the correlation between constructs in diagonal with the square root of AVEs seen in bold prints as greater. It could be concluded from the Table 2 that the items have higher validity results with their own construct compared with other items. This is an expected characteristic according to Fornell-Larcker criterion [41] since the criterion inherits that latent variable relates more with its indicators than the others.

These findings are indicators to the discriminate and convergence validity of the used items. Before we proceeded further in examining the structural model, we conducted a multicollinearity test via Variance Inflation Factors (VIFs) and all VIF values are between 1.01 and 1.23 respectively, which are well below the recommended maximum value of 10. This signifies that there is no issue of multicollinearity for the results.

After confirming the reliability and validity of the items by examining their factor loading, composite reliability and average variance extracted (AVE), the path model is constructed as shown in Figure 3 with the aid of LISREL version 9.30. In the model, constructs are represented in ovals while the relationships between constructs and dependent variables are represented by arrows. The model fit indices (x2/df = 2.04, df = 13, p = 0.01, CFI = 0.94, GFI =0.97, AGFI = 0.93, RMSEA = 0.05) all shows to be satisfactory with a good predictive power and follows the recommended criteria given by [37], [42], and [43]. The predictive power of the model (R^2) and path cofficient (β) are all indicators of how fit the model is [44].

Hypothesis testing is completed by the examination of path coefficients (β) and associated significance level between the dependent and independent variables having confirmed our model fit indices. Table 3 presents the summary of the hypothesis testing. It could be seen from the Figure 3 that performance expectancy (H1) is supported since it has a positive ($\beta = 0.31$; t = 5.80) relationship with behavioral intention (BI). Effort expectancy and social influence both have a significant impact on BI as the two factors shows a positive relationship indicating that H2 and H3 are supported. Facilitating condition ($\beta = 0.22$; t = 4.82) and data security ($\beta = 0.15$; t = 3.07) were also seen to enhance consumer's behavioral intention to accept CBHS since they both have a positive relationship with behavioral intention; supporting H4 and H6 respectively. Information sharing was also seen to have a positive relationship with behavioral intention with path coefficient ($\beta = 0.11$; t = 2.53) meaning that H7 is supported. However, cloud based health knowledge (H5) is not supported as it has a negative relationship ($\beta = 0.09$; t = 1.49) with BI.

Furthermore, it was revealed that all the independent variables have a significant positive relationship among each other with the exception of cloud based health knowledge which has a negative relationship with the other independent

TABLE 1. Psychometric properties of the constructs.

Construct	Item	Factor loading	CR	AVE
Performance Expectancy	PE1	0.865	0.9233	0.7505
	PE2	0.890		
	PE3	0.873		
	PE4	0.837		
Effort Expectancy	EE1	0.834	0.9001	0.6928
	EE2	0.864		
	EE3	0.830		
	EE4	0.800		
Social Influence	SI1	0.825	0.9110	0.7193
	SI2	0.885		
	SI3	0.855		
	SI4	0.826		
Facilitating conditions	FC1	0.757	0.8966	0.6344
	FC2	0.827		
	FC3	0.813		
	FC4	0.826		
	FC5	0.757		
Cloud Based Health Knowledge	CBHK1	0.857	0.8611	0.7562
	CBHK2	0.882		
Data Security	DS1	0.820	0.8999	0.6922
	DS2	0.833		
	DS3	0.838		
	DS4	0.837		
Information Sharing	IS1	0.765	0.8775	0.6422
	IS2	0.855		
	IS3	0.819		
	IS4	0.763		
Behavioral Intention towards CBHS	BI1	0.900	0.9242	0.7530
	BI2	0.910		
	BI3	0.828		
	BI4	0.830		

TABLE 2. Discriminant validity of constructs.

Constructs	PE	EE	SI	FC	CBHK	DS	IS	BI
PE	**0.866**							
EE	0.228	**0.832**						
SI	0.237	0.332	**0.848**					
FC	0.227	0.296	0.308	**0.796**				
CBHK	0.362	0.282	0.317	0.200	**0.869**			
DS	0.227	0.219	0.216	0.288	0.244	**0.831**		
IS	0.121	0.242	0.184	0.276	0.210	0.243	**0.801**	
BI	0.068	0.086	-0.042	0.004	-0.018	0.051	0.055	**0.867**

Diagonal elements in bold prints are the square root of AVEs

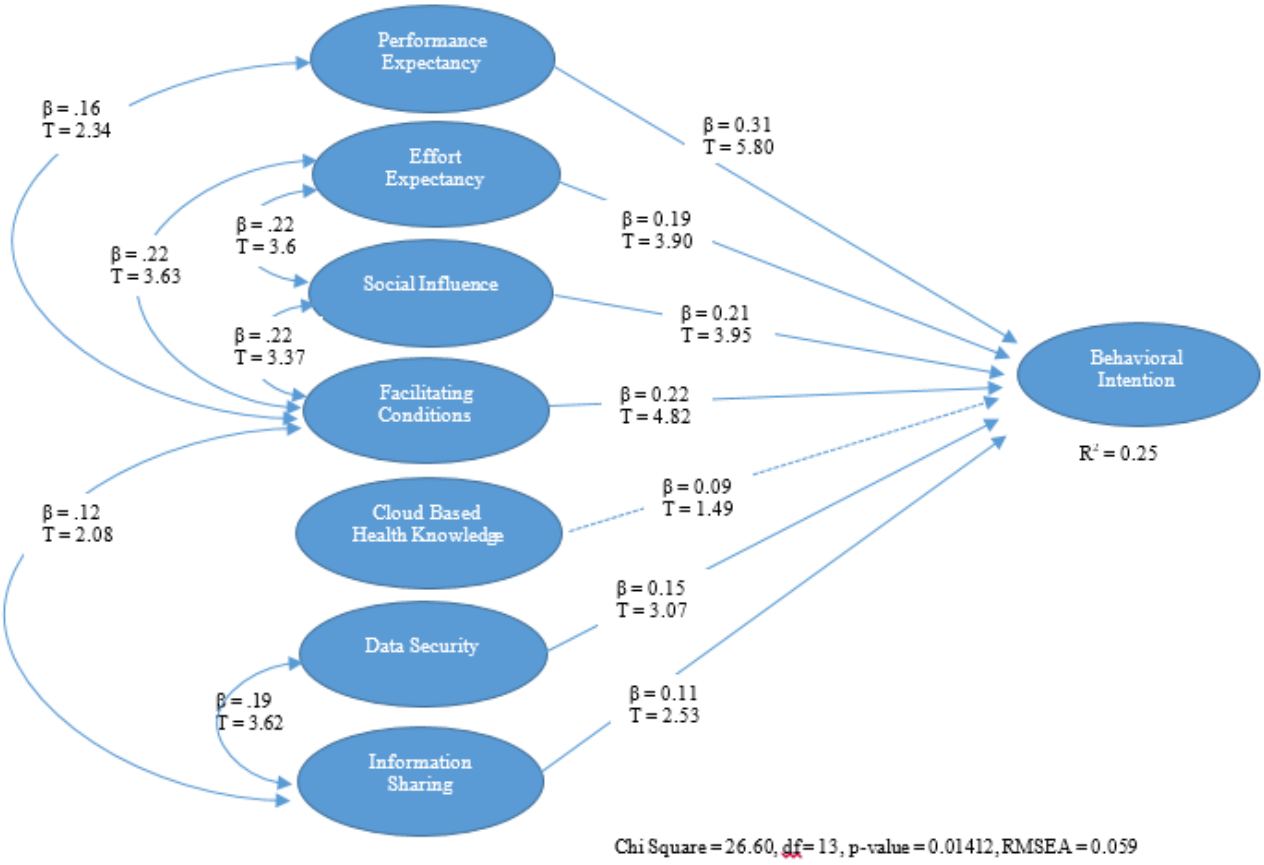

FIGURE 3. Results of the structural model.

variables. It is also quite crucial to realize the particular relationship between data security and information sharing since it is well-known that health care consumers are quite sensitive of their data/information as well the privacy. In accordance, data security and information sharing has a positive correlation ($\beta = .19$; t = 3.62).

It could be seen from Table 3 that the main predictors of behavioral intention of cloud based health system in Benue state, Nigeria are performance expectancy ($\beta = 0.31$; t = 5.80), effort expectancy ($\beta = 0.19$; t = 3.90), social influence ($\beta = 0.21$; t = 3.95), facilitating condition ($\beta = 0.22$; t = 4.82), data security ($\beta = 0.15$; t = 3.07) and information sharing ($\beta = 0.11$; t = 2.53). These findings suggest that performance expectancy, effort expectancy, social influence, facilitating conditions, data security and information sharing are statistically significant and have a direct effect on health

TABLE 3. Summary of hypothesis result.

Independent variables			Hypothesis	Path coefficient (β)/Sig.	t-values	Results
PE	→	BI	H1	0.31/***	5.80	Supported
EE	→	BI	H4	0.19/***	3.90	Supported
SI	→	BI	H3	0.21/***	3.95	Supported
FC	→	BI	H6	0.22/***	4.82	Supported
CBHK	→	BI	H2	0.09	1.49	Rejected
DS	→	BI	H5	0.15/***	3.07	Supported
IS	→	BI	H7	0.11/**	2.53	Supported

** P < .005, *** P < .001

TABLE 4. Recommended and actual values.

Fit indices	Recommended value	Actual value	Reference
X^2/df	< 3	2.04	[42]
CFI	> 0.9	0.94	[43]
AGFI	> 0.8	0.93	[44]
RMSEA	< 0.8	0.59	[42]

care consumer's behavioral intention to adopt the cloud based health system.

The tabular representation of the model fit indices, recommended values and the results of the research study are depicted in Table 4.

V. DISCUSSIONS

The potentials of cloud based solutions could improve quality healthcare in developing countries, like Nigeria. This study specifically focuses on the factors affecting cloud based health system adoption and utilization from the viewpoint of health care consumers in Nigeria. UTAUT2 has been used as a technology acceptance model in accordance with the previous related research studies to model the behavioral intention of users in the context of healthcare. The proposed CBHS model could proffer solutions to our findings and empower healthcare consumers with the necessary healthcare facilities that will advance the quality of health care services they receive in the context of the Nigerian health care system. The implications of the research findings are categorized into two: theoretical findings, managerial and organizational implications.

A. THEORETICAL FINDINGS

Similar research studies in the literature which considers cloud based monitoring systems [10], [15], [21], [23], [24], [45] have shown that the factors performance expectancy, effort expectancy and social influence have significant positive impact on the behavioral intention. Facilitating conditions, data security, and information sharing all showed a positive impact on BI supporting H4, H6 and H7.

As discussed earlier, cloud based health knowledge did not show a positive impact on BI in the study and as such; H5 is not supported. The rejection of this hypothesis (H5) indicates that healthcare consumers do not consider knowledge as a bottleneck to the use of the cloud based health system. With them, once it is in use, they can learn through the process. It could be stated that once there is adequate availability of the required IT infrastructure [46], [47] with user friendly application platform [48]: then, the consumers would be willing to use the technology.

These variables are fundamental factors in the health cloud environment [49] hence these factors have to be available for the successful adoption of the technology. These findings are in line with other related studies in health cloud [50], [51].

B. MANAGERIAL AND ORGANIZATIONL IMPLICATIONS

The finding of this research study could be a milestone for the planning, designing and the implementation process of a sustainable cloud based health system adoption in developing countries. It is quite important for both managers and decision makers in Nigeria to consider the theoretical findings of this research study thoroughly before the implementation of CBHS. Hence, it would be worthwhile if a prototype is developed first and used by the real beneficiaries. In that way, the real system can be designed and implemented hitched free putting into cognizance the issues that would be raised during the prototype trial [52]. The case of Nigeria is peculiar in that according to the review of eHealth challenges in Nigeria, which we conducted previously [53], they are yet to have a functional implemented national health system making health care service delivery slow and available to only a few. If the reverse were to be the case, access to health care services delivery will be a lot easier and cheaper.

Previous research studies on the adoption of cloud computing in healthcare had identified that cloud technologies inherit several advantages for both service providers and healthcare consumers which includes quality service delivery and cost-efficient solutions with enhanced collaboration between healthcare organizations.

These collaborations reveal more efficient data exchange with fast feedback for the patients through information sharing. Patients' records (e.g. medical records, X-rays, prescriptions etc.) could be readily available and accessible anywhere

for the healthcare service professionals anytime they need [54], [55]. These findings are in line with our research findings where information sharing was found to have a positive influence on the behavior of consumers who intend to use the CBHS. Furthermore, the availability and accessibility of patient information could be a good resource for organizational and managerial decision making. Better service quality could be achieved through enhanced and robust disease identification for the treatment processes. Finally, IT cost-efficiency is one of the benefits that comes with healthcare cloud computing for organizations. Implementing healthcare cloud computing means that all processes that has to do with IT will be automatically migrated to the cloud infrastructure; thereby, aiding the remote accessibility on the basis of ''Pay –as – you – go'' framework. This allows healthcare organizations to pay only for the services used; hence, there is reduction in the cost of service delivery for the organization [54].

Presently in Nigeria, there is the issue of inadequate healthcare professionals to handle the over whelming number of people who needs medical attention, prompting healthcare organizations to secure a way that would be cost effective in caring for the healthcare needs of the people. Hence, the necessity of the proposed system is out most important for efficient healthcare delivery in Nigeria.

Factors were identified which affects the successful adoption of e-health cloud based health system. It could be concluded that implementation of the proposed system could also benefit the healthcare organizations from undue pressure which provides remote access to health care services for patients.

In general, according to the findings, this model has 25% at explaining the behavioral intention of health care consumers. Although it is low; it however means that it creates a positive intention on healthcare consumers and if the proposed CBHS is clearly explained to them and the necessary awareness is created, it will go a long way at boosting the adoption rate. It is important to stress that the significance to managers mentioned here is not only peculiar to the acceptance of CBHSs but also for the planning, design, implementation and regularity of subsequent usage when the system is fully implemented and operational. In addition, the significance of this study will also be beneficial to organizations or other developing and third world countries who are considering to adopt the cloud based health system or any other related health cloud.

Furthermore, this study was conducted to answer three crucial questions:

a. *What are the factors that influence the acceptance of CBHS by healthcare consumers?*
   Considering the findings from this research, and also findings from previously published studies [20], [56], [57] factors that influence the acceptance of CBHS by health care consumers in Nigeria were identified and characterized into four cardinal areas: (1) performance expectancy associated with perceived usefulness of the platform for healthcare consumers and remote accessibility; (2) effort expectancy, associated with ease of use for the healthcare consumer; (3) facilitating conditions, associated with the availability of required IT infrastructures, technological know-how and technical support; (4) data security, associated with privacy and trust of healthcare consumers; (5) Information sharing, associated with social influence, value of service and the need of the platform.
b. *Is there any correlation between data security and information sharing? If there is a relationship between data security and information sharing, does the relationship influence the behavioral intention of health care consumers in the use of the CBHS?*
   The result attained through the analysis of the path model coefficients, for hypothesis testing in order to ascertain the degree of relationship between the variables showed a substantial positive correlation between the two independent variables of the research hypothesis (see figure 3) and also shows data security and information sharing to have a positive correlation with the exception of cloud based health knowledge which has a negative relationship with the other independent variables. These discoveries agrees with the results of other related studies [29].
c. *How can healthcare delivery be accessed remotely in Nigeria?*
   The research findings indicate that health care service providers in Nigeria are yet to fully implement cloud computing into the Nigerian health care system. Therefore, there is a need for the development and full implementation of a cloud based health services solutions and the consolidation of existing networks as suggested by [58]. Also, findings from a previous study [59] indicated that there are inadequate funds available to the Nigerian healthcare sector. Hence, there is a need for improvement as suggested by the World Health organization (WHO).

VI. CONCLUSIONS AND LIMITATIONS

This study identifies the factors for the behavioral intention of Nigerian health care consumers towards the acceptance of cloud based health system using the UTAUT2 extended. The study concludes that, out of the seven hypotheses, six (performance expectancy, effort expectancy, social influence, facilitating conditions, data security and information sharing) were found to have a positive impact on the behavioral intention of health care consumers towards the acceptance of the cloud based health system while one (cloud based health knowledge) was found not to positively have an impact on consumers behavioral intentions. It could be suggested that friendly user interface and necessary trainings could overcome the missing CBHK of the consumers. It is therefore imperative for decision makers, health care providers and managers consider these critical factors which have a positive impact on BI prior to the design and implementation of a

cloud based health system. It is of out-most importance for them to make adequate provision/maintenance of facilitating conditions and ensure that healthcare data are well secured as the success of cloud based health system is hinged on these two constructs. Moreover, as it could be seen from the findings that consumers are ready to accept and learn through the process once the issue of facilitating conditions and data security is taken care of.

Healthcare consumers are well-aware the benefits of the full implementation of CBHS in Nigeria health care system: hence, if the influencers of CBHS are not properly addressed, the implementation of CBHS suffers setbacks which can deter the progress of health care delivery and result in increased death and hardship on the people.

This study contributes to the existing literature in that it exposes some factors that facilitates the acceptance or otherwise of cloud based health system: a relatively new concept. The study also contributes to knowledge in that it validates other UTAUT2 results from other related health care context and affirms that extended UTAUT2 is capable of predicting the influencers of CBHS acceptance by healthcare consumers in Nigeria. Our developed system is such that received positive responses from healthcare consumers and they do agree that the proposed system can bring about effectiveness and convenience for them.

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REFERENCES

[1] R. Kochhar. (2014). 10 projections for the global population in 2050. Pew Research Center. Accessed: Jun. 20, 2017. [Online]. Available: http://www.pewresearch.org/fact-tank/2014/02/03/10-projections-for-the-global-population-in2050/

[2] M. Currie, L. J. Philip, and A. Roberts, "Attitudes towards the use and acceptance of eHealth technologies: A case study of older adults living with chronic pain and implications for rural healthcare," *BMC Health Services Res.*, vol. 15, no. 1, p. 162, 2015.

[3] S. Yaya, G. Bishwajit, M. Ekholuenetale, V. Shah, B. Kadio, and O. Udenigwe, "Urban-rural difference in satisfaction with primary healthcare services in Ghana," *BMC Health Services Res.*, vol. 17, no. 1, p. 776, 2017.

[4] *Trends in Maternal Mortality 1990 to 2013*, UNICEF, WHO, New York, NY, USA, 2014.

[5] A. I. Muhamad, M. R. M. Rosman, M. I. Ramzi, and M. I. M. Salleh, "Conceptualizing medical application software for managing electronic health records (EHR) and cash flow management in private clinics," *Int. J. Innov., Manage. Technol.*, vol. 3, no. 2, p. 151, 2012.

[6] H. Yang and M. Tate, "A descriptive literature review and classification of cloud computing research," *Commun. Assoc. Inf. Syst.*, vol. 31, no. 2, pp. 35–60, 2012.

[7] M. Parekh and B. Saleena, "Designing a cloud based framework for healthcare system and applying clustering techniques for region wise diagnosis," *Procedia Comput. Sci.*, vol. 50, pp. 537–542, Mar. 2015.

[8] A. Dillon and M. G. Morris, "User acceptance of new information technology: Theories and models," in *Annual Review of Information Science and Technology*. Medford, OR, USA: Information Today, 1996.

[9] K.-M. Kuo, C.-F. Liu, and C.-C. Ma, "An investigation of the effect of nurses' technology readiness on the acceptance of mobile electronic medical record systems," *BMC Med. Inform. Decision Making*, vol. 13, p. 188, Aug. 2013.

[10] P. J. Hsieh, "An empirical investigation of patients' acceptance and resistance toward the health cloud: The dual factor perspective," *Comput. Hum. Behav.*, vol. 63, pp. 959–969, Oct. 2016.

[11] S. Mathew, "Cloud computing: A new foundation towards health care," *Int. J. Innov. Technol. Exploring Eng.*, vol. 3, no. 2, pp. 118–121, 2013.

[12] F.-Y. Pai and K.-I. Huang, "Applying the technology acceptance model to the introduction of healthcare information systems," *Technol. Forecasting Social Change*, vol. 78, no. 4, pp. 650–660, 2011.

[13] C. Baru, N. Botts, T. Horan, K. Patrick, and S. S. Feldman, "A seeded cloud approach to health cyberinfrastructure: Preliminary architecture design and case applications," in *Proc. 45th Hawaii Int. Conf. Syst. Sci. (HICSS)*, Jan. 2012, pp. 2727–2734.

[14] N. A. Risso *et al.*, "A cloud-based mobile system to improve respiratory therapy services at home," *J. Biomed. Inform.*, vol. 63, pp. 45–53, Oct. 2016.

[15] P. D. Kaur and I. Chana, "Cloud based intelligent system for delivering health care as a service," *Comput. Methods Programs Biomed.*, vol. 113, no. 1, pp. 346–359, 2014.

[16] D. Thilakanathan, S. Chen, S. Nepal, and R. A. Calvo, "Secure data sharing in the Cloud," in *Security, Privacy and Trust in Cloud Systems*. Berlin, Germany: Springer, 2014, pp. 45–72.

[17] M. Henze, L. Hermerschmidt, D. Kerpen, R. Häußling, B. Rumpe, and K. Wehrle, "A comprehensive approach to privacy in the cloud-based Internet of Things," *Future Gener. Comput. Syst.*, vol. 56, pp. 701–718, Mar. 2016.

[18] F. D. Davis, R. P. Bagozzi, and P. R. Warshaw, "User acceptance of computer technology: A comparison of two theoretical models," *Manage. Sci.*, vol. 35, pp. 982–1003, Aug. 1989.

[19] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User acceptance of information technology: Toward a unified view," *MIS Quart.*, vol. 27, no. 3, pp. 425–478, 2003.

[20] V. Venkatesh, J. Y. L. Thong, and X. Xu, "Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology," *MIS Quart.*, vol. 36, no. 1, pp. 157–178, 2012.

[21] Y. Lee, K. A. Kozar, and K. R. T. Larsen, "The technology acceptance model: Past, present, and future," *Commun Assoc. Inf. Syst.*, vol. 12, no. 1, p. 50, 2003.

[22] R. J. Holden, O. Asan, E. M. Wozniak, K. E. Flynn, and M. C. Scanlon, "Nurses' perceptions, acceptance, and use of a novel in-room pediatric ICU technology: Testing an expanded technology acceptance model," *BMC Med. Inform. Decision Making*, vol. 16, no. 1, p. 145, 2016.

[23] I. A. Akour and M. A. Dwairi, "Testing technology acceptance model in developing countries: The case of Jordan," *Int. J. Bus. Social Sci.*, vol. 2, no. 14, 2011.

[24] S. J. Miah, J. Hasan, and J. G. Gammack, "On-cloud healthcare clinic: An e-health consultancy approach for remote communities in a developing country," *Telematics Inform.*, vol. 34, no. 1, pp. 311–322, 2017.

[25] K. Sailunaz, M. Alhussein, M. Shahiduzzaman, F. Anowar, and K. A. Al Mamun, "CMED: Cloud based medical system framework for rural health monitoring in developing countries," *Comput. Elect. Eng.*, vol. 53, pp. 469–481, Jul. 2016.

[26] F. C. Payton, G. Pare, C. LeRouge, and M. Reddy, "Health care IT: Process, people, patients and interdisciplinary considerations," *J. Assoc. Inf. Syst.*, vol. 12, no. 2, p. 4, 2011.

[27] S. A. Carlsson, S. Henningsson, S. Hrastinski, and C. Keller, "Socio-technical IS design science research: Developing design theory for IS integration management," *Inf. Syst. e-Bus. Manage.*, vol. 9, no. 1, pp. 109–131, 2011.

[28] M. Soegaard and R. F. Dam, *The Encyclopedia of Human-Computer Interaction*. Denmark: Interaction Design Foundation, 2012.

[29] S. Kim, K.-H. Lee, H. Hwang, and S. Yoo, "Analysis of the factors influencing healthcare professionals' adoption of mobile electronic medical record (EMR) using the unified theory of acceptance and use of technology (UTAUT) in a tertiary hospital," *BMC Med. Inform. Decision Making*, vol. 16, no. 1, p. 12, 2015.

[30] P. Lee *et al.*, "Cloud-based BP system integrated with CPOE improves self-management of the hypertensive patients: A randomized controlled trial," *Comput. Methods Programs Biomed.*, vol. 132, pp. 105–113, Aug. 2016.

[31] M. Alloghani, A. Hussain, D. Al-Jumeily, and O. Abuelma'atti, "Technology acceptance model for the use of m-health services among health related users in UAE," in *Proc. Int. Conf. Develop. E-Syst. Eng. (DeSE)*, Dec. 2015, pp. 213–217.

[32] W. L. Currie and J. J. M. Seddon, "A cross-national analysis of eHealth in the European Union: Some policy and research directions," *Inf. Manage.*, vol. 51, no. 6, pp. 783–797, 2014.

[33] D. W. Roblin, T. K. Houston, J. J. Allison, P. J. Joski, and E. R. Becker, "Disparities in use of a personal health record in a managed care organization," *J. Amer. Med. Inform. Assoc.*, vol. 16, no. 5, pp. 683–689, 2009.

[34] C. K. L. Or and B.-T. Karsh, "A systematic review of patient acceptance of consumer health information technology," *J. Amer. Med. Informat. Assoc.*, vol. 16, no. 4, pp. 550–560, 2009.

[35] S. A. Al-Somali, R. Gholami, and B. Clegg, "Internet banking acceptance in the context of developing countries: An extension of the technology acceptance model," in *Proc. Eur. Conf. Manage. Technol.*, 2008.

[36] J. F. Hair, C. M. Ringle, and M. Sarstedt, "PLS-SEM: Indeed a silver bullet," *J. Marketing Theory Pract.*, vol. 19, no. 2, pp. 139–152, 2011.

[37] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *J. Marketing Res.*, vol. 18, no. 1, pp. 39–50, 1981.

[38] B. H. Wixom and H. J. Watson, "An empirical investigation of the factors affecting data warehousing success," *Manage. Inf. Syst. Quart.*, vol. 25, no. 1, pp. 17–41, 2001, doi: 10.2307/3250957.

[39] W. M. A. B. W. Afthanorhan, "A comparison of partial least square structural equation modeling (PLS-SEM) and covariance based structural equation modeling (CB-SEM) for confirmatory factor analysis," *Int. J. Eng. Sci. Innov. Technol.*, vol. 2, no. 5, pp. 198–205, 2013.

[40] J. F. Hair, R. E. Anderson, R. L. Tatham, and W. C. Black, *Multivariate Data Analysis: With Readings*. Englewood Cliffs, NJ, USA: Prentice-Hall, 1995.

[41] S. B. MacKenzie, P. M. Podsakoff, and N. P. Podsakoff, "Construct measurement and validation procedures in MIS and behavioral research: Integrating new and existing techniques," *MIS Quart.*, vol. 35, no. 2, pp. 293–334, 2011.

[42] J. Gaskin, *Confirmatory Factor Analysis*. Accessed: Nov. 25, 2017. [Online]. Available: http://statwiki.kolobkreations.com/wiki/Confirmatory_Factor_Analysis#Model_Fit

[43] R. P. Bagozzi and Y. Yi, "On the evaluation of structural equation models," *J. Acad. Marketing Sci.*, vol. 16, no. 1, pp. 74–94, 1988.

[44] P. Y. K. Chau and P. J.-H. Hu, "Information technology acceptance by individual professionals: A model comparison approach," *Decision Sci.*, vol. 32, no. 4, pp. 699–719, 2001.

[45] P. Chwelos, I. Benbasat, and A. S. Dexter, "Empirical test of an EDI adoption model," *Inf. Syst. Res.*, vol. 12, no. 3, pp. 304–321, 2001.

[46] R. Ward, "The application of technology acceptance and diffusion of innovation models in healthcare informatics," *Health Policy Technol.*, vol. 2, no. 4, pp. 222–228, 2013.

[47] J. Tavares and T. Oliveira, "E-health Web based technologies patient adoption," *Rev. Saude Publication*, vol. 48, p. 25, 2014.

[48] D. E. F. de Oliveira Rodrigues, J. Á. da Cruz de Assis Lopes, and J. M. S. F. Tavares, "Manifold-marketing: A new marketing archetype for the information age, applied to the adoption of oral contraceptives and other drugs by end-users," in *Proc. 3rd Annu. Conf. Int. Netw. Bus. Manage. J. (INBAM)*, Lisbon, Portugal, Jun. 2013, pp. 59–80.

[49] M.-L. Jung and K. Loria, "Acceptance of swedish e-health services," *J. Multidisciplinary Healthcare*, vol. 3, pp. 55–63, Nov. 2010, doi: 10.2147/JMDH.S9159.

[50] D. Zissis and D. Lekkas, "Addressing cloud computing security issues," *Future Gener. Comput. Syst.*, vol. 28, no. 3, pp. 583–592, 2012.

[51] J.-W. Lian, D. C. Yen, and Y.-T. Wang, "An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital," *Int. J. Inf. Manage.*, vol. 34, no. 1, pp. 28–36, 2014.

[52] J. Bjerkan, M. Hedlund, and R. Hellesø, "Patients' contribution to the development of a Web-based plan for integrated care—A participatory design study," *Inform. Health Social Care*, vol. 40, no. 2, pp. 167–184, Mar. 2015, doi: 10.3109/17538157.2014.907803.

[53] P. E. Idoga, "A literature review of eHealth sector and challenges in Nigeria," in *Proc. HONET-ICT*, Oct. 2016, pp. 145–149.

[54] V. K. Nigam and S. Bhatia, "Impact of cloud computing on health care," *Int. Res. J. Eng. Technol.*, vol. 3, no. 5, pp. 2804–2810, 2016.

[55] A. M.-H. Kuo, "Opportunities and challenges of cloud computing to improve health care services," *J. Med. Internet Res.*, vol. 13, no. 3, p. e67, Jul. 2011.

[56] K. Steininger, B. Stiglbauer, B. Baumgartner, and B. Engleder, "Factors explaining physicians' acceptance of electronic health records," in *Proc. 47th Hawaii Int. Conf. Syst. Sci. (HICSS)*, Jan. 2014, pp. 2768–2777.

[57] M. Nematollahi *et al.*, "Factors affecting in adoption and use of electronic medical record based on unified theory of acceptance and use of technology in Iran," *Shiraz E-Med J.*, vol. 18, no. 9, p. e57582, 2017, doi: 10.5812/semj.57582.

[58] T. K. Young *et al.*, "Transforming health care in remote communities: Report on an international conference," *BMC Proc.*, vol. 10, no. 6, p. 6, 2016.

[59] M. A. Zayyad and M. Toycan, "Factors affecting sustainable adoption of e-health technology in developing countries: An exploratory survey of Nigerian hospitals from the perspective of healthcare professionals," *PeerJ*, vol. 6, p. e4436, Mar. 2018.

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