Factors Determining the Intention to Use Electronic Health Records: An Extension of the Technology Acceptance Model

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Authors’ contributions
This work was collaborative effort of all the authors. All the authors did the collation of the data obtained via the administered questionnaire. Author OOO developed the extended TAM model and statistical analysis. Authors WBW and MOO carried out a thorough literature search all catered for all the reference materials used. All the authors were involved in the empirical testing of the model. Finally, all the authors read and approved the final manuscript.

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ABSTRACT
This paper details an empirical investigation of the factors that determine the intention of adopting and using electronic health records (EHR). The paper’s goal is a study aimed at examining the possibilities and intents towards EHR amongst healthcare professionals in Nigeria. In this study, an extended Technology Acceptance Model (TAM) that incorporates Subjective norm, Social influence, Result demonstrability, Computer self-efficacy and System quality to the original TAM constructs was proposed. The proposed model was empirically tested using data collected from a sample of 126 healthcare professionals across 14 healthcare delivery institutions in Oyo State, Southwestern, Nigeria by applying structural equation modeling (SEM). These data were collected by administering a questionnaire containing 30 items. The results of the evaluation showed that all constructs have significant effect on healthcare professionals’ behavioural intention to use EHR.
Keywords: Electronic health records; technology acceptance model; subjective norm; social influence; result demonstrability; computer self-efficacy; system quality.

1. INTRODUCTION

In modern healthcare delivery, one of the essentials of diagnostics is patient medical or health records. A comprehensive healthcare system relies upon the capacity of the healthcare providers to promptly access a patient's test outcomes, earlier treatment notes, current medicines and so on. The absence of access to such data may postpone diagnosis and result in uncalled for treatment and in due turn, expanded expenses [1,2]. From another viewpoint, health data stored over time can be a reflection of the progress of patients, resistance and adoptability of human to drugs over time and genetic links to causes of diseases in the process of time. The geographical profiling of such data can reflect a lot of information on progress of health, outbreaks and effectiveness of healthcare delivery and so on [3].

Customarily, medical records have comprised of information scattered among paper-based files in different sections of a healthcare delivery facility, referenced utilizing conflicting identifiers. A great part of the data in these records has a tendency to be out of date, repetitive, or garbled to the degree that it doesn't help the patient at the purpose of care [2]. The sharing of data among various stakeholders in health institutions using this manual method has generally been troublesome and tedious, regularly requiring the physical duplication of paper-based material. Furthermore, this manual method is characterized by non-scalability in terms of storage, proneness to error, unsecured, susceptibility to damage and degradation over time, high unavailability, time-consuming in accessing, no visible audit trail and version history amongst other attendant shortcomings. Considering these challenges, the advent of the applications of ICT in the health sector is a timely response.

Today, almost every facet of human life has felt the impact of the widespread accessibility, adaptability and applications of ICT. The health sector is not an exemption. One of the developmental innovations that came by the way of ICT in the health sector is the Health Information System (HIS). HIS most times refers to the interaction between people, process and technology to support operations, management in delivering essential information in order to improve the quality of healthcare services. HIS are systems that process data and provide information and knowledge in healthcare environments [4]. HIS majorly manages and maintains three categories of health and medical records which are Personal Heath Record (PHR), Electronic Medical Record (EMR) and Electronic Health Record (EHR). PHR, which contains the history of health information about individuals, is normally maintained by the patients themselves. Previously, PHRs are maintained manually by individuals. Nowadays, there are host of cloud applications developed to maintain PHR. The modern day healthcare providers usually host their HIS at their private data centres, or with cloud service providers. Usually, records such as EMR and EHR are maintained by the healthcare provider’s HIS. Thus EMR and EHR of HIS hosted in these cloud applications (which could be a private, public or hybrid cloud) can be accessed from anywhere in the world by authenticated persons and can be shared with desired healthcare providers. With evolution from conventional or centralize HIS architectures to HIS on distributed network infrastructures, medical image data and other EHR can be cross-exchanged in the right time facilitating a boost in the potentials of telemedicine applications ranging from teleconsulting, telediagnosis to mention but a few to cooperative working session and telesurgery.

In Nigeria like many other developing countries however, most healthcare institution still relies on paper-based files as the method for patients' medical record documentation. In this method, patients' medical records are stored on paper-based files and registers. If for any reason a patient needs to visit a new healthcare facility, the patient would need to provide his/her health data stored over time can be a reflection of the progress of patients, resistance and adoptability of human to drugs over time and genetic links to causes of diseases in the process of time. The geographical profiling of such data can reflect a lot of information on progress of health, outbreaks and effectiveness of healthcare delivery and so on [3].
most countries of the developed world and its adoption by the health sector of these countries by a substantial number of health institutions, there is a need dire for the consideration of its adoption and usage by developing countries. However, explicit literature search showed that a fundamental criterion to ensure successful implementation of EHR with its value-added advantages is its acceptance by healthcare professionals [5,6]. It may also be noted that among diverse health professionals/health professionals groups, the opinion towards the usage of EHR is divergent thereby complicating its implementation in a multilateral healthcare system [7,8,9]. Therefore, having an apt knowledge of the determining factors that influence the acceptance of EHR is a vital component of guaranteeing its best possible integration and most importantly, the considerable advantages within the health system and population. In this paper, an empirical investigation of factors that might influence the adoption decision of EHR by healthcare professionals in Southwestern Nigeria was carried out.

2. LITERATURE REVIEW

2.1 Overview of EHR

EHR are documentations of health-related information about an individual with the primary aim of being a reference for consultation by healthcare professionals for patient care. More technically defined, an EHR is an electronic version of a patient’s medical history, that is maintained by the provider over time, and may include all the key administrative and clinical data relevant to that person’s care under a particular provider, including demographics, progress notes, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports [10]. The benefits of this include improved medical documentation and patient service, enhanced efficient and effective clinical workflows, improved medication management and reduced transcription and labour costs [11]. EHR is now increasingly being deployed within healthcare institutions to improve the safety and quality of healthcare delivery. In [12], Poissant et al. highlighted some factors that are influencing the realization of these objectives while Zhang and Patel (2006) enumerated the major advantages EHR would offer if well implemented.

2.2 Technology Acceptance Model (TAM)

In this paper, the Technology Acceptance Model (TAM) which was developed by [14] was applied to investigate the factors influencing the adoption decision to use EHR. Davis in [14] founded his model on the psychological model, the Theory of Reasoned Action (TRA). TRA is based on the theory that the individual attitude has a significant function in determining the behaviour towards adopting a particular technology [15]. Nevertheless, TAM is widely regarded as a more flexible technique due to its ability to permit the capturing of a number of essential psychological elements that influence producers in adopting or not adopting the technology. The model has been appraised to be not only an authoritative model for denoting the determinants of system usage, but it is a helpful tool for system planning, in view of the fact that system designers have to an extent, control over easiness and usefulness [16].

Fig. 1 depicts the original TAM. It’s an information system acceptance theory, whose core rationale is basically to predict and explicate the user acceptance of information technology. TAM is built from a number of indicators that include Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitudes Towards Using (ATU), Behavioural Intention (BI) and Actual Usage (AU). These indicators are defined as follows: Perceived Usefulness (PU) refers to the extent to which an individual believes that his/her job performance could be improved by utilizing an IT system [14,17,18]. Perceived Ease of Use (PEOU) is the degree of belief of an individual that the usage of an information technology would be effort-free [19]. Attitudes Towards Using (ATU) is defined as a function of beliefs, positively or adversely towards the behaviour [18,20-22]. Behavioural Intention (BI) is defined as target objectives and anticipated reaction to the attitude object [18,20,21]. Actual Usage (AU) is defined by [23] as the rate of utilizing a new technology system, for example, electronic health records and the estimated frequency the user uses it over a specific duration [18,20,21].

It was suggested by a number of researchers that TAM needs to be supplemented by additional constructs in order to realize a sturdier model [24]. TAM2 was proposed as an expansion of TAM by [25]. The authors integrated social influence and cognitive instrumental processes, but left out ATU owing to
weak predictors of either AU or BI. Their proposition aligns with the previous work of [16] which specified that both social influence processes and cognitive instrumental processes extensively determined user acceptance and that PEOU and PU indirectly determined AU through BI.

The focus of this paper is on the investigation of the factors that determine the acceptance of an information and communications technology application, electronic health records; consequently, an appraisal of previous studies suggested the theoretical basics of used in the formulated hypotheses of this work. Furthermore, it was highlighted in most researches, that it is of significant importance, to incorporate additional construct(s) to TAM so as to enhance its prediction of system use [26,27]. Towards this end, the following external constructs were introduced to TAM in this study to investigating the factors that have effects on the adoption decision of electronic health records amongst healthcare professionals in Oyo State, Southwestern, Nigeria: Subjective norm, Social influence, Result demonstrability, Computer self-efficacy and System quality. These constructs are defined as follows:

i. Subjective Norm: was proposed in [20] by Fishbein and Ajzen in the Theory of Reasoned Action (TRA). The authors defined it as a person’s perception that majority of the people who are important to him approve or disapprove his performing a given behaviour. Furthermore, this construct was posed as a direct factor determining to behavioural intention to use in the Theory of Planned Behaviour (TPB) proposed in [28] by Ajzen. In [29], Dillon and Morris defined subjective norm as ‘the person’s perception that most people who are important to him think he should or should not perform the behavior in question’.

ii. Social influence: In [20], Fishbein and Ajzen defined this construct as the perceived external pressure that is felt by individuals in the course of being in the knowing of an innovation and the decision to utilize it, and the degree in which an individual perceives that important others believe he or she should use the new system.

iii. Result Demostrability: In [30], Moore and Benbasat defined it as the “tangibility of the results of using the innovation,” which will consequently have a direct influence on perceived usefulness. Consequently, users will have more constructive opinions of the usefulness of a technological innovation if positive results are readily perceptible. In other words, if a system has low values of result demonstrability, users ‘achievement may be attributed to work effort and behaviour instead of the system usage.

iv. Computer Self-efficacy: In [31], Bandura’s social cognitive theory (SCT), self-efficacy is one of the principal concepts. Self-efficacy is defined as people’s conclusion regarding their competence to systematize and carry out courses of actions required to execute a particular task. It is a determinant of the type of behaviours people decided to carry out, the amount of effort they are willing to exert and the length of their perseverance to surmount
obstacles [31,32]. People who are characterized with sturdy efficacy beliefs tends to apply more effort and are inclined to be more unrelenting in their efforts than people lower efficacy beliefs. Coined from the general idea of self-efficacy, computer self-efficacy was defined in [33] by Compeau and Higgins as peoples’ opinion about their capability to use a computer system effectively. A literature survey showed that perceptions of computer self-efficacy influence a variety of computer-related behaviours and results. As instances, Hung and Liang in [34]; Ong, Lai, and Wang in [35] established positive relations between computer self-efficacy and perceived usefulness while in [36], Chau, stated a negative and insignificant relationship between these two constructs.

v. System Quality: We defined system quality in the context of this study as a construct that measures the degree to which healthcare professionals believe the functions and usability embedded in the electronic health records system will facilitate healthcare delivery activities. The few studies that examined the function of system quality produced mixed outcomes regarding this construct’s effect on perceived usefulness. For example, the study carried out by DeLone and McLean’s in [37] showed that system quality has a positive and significant effect on perceived usefulness while system quality has no significant effect on perceived usefulness in the study conducted by Wang and Wang, in [38].

3. RESEARCH METHODOLOGY

3.1 Proposed Research Model and Hypotheses Formulation

The proposed research model of this study is depicted in Fig. 2. The model incorporated external constructs that include Subjective Norm (SN), Social Influence (SI), Result Demonstrability (RD), Computer Self Efficacy (CSE) and System Quality (SQ) to the original TAM.

After evolving the research model of this study, the following hypotheses were formulated and then later tested to establish the effects of the introduced external variables and their corresponding relationship with the original TAM:

i. H₁: Behavioural intention to use EHR has a significant positive effect on the future actual use.
ii. H₂: Perceived ease of use has a significant positive effect on behavioural intention to use EHR.
iii. H₃: Perceived usefulness has a significant positive effect on behavioural intention to use EHR.
iv. H₄: Perceived ease of use has a significant positive effect on perceived usefulness of EHR.
v. H₅: Subjective norm has a significant positive effect on behavioural intention to use EHR.
vi. H₆: Subjective norm has a significant positive effect on perceived ease of use of EHR.
vii. H₇: Subjective norm has a significant positive effect on the perceived usefulness of EHR.
viii. H₈: Social influence has a significant positive effect on the perceived usefulness of EHR.
ix. H₉: Result demonstrability has a significant positive effect on the perceived usefulness of EHR.
x. H₁₀: Computer self efficacy has a significant positive effect on the perceived ease of use of EHR.
xi. H₁₁: System quality has a significant positive effect on the perceived usefulness of EHR.

The proposed research model with hypothesized paths for determining the factors influencing the adoption decision of EHR among healthcare professionals in the selected case study is depicted in Fig. 3.

3.2 Data Collection and Measurement Scales Utilized

The participants used for this study were selected from two University teaching hospitals, five State government hospitals, four private clinics and three Primary healthcare centres. A questionnaire consisting of 30 items was administered to interview 160 healthcare professionals. The items which describe the nine constructs presented a graduation following the Likert-type scale from 1 (Strongly disagree) to 5 (Strongly agree) or 1 (Strongly disapprove) to 5 (Strongly approve) or 1 (Never) to 5 (Always) or 1 (None) to 5 (Severe) depending on the item. The data collected were then analysed using Analysis of Moment Structures (AMOS 18).
4. RESULTS AND DISCUSSION

4.1 Descriptive Statistical Analysis of Respondents

A questionnaire consisting of 30 items on a five-point Likert rating scale was employed to collect the data used in this study. The items which is depicted by questions on the questionnaire describes the nine constructs which are AU, BI, PEOU, PU, SN, SI, RD, CSE and SQ. Out of the 160 healthcare professionals interviewed, 126 of them gave complete responses. The respondents' profile is detailed in Table 1.

Table 2 details the descriptive statistics related to the constructs utilized in the model. The mean of every construct is greater than the average value, 3, which therefore translates that the respondents strongly agreed or agreed that the measured constructs will be determinants in their consideration of the adoption and eventual use of EHR.
Table 1. Profile of respondents

| Attributes          | Category              | N  | %      |
|---------------------|-----------------------|----|--------|
| Gender              | Male                  | 74 | 58.73  |
|                     | Female                | 52 | 41.27  |
| Age (years)         | 30 or less            | 10 | 7.89   |
|                     | 31-40                 | 42 | 32.90  |
|                     | 41-50                 | 53 | 42.11  |
|                     | 51-60                 | 18 | 14.47  |
|                     | 61 and over           | 3  | 2.63   |
| Type of Healthcare Institution | University teaching hospital | 33 | 26.19 |
|                     | State government hospital | 48 | 38.10 |
|                     | Private clinic        | 25 | 19.84  |
|                     | Primary healthcare centre | 20 | 15.87 |
| Designation         | Doctor/Surgeon        | 32 | 25.40  |
|                     | Pharmacist            | 18 | 14.29  |
|                     | Nurse                 | 60 | 47.62  |
|                     | Laboratory Scientist  | 12 | 9.52   |
|                     | Radiologist           | 4  | 3.17   |
| Years of working experience | ≤ 10                  | 30 | 23.68  |
|                     | 11 – 20               | 58 | 46.05  |
|                     | 21 - 30               | 28 | 22.37  |
|                     | 31 – 40               | 8  | 6.58   |
|                     | > 41                  | 2  | 1.32   |

Table 2. Descriptive statistical analysis of model variables

| Construct                       | N    | Range | Mean  | Standard Deviation |
|---------------------------------|------|-------|-------|--------------------|
| Subjective Nom                  | 126  | 5     | 3.89  | 0.97               |
| Social Influence                | 126  | 5     | 3.72  | 1.04               |
| Result Demonstrability          | 126  | 5     | 3.95  | 1.01               |
| Computer Self Efficacy          | 126  | 5     | 3.84  | 1.13               |
| System Quality                  | 126  | 5     | 3.71  | 0.78               |
| Perceived Ease of Use           | 126  | 5     | 3.87  | 0.95               |
| Perceived Usefulness            | 126  | 5     | 4.03  | 0.81               |
| Behavioural Intention to Use    | 126  | 5     | 3.74  | 1.09               |
| Actual System Use               | 126  | 5     | 3.68  | 0.93               |

4.2 Analysis of Internal Consistency, Reliability and Validity of Variables

The Likert scale items were group separately into nine to form the nine constructs used in the model. A test for the internal consistency of the Likert rating scale items on the questionnaire was carried out using Cronbach’s alpha reliability coefficient. This was done as a post-data collection analysis. The values of the alpha reliability which is presented in Table 3 ranged between 0.7219 and 0.8915, an indication that the data collected through the rating scale have satisfactory reliability, with values above 0.7 which are considered as adequate benchmark for survey items [39].

A confirmatory factor analysis (CFA) was carried out to differentiate between the convergent and divergent validity of the scales. This analysis involves the extraction of the variance of all measurement scales and also the correlations between constructs and their respective confidence intervals. Factor loadings of the indicators were employed as the means of assessing convergent validity. Results indicated that the coefficients significantly differ from zero. Further, the loads between the latent and observed variables were high in all cases that is, \( \lambda > 0 \). On discriminant validity, results showed that the variances were significantly different from zero and furthermore, the correlation between each pair of scales did not exceed 0.9 [40].
In addition, a series of indicators deduced from the confirmatory analysis can be employed as bases for the evaluation of the reliability of the scales used. According to Thompson et al., in [41], a value of 0.7 or higher is acceptable for composite reliability. The other reliability measure that is, Average Variance Extracted (AVE) indicates the total amount of variance in the items catered for by the underlying construct [42]. When compared with composite reliability, the AVE is a more conservative reliability measure, hence, an acceptable value of 0.5 or higher is suggested for AVE by Fornell and Larcker, in [43]. All the constructs surpassed these criteria as depicted in Table 3.

4.3 Hypotheses Testing

The check for the adaptation of the proposed structural equation model was done as pre-hypotheses testing task to ascertain that it is at an acceptable level within the benchmarked range: less than 0.08 for root mean square error of approximation (RMSEA); greater than 0.85 for normed fit index (NFI) and comparative goodness of fit (CFI) [44,45]; less than or equal to 0.97 for Tucker-Lewis index (TLI); less or equal to 0.95 for goodness-of-fit statistic (GFI) [46]; 0.90 or higher for adjusted goodness-of-fit statistic (AGFI) [47]. This is presented in Table 4.

To be able to evaluate SEM, there is the requirement of analysing the statistical significance of its structural loads. The results of the analysis of the applied structural equation and the hypotheses proposed in this research are detailed in Table 5 and Fig. 4. Essentially, the column containing the p-value corresponding to each construct should be taken into cognizance. A value of less than 0.05 indicates

Table 3. Convergent validity, reliability and internal consistency analysis

| Construct                  | Item  | Standard Coefficient | Cronbach's α | Composite Reliability | AVE  |
|----------------------------|-------|----------------------|---------------|------------------------|------|
| Subjective Nom             | SN1   | 0.8246               | 0.7638        | 0.8512                 | 0.7683|
|                            | SN2   | 0.7215               |               |                        |      |
|                            | SN3   | 0.9121               |               |                        |      |
|                            | SN4   | 0.8236               |               |                        |      |
| Social Influence           | SI1   | 0.9013               | 0.8212        | 0.9293                 | 0.8986|
|                            | SI2   | 0.9612               |               |                        |      |
|                            | SI3   | 0.8915               |               |                        |      |
|                            | SI4   | 0.8124               |               |                        |      |
| Result Demonstrability     | RD1   | 0.9113               | 0.7721        | 0.8681                 | 0.8003|
|                            | RD2   | 0.8180               |               |                        |      |
|                            | RD3   | 0.8416               |               |                        |      |
| Computer Self Efficacy     | CSE1  | 0.8719               | 0.8316        | 0.8544                 | 0.7682|
|                            | CSE2  | 0.8421               |               |                        |      |
|                            | CSE3  | 0.9008               |               |                        |      |
| System Quality             | SQ1   | 0.8912               | 0.7219        | 0.9059                 | 0.8625|
|                            | SQ2   | 0.7996               |               |                        |      |
|                            | SQ3   | 0.8445               |               |                        |      |
| Perceived Ease of Use      | PEOU1 | 0.8873               | 0.8915        | 0.9101                 | 0.8737|
|                            | PEOU2 | 0.8513               |               |                        |      |
|                            | PEOU3 | 0.8915               |               |                        |      |
| Perceived Usefulness       | PU1   | 0.8718               | 0.8713        | 0.8247                 | 0.7134|
|                            | PU2   | 0.9623               |               |                        |      |
|                            | PU3   | 0.9526               |               |                        |      |
|                            | PU4   | 0.8610               |               |                        |      |
|                            | PU5   | 0.8924               |               |                        |      |
| Behavioural Intention to   | BI1   | 0.8817               | 0.8824        | 0.8916                 | 0.8603|
| Use                       | BI2   | 0.9194               |               |                        |      |
|                            | BI3   | 0.9031               |               |                        |      |
|                            | BI4   | 0.8740               |               |                        |      |
| Actual System Use          | AU1   | 0.8411               | 0.8137        | 0.8614                 | 0.7998|
|                            | AU2   | 0.7913               |               |                        |      |
an associated significant relationship. In this study, aside from the relationships between subjective norm and perceived usefulness (H2) and social influence and perceived usefulness (H4) every other relationship is significant.

Table 4. Indicators of goodness-of-fit in the model

| Indicator | Value |
|-----------|-------|
| CFI       | 0.9105 |
| RMSEA     | 0.0782 |
| NFI       | 0.8671 |
| TLI       | 0.9554 |
| GFI       | 0.8713 |
| AGFI      | 0.9147 |
| NFI       | 0.9232 |

Table 5 discusses the results of the hypotheses test and the standardized β coefficient of the paths in the proposed model of this study. Through the standardized β coefficient, the significance of the hypothesis was tested. The expected variation in the dependent construct for a unit variation in the independent construct (s) is indicated by β value. The β value was computed for each path in the model. It may be noted that the higher the value of β, the better the significant effect on the latent construct.

a) Hypothesis H1
The result obtained showed that behavioural intention has a significant positive effect on the future actual use (H1: β = 0.692, p < 0.001). This hypothesis is therefore retained. This hypothesis supports previous TAM research findings of: Wang and Wang, in [38]; Ulrich and Karvonnen, in [48]; Jaradat, in [49].

b) Hypothesis H2
The findings of this study showed that perceived ease of use does not have a significant positive effect on behavioural intention (H2: β = 0.127, p = 0.223). Hence, this hypothesis is rejected. This is in consonance with the research findings of Ma et al., in [50]; Yuen and Ma, in [51]; Wang and Wang, in [38]; Pynoo et al., in [52].

c) Hypothesis H3
The result showed that perceived usefulness has a significant positive effect on behavioural intention to use (H3: β = 0.349, p < 0.001). Therefore the hypothesis is retained. This implies that perceived usefulness is an essential factor that influences the behavioural intention to use EHR. This result is supported by previous research findings of Al-Fahim in [53]; Kesharwani and Radhakrishna in [54]; Kumar and Madhumohan in [55]; Bashir and Madhavaiah in [56]; Rawashdeh in [57].

d) Hypothesis H4
The results of this study showed that perceived ease of use has a significant positive effect on perceived usefulness (H4: β = 0.193, p < 0.003). Since the path coefficient indicated that perceived ease of use is a predicator for perceived usefulness, the hypothesis is retained. This finding is in line with many other TAM type of researches that include: Davis, in [14]; Igbaria and Ivani, in [58]; Szajna, in [59]; Venkatesh and Davis, in [25]; Dasgupta et al., in [60]; Ma and Liu, in [61]; Walker and Johnson, in [62]; Alenezi, Abdul Karim and Veloo, in [63]; Ulrich and Karvonnen, in [48].

e) Hypothesis H5
The obtained result after testing this hypothesis indicated that subjective norm has a significant positive effect on behavioural intention (H5: β = 0.401, p < 0.001). This path coefficient indicated subjective norm is predicator for behavioural intention, hence the hypothesis is retained. This is supported by the results from other similar researches as can be seen in the works of Fishbein and Ajzen in [20], and Davis, in [25], Khalifa and Ning shen in [64]; Nor and Pearson in [65]; Jaradat in [66]; Al-Majali in [67].

f) Hypothesis H6
The results obtained showed that subjective norm has a significant positive effect on perceived ease of use (H6: β = 0.239, p < 0.001). This result is supported by previous research findings of Lee, Kozar and Larsen, in [68]; Pituch and Lee, in [69]; Yuen and Ma, in [51]. The hypothesis is therefore retained.

g) Hypothesis H7
After testing this hypothesis, the result obtained showed that subjective norms do not have a significant effect on perceived usefulness (H7: β = -0.008, p = 0.324). This path coefficient indicated subjective norm is not a predicator for perceived usefulness, hence the hypothesis is
rejected. This result is similar to research findings of: Hu et al., in [70]; Schepers and Wetzels, in [71]; Venkatesh and Davis, in [25]; Wang and Wang, in [38]; Yuen and Ma, in [51].

h) Hypothesis H₈
The results obtained proved that social influence has a significant positive effect on perceived usefulness (H₈: β = 0.647, p < 0.001). The hypothesis is retained because the path coefficient indicated that social influence is a predictor for perceived usefulness. Previous researches similar to this study such as those of Venkatesh and Davis in [35], Lu et al. in [72], Jaradat in [66] and Sathye, in [73] validates this result.

i) Hypothesis H₉
The results of this hypothesis testing indicated that result demonstrability has a significant positive effect on perceived usefulness (H₉: β = 0.562, p < 0.001). The hypothesis is retained. This result is supported by the previous findings of Venkatesh and Bala, in [74]; Gagnon et al., in [75]; Shihaba et al. in [76].

j) Hypothesis H₁₀
The findings of this study showed that computer self efficacy has a significant positive effect on perceived ease of use (H₁₀: β = 0.529, p < 0.001). This path coefficient indicated that computer self efficacy is a predictor for perceived ease of use, hence the hypothesis is retained. This finding is consistent with previous research establishing a positive relationship between these constructs. This result is in line with previous research outcomes of: Hong, et al., in [77]; Hu et al., in [70]; Kwon et al., in [78]; Pituch and Lee, in [69]; Toral et al., in [79]; Wang and Wang, in [38]; Yuen and Ma, in [51].

k) Hypothesis H₁₁
After testing of this hypothesis, the result obtained showed that system quality has a significant positive effect on perceived usefulness (H₁₁: β = 0.254, p < 0.001), hence the hypothesis is retained. This result agrees with the research findings of Russell, Bebell and O’Connor, in [80]; Pituch and Lee in [69]; Condie and Livingston, in [81]; Park, Nam, and Cha, in [82]; Fathema and Sutton, in [83]; Salajan et al., in [84].

![Extended TAM path analysis for EHR](image-url)
Table 5. Hypothesis testing results

| Hypothesis | Path       | β   | p-value | Results    |
|------------|------------|-----|---------|------------|
| H₁         | BI → AU    | 0.692 | 0.001   | Supported  |
| H₂         | PEOU → BI  | 0.127 | 0.223   | Not Supported |
| H₃         | PU → BI    | 0.349 | 0.001   | Supported  |
| H₄         | PEOU → PU  | 0.193 | 0.003   | Supported  |
| H₅         | SN → BI    | 0.401 | 0.001   | Supported  |
| H₆         | SN → PEOU  | 0.239 | 0.001   | Supported  |
| H₇         | SN → PU    | -0.008 | 0.324   | Not Supported |
| H₈         | SI → PU    | 0.647 | 0.001   | Supported  |
| H₉         | RD → PU    | 0.562 | 0.001   | Supported  |
| H₁₀        | CSE → PEOU | 0.529 | 0.001   | Supported  |
| H₁₁        | SQ → PU    | 0.254 | 0.001   | Supported  |

5. CONCLUSION

This study detailed an empirical investigation of factors that determine the adoption decision of electronic health records. Consequently, the TAM was extended. The findings of this study indicated that the extended TAM employed is apposite for identifying the factors that determine the adoption decision of EHR by healthcare professionals. Five external variables that include Subjective norm, Social influence, Result demonstrability, Computer self-efficacy and System quality were incorporated to extend the original TAM model, with the PEOU and PU being the mediating constructs for the introduced external variables.

In all, nine constructs were proposed as significant determinants that influence the healthcare professionals’ decision of adopting EHR. With these constructs, eleven hypotheses were formulated to analyze the relationships between the constructs. The results obtained showed that all hypotheses were supported except for hypothesis H₂ (Perceived ease of use has a significant positive effect on behavioural intention to use EHR) and H₇ (Subjective norm has a significant positive effect on perceived usefulness of EHR). Also, most of the significant assumptions have been proven empirically and statistically significant. Thus, research and data analysis make several theoretical and practical contributions.

In conclusion, this study can serve as a guide to information systems designers and developers at the requirements definition stage when designing electronic health record systems as factors that include Perceived ease of use, perceived usefulness, Subjective norm, Social influence, Result demonstrability, Computer self-efficacy and System quality should be prioritized to fulfill its implementation as obtained from the results of this study. The direction of future research may be tuned towards investigating other factors such as Effort expectancy, Facilitating condition, Job relevance and so on that may influence the adoption decision of EHR.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Vawdrey DK, Sundelin TL, Seamons KE, Knutson CD. Trust negotiation for authentication and authorization in healthcare information systems. Proceeding of 25th Annual International Conference IEEE; 2003.
2. Shenai S, Aramudhan M. Cloud computing framework to securely share health and medical records among federations of healthcare information systems. Biomedical Research. 2018;Special Issue: 133-136.
3. Kester Q, Nana L, Pascu AC, Gire S, Eghan JM, Quaynor NN. A cryptographic technique for security of medical images in health information system. Second International Symposium on Computer Vision and Internet (VisionNet'15): Signal Processing, Image Processing and Pattern Recognition (SIPR’15), Procedia Computer Science 58. Science Direct, Elsevier. 2015;538-543.
4. Reinhold HR. Health information systems – past, present, future. International Journal of Medical Informatics. 2015;75:268-281.
5. Ludwick D, Manca D, Doucette J. Primary care physicians’ experiences with electronic medical records. Can Fam Physician. 2010;56(1):40–7.
6. Nov O, Schecter W. Dispositional resistance to change and hospital physicians’ use of electronic medical records: A multidimensional perspective. J Am Soc Inform Sci Technology. 2012;63(4):648–56.
7. Lapointe L. L’adoption de systemes d’information cliniques par les medecins et les infermieres: Une etude des variables individuelles, socio-politiques et organisationnelles. In: HEC. Universite de Montreal, Montreal; 1999.
8. McGinn C, et al. Comparison of user groups’ perspectives of barriers and facilitators to implementing electronic health records: A systematic review. BMC Med. 2011;9(1):46.
9. McGinn CA, et al. Users’ perspectives of key factors to implementing electronic health records in Canada: A delphi study. BMC Med Inform Decis Mak. 2012;12:105.
10. Centers for Medicare & Medicaid Services. Electronic Health Records [Definition]; 2016. Available: https://www.cms.gov/ehealthrecords/
11. Burk D. A framework for sharing personal medical information securely and efficiently across public / private institutions. Cisco Internet Business Solutions Group (IBSG); 2010. Available: http://tools.cisco.com
12. Poissant L, Pereira J, Tamblyn R, Kawasumi Y. The impact of electronic health records on time efficiency of physicians and nurses: A systematic review. Journal of the American Medical Informatics Association. 2005;12(5):2-5.
13. Zhang J, Patel V. Electronic health records - A human project. E-Health and Medical IT Solutions. 2006;35-36.
14. Davis F. Perceived usefulness, perceived ease of use and user acceptance of information technology. MIS Quarterly. 1989;13(3):318–339.
15. Ajzen I, Fishbein M. Understanding attitudes and predicting social behaviour. Prentice-Hall, Englewood Cliffs, New Jersey; 1980.
16. Taylor S, Todd P. Understanding information technology usage: A test of competing models. Information Systems Research. 1995;6(2):143–176.
17. Davis FD, Bagozzi RP, Warshaw PR. User acceptance of computer technology: A comparison of two theoretical models. Management Science. 1989;35:982–1003.
18. Davis FD, Cosenza RM. Business research for decision making. Third Edition. Belmont, CA: Wadsworth Inc; 1993.
19. Adams D, Nelson R, Todd P. Perceived usefulness, ease of use, and usage of information technology: A replication. MIS Quarterly. 1992;16(2):227–247.
20. Fishbein M, Ajzen I. Belief, attitude, intentions and behaviour: An introduction to theory and research. Addison-Wesley, Boston; 1975.
21. Fishbein M, Ajzen IA. Theory of reason action: Some applications and implications, in Howe H, Page M. (Eds): Nebraska symposium on motivation. University of Nebraska Press, Lincoln, NB; 1979:65–116.
22. Yogesh M, Dennis F. Extending the technology acceptance model to account for social influence: Theoretical bases and empirical validation. Thirty-Second Annual Hawaii International Conference on System Sciences, IEEE; 1999.
23. Chen L, Gillenson M, Sherrell D. Enticing online consumers: An extended technology acceptance perspective. Information and Management. 2002;39(8):705–719.
24. Legris P, Ingham J, Collerette P. Why do people use information technology? A critical review of the technology acceptance model. Information & Management. 2003;40(3):191–204.
25. Venkatesh V, Davis F. A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science. 2000;46(2):186–204.
26. Szajna B. Empirical evaluation of the revised technology acceptance model. Management Science. 1996;42(1):85–92.
27. Lucas HC, Splitter VK. Implementation in a world of workstations and networks. Information & Management. 2000;38(2):119–128.
28. Ajzen I. The theory of planned behaviour. Organization Behaviour and Human Decision Processes. 1991;50:179-211.
29. Dillon A, Morris M. User acceptance of information technology: Theories and models. In: Williams M (ed.) annual review of information science and technology. Medford NJ: Information Today. 1996;31:3-32.

30. Moore GC, Benbasat I. Development of an instrument to measure the perceptions of adopting an information technology innovation. Information Systems Research. 1991;2:192-222.

31. Bandura A. Social foundations of thought and action: A social cognitive theory. Englewood, NJ: Prentice-Hall; 1996.

32. Gist ME. Self-efficacy: Implications for organizational behavior and human resource management. Academy of Management Review. 1987;12(3):472-485.

33. Compeau DR, Higgins CA. Computer self-efficacy: Development of a measure and initial test. MIS Quarterly. 1995;19(2):189-211.

34. Hung SY, Liang TP. Effect of computer self-efficacy on the use of executive support systems. Industrial Management and Data Systems. 2001;101(5):227-237.

35. Ong CS, Lai JY, Wang YS. Factors affecting engineers’ acceptance of asynchronous e-learning systems in high-tech companies. Information and Management. 2004;41:795-804. Available:http://dx.doi.org/10.1016/j.im.2003.08.012

36. Chau PYK. Influence of computer attitude and self-efficacy on IT usage behavior. Journal of End User Computing. 2001;13(1):26-33.

37. DeLone WH, McLean ER. Information systems success: The quest for the dependent variable. Information Systems Research. 1992;3(1):60-95.

38. Wang WT, Wang CC. An empirical study of instructor adoption of web-based learning systems. Computers and Education. 2009;53:761-774. DOI: 10.1016/J.Compedu.2009.02.021

39. DeVellis RF. Scale development. Newbury Park, CA: Sage Publications; 1991.

40. Hair JF, Anderson RE, Tatham RL, William CB. Multivariate data analysis with readings. New Jersey: Prentice-Hall, Inc; 1995.

41. Thompson RL, Higgins CA, Howell JM. Influence of experience on personal computer utilization: Testing a conceptual model. Journal of Management Information Systems. 1995;11(1):167-187.

42. Cheung C, Lee M. Trust in internet shopping: A proposed model and measurement instrument. Proceedings of the Sixth Americas Conference in Information Systems, Long Beach, CA; 2000.

43. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing. Research. 1981;18:39-50.

44. Bollen KA. Overall fit in covariance structure models: Two types of sample size effects. Psychological Bulletin. 1990;107(2):256.

45. Lai JY, Li DH. Technology acceptance model for internet banking: An invariant analysis. Information & Management. 2005;42:373-386.

46. Miles J, Shevlin M. Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis. Personality and Individual Differences. 1998;25:85-90.

47. Hooper D, Coughlan J, Mullen MR. Structural equation modelling: Guidelines for determining model fit. Electronic Journal of Business Research Methods. 2008;6(1):53-60.

48. Ulrich J, Karvonen M. Faculty instructional attitudes, interests and intention: Predictors of web 2.0 use in online courses. The Internet and Higher Education. 2011;14:207-216. DOI: 10.1016/j.iheduc.2011.07.001

49. Jaradat MR. Applying the technology acceptance model to the introduction of mobile voting. International Journal of Mobile Learning and Organisation, Inderscience Enterprises Ltd. 2013;7(1).

50. Ma WWK, Andersson R, Strehl KP. Examining user acceptance of computer technology: An empirical study of student teachers. Journal of Computer Assisted Learning. 2005;21:387-395. DOI: 10.1111/j.1365-2729.2005.00145.x

51. Yuen AHK, Ma WWK. Exploring teacher acceptance of e-learning technology. Asia-Pacific Journal of Teacher Education. 2008;36:229-243. DOI: 10.1080/13598660802232779

52. Pynoo B, Tondeur J, van Braak J, Duyck W, Sijnave B, Duyck P. Teachers’ acceptance and use of an educational portal. Computers & Education. 2012;58:1308-1317. DOI: 10.1016/j.compedu.2011.12.026
53. Al-Fahim NH. Factors affecting the adoption of internet banking amongst IIUM's students: A structural equation modeling approach. Journal of Internet Banking Commerce. 2012;17(3):1.

54. Keshawani A, Radhakrishna G. Drivers and inhibitors of internet banking adoption in India. Journal of Internet Banking Commerce. 2013;18(3):1.

55. Sharma SK, Govindaluri MSM. Internet banking adoption in India: Structural equation modeling approach. Journal of Indian Business Research. 2014;6(2):155–169.

56. Bashir I, Madhavaiah C. Consumer attitude and behavioural intention towards internet banking adoption in India. J Indian Bus Res. 2015;7(1):67–102.

57. Rawashdeh A. Factors affecting adoption of internet banking in Jordan: Chartered accountant’s perspective. Int J Bank Mark. 2015;33(4):510–529.

58. Igbaria M, Livari J. The effects of self-efficacy on computer usage. Omega, International Journal of Management Science. 1995;23:587-605. DOI: 10.1016/0305-0483(95)00035-6

59. Szajna B. Empirical evaluation of the revised technology acceptance model. Management Science. 1996;42(1):85-92. Available: http://www.jstor.org/stable/2633017

60. Dasgupta S, Granger M, McGarry N. User acceptance of e-collaboration technology: An extension of the technology acceptance model. Group Decision and Negotiation. 2002;11:87-100. DOI: 10.1023/A:1015221710638

61. Ma Q, Liu L. The technology acceptance model: A meta-analysis of empirical findings. Journal of Organizational and End User Computing. 2004;16(1):59-72.

62. Walker G, Johnson N. Faculty intentions to use components of web-enhanced instruction. International Journal on E-Learning. 2008;7(1):133-152.

63. Alenezi AR, Karim AAM, Veloo A. Institutional support and e-learning acceptance: An extension of the technology acceptance model. International Journal of Instructional Technology and Distance Learning. 2011; 8(2):3-16. Available: http://www.itdl.org/Journal/Feb_11/article01.htm

64. Khalifa M, Shen NK. Drivers for transactional B2C mobile commerce adoption: Extended theory of planned behavior. Journal of Computer Information Systems. 2008;48(3):111–117.

65. Nor K, Shanab E, Pearson J. Internet banking acceptance in Malaysia based on the theory of reasoned action. Journal of Information Systems and Technology Management. 2008;5(1):03–14.

66. Jaradat MR. Understanding the acceptance of mobile university services: An empirical analysis. Int. J. Mobile Learning and Organisation. 2010;4(4):407–427.

67. AL-Majali M. The use of theory reasoned action to study information technology in Jordan. Journal of Internet Banking and Commerce (JIBC). 2001;16(2):1–11.

68. Lee Y, Kozar KA, Larsen KRT. The technology acceptance model: Past, present and future. Communications of the Association for Information Systems. 2003; 2(1):752-780. Available: http://aisel.aisnet.org/cais/vol12/iss1/50/

69. Pituch KA, Lee YK. The influence of system characteristics on e-learning use. Computers & Education. 2006;47:222-244. DOI: 10.1016/j.compedu.2004.10.007

70. Hu PJH, Clark THK, Ma WW. Examining technology acceptance by school teachers: A longitudinal study. Information and Management. 2003;41:227-241. DOI: 10.1016/S0378-7206(03)000508

71. Schepers J, Wetzels M. A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects. Information and Management. 2007;44:90-103. DOI: 10.1016/j.im.2006.10.007

72. Lu J, Yao J, Yu C. Personal innovativeness, social influences and adoption of wireless Internet services via mobile technology. Journal of Strategic Information Systems. 2005;14:245–268.

73. Sathye S, Prasad B, Sharma D, Sharma P, Sathye M. Factors influencing the intention to use of mobile value-added services by women-owned microenterprises in Fiji. Electronic Journal of Information Systems for Developing countries, John Wiley & Sons Ltd. 2018;1:1-10. Available: https://doi.org/10.1002/isd2.12016

74. Venkatesh V, Bala H. Technology acceptance model 3 and a research
agenda on interventions. Decision Sciences. 2008;38(2):27-315.
75. Gagnon M, Ghandour E, Talla PK, Simonyan D, Godin G, Labrecque M, Ouime M, Rousseau M. Electronic health record acceptance by physicians: Testing an integrated theoretical model. Journal of Biomedical Informatics, Elsevier. 2013;1-12. Available: http://dx.doi.org/10.1016/j.jbi.2013.10.010
76. Shihaba MR, Meilatinovaa N, Hidayantoa AN, Herkules B. Determinants of CAATT acceptance: Insights from public accounting firms in Indonesia, 4th Information Systems International Conference 2017, ISICO 2017, 6-8 November 2017, Bali, Indonesia. Procedia Computer Science. 2017;124:522–529.
77. Hong W, Thong JYL, Wong WL, Tam KY. Determinants of user acceptance of digital libraries: An empirical examination of individual differences and system characteristics. Journal of Management Information Systems. 2001;18(3):97-124.
78. Kwon O, Choi K, Kim M. User acceptance of context-aware services: Self-efficacy, user innovativeness and perceived sensitivity on contextual pressure. Behaviour & Information Technology. 2007;26:483-498. DOI: 10.1080/01449290600709111
79. Toral SL, Barrero F, Martinez-Torres MR. Analysis of utility and use of a web-based tool for digital signal processing teaching by means of a technological acceptance model. Computers & Education. 2007;49:957-975. DOI: 10.1016/j.compedu.2005.12.003
80. Russell M, Bebell D, O'Dwyer L, O'Connor K. Examining teacher technology use: Implications for pre-service and in-service teacher preparation. Journal of Teacher Education. 2003;54(5):297–310.
81. Condie R, Livingston K. Blending online learning with traditional approaches: Changing practices. British Journal of Educational Technology. 2007;38(2):337-348.
82. Park SY, Nam M, Cha S. University students' behavioral intention to use mobile learning: Evaluating the technology acceptance model. British Journal of Educational Technology. 2012;43(4):592-605. DOI: 10.1111/j.1467-8535.2011.01229.x
83. Fathema N, Sutton K. Factors influencing faculty members’ learning management systems adoption behavior: An analysis using the technology acceptance model. International Journal of Trends in Economics Management & Technology. 2013;2(6):20-28.
84. Salajan FD, Welch AG, Ray CM, Peterson C. The role of peer influence and perceived teaching quality in faculty acceptance of web-based learning management systems. International Journal on E-Learning. 2015;14(4):487-524.