

Predicting Health Care Providers' Acceptance of a Personal Health Record Secure Messaging Feature

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Abstract

Background Personal health records (PHRs) can facilitate patient-centered communication through the secure messaging feature. As health care organizations in the Kingdom of Saudi Arabia implement PHRs and begin to implement the secure messaging feature, studies are needed to evaluate health care providers' acceptance. **Objective** The aim of this study was to identify predictors of health care providers' behavioral intention to support the addition of a secure messaging feature in PHRs using an adapted model of the Unified Theory of Acceptance and Use of Technology as the theoretical framework.

Methods Using a cross-sectional survey design, data on acceptance of secure messaging features in PHRs were collected from health care providers working at the Ministry of National Guard Health Affairs between April and May 2021. The proposed model was tested using partial least squares structural equation modeling in SmartPLS.

Results There were 224 participants: female (66.5%), 40 to 49 years of age (39.9%), nurses (45.1%), and those working more than 10 years in the organization (68.8%). Behavioral intention to support the addition of a secure messaging feature was significantly influenced by performance expectancy ($\beta = 0.21$, $p = 0.01$) and attitude ($\beta = 0.50$, $p < 0.01$), while other predicting factors, such as effort expectancy, social

Keywords

- ▶ personal health records
- ▶ secure messaging
- ▶ UTAUT
- ▶ eHealth
- ▶ health care providers

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influence, and facilitating condition, did not significantly affect the intention. Furthermore, age, years of experience, and professional role did not moderate the relationships.

Conclusion Health care professionals will support introducing a secure messaging feature in the PHRs if they serve the intended purpose. Considering attitude also plays a significant role in acceptance, it is necessary to arrange for training and support, so that caregivers, health care providers, and the patients become familiar with the benefits and expected outcomes of using the feature.

Background and Significance

With the turn of the century, there was a global strategy to create stronger health care systems to meet three aims—affordable, accessible, and high quality care—using eHealth applications.¹ eHealth is the application of information and communication technologies across a range of health care processes that uses health information technology (HIT) to support the delivery of safe, patient-centered care.^{2,3} HIT tools include health information systems, telemedicine, electronic health records (EHRs), personal health records (PHRs), clinical decision-support tools, online or electronic learning (eLearning) tools, and mobile devices.^{4–6} The United States enacted the Health Information Technology for Clinical and Economic Health (HITECH) Act to promote the adoption and meaningful use of HIT.⁷ This led to the widespread adoption of technologies, such as electronic prescribing and PHRs including secure messaging.⁸

HIT has been promoted to support the delivery of patient-centered care. Finney Rutten et al suggested HIT applications deliver patient-centered care through patient-centered communication.⁹ The six functions of patient-centered communication are as follows: (1) foster healing relationships, (2) exchange information, (3) respond to emotions, (4) manage uncertainty, (5) make decisions, and (6) enable self-management.^{9,10} Through understanding patient needs, values, and preferences, the relationship between patients and health care providers (HCPs) can be strengthened and improvements in health outcomes may be achieved.^{11,12}

PHRs are an eHealth tool that allows patients to interact with their personal health information, HCPs, and health care systems.¹³ PHR functionalities vary but may include scheduling appointments, refilling prescriptions, viewing laboratory results, and secure messaging.^{14,15} An important area of research has centered around the effects of secure messaging through PHRs on communication between patients and HCPs, patient engagement, and positive health outcomes.^{16–22} Secure messaging is a feature within PHRs that allows asynchronous communication between patients and their HCPs.²³ Electronic communication bridges the gap between patients and HCPs and enables patients to have continuous access to care.^{24–26} The majority of chronic disease care occurs away from the HCP and the clinical environment. However, communication is frequently need-

ed by either the patient or HCP. Patients may need clarification, prescription refills, or questions answered.²⁴ HCPs may need to contact patients to discuss laboratory results, modify medical orders, or change the care plan.²⁴

The focus of this study is the Kingdom of Saudi Arabia where the Ministry of Health launched its national eHealth strategy under the National Transformation Program in 2011.²⁷ The country allocated 4 billion Saudi Arabian Riyals (SAR; U.S. \$1.1 billion) between 2008 and 2011 to develop eHealth systems and laid a roadmap to implement eHealth in phases.^{28,29} The National Health Information Center in the country supports the exchange of health information electronically across health sectors and with other relevant bodies and motivates “all concerned entities to transform into electronic healthcare services.”³⁰ In a systematic review on the adoption and acceptance of various eHealth technologies in the country, 6 of the 15 studies involved EHRs and 2 studies involved electronic medical records.²⁷ There were no studies on PHRs, and no published data on the national adoption of any of the eHealth technologies. Finally, eHealth is still in its infancy, and there is limited national research on the adoption and implementation of HIT in the country.^{31–34}

Previous studies in the Kingdom of Saudi Arabia have found patients are interested in a secure messaging feature in PHRs. Alhammad found that 66.4% of participants would like to send e-mails to the doctor/clinic and 60.9% would like to receive reminders for preventive health services.³⁵ Al Sahan and Saddik reported that 74.1% of participants would like to communicate with the physician.³⁶ A single study in a rural primary care clinic in the Eastern Province of the Kingdom of Saudi Arabia evaluated the benefits of secure messaging and found improved glycemic control in 31 patients with diabetes.³⁷ However, no research to date has assessed HCP attitudes toward a secure messaging feature within the PHR. Acceptance is a major factor in successful implementation of eHealth technology and understanding HCPs perspectives can help to inform future efforts to support the goals of patient-centered communication and aid in the digital transformation of health care.

Objective

The aim of this study was to identify predictors of health care providers' behavioral intention to support the addition of a

secure messaging feature using the adapted model of the Unified Theory of Acceptance and Use of Technology (UTAUT) as a theoretical framework. The research questions were as follows:

- Does an adapted UTAUT model with the constructs of performance expectancy, effort expectancy, social influence, facilitating conditions, and attitude predict HCPs' behavioral intention to support secure messaging?
- Do age, professional role, and years of experience moderate the relationships between the main constructs and behavioral intention?

Theoretical Framework

The UTAUT was proposed by Venkatesh et al as a unified technology acceptance model, integrating eight theoretical models with a basis in information systems, psychology, and sociology.³⁸ The four core constructs of UTAUT—performance expectancy, effort expectancy, social influence, and facilitating conditions—were used. The construct of attitude, defined as positive or negative feelings related to performing a specific behavior, was added as an individual characteristic and an endogenous mechanism to extend UTAUT.³⁹ The five constructs act directly on the behavioral intention to support secure messaging.

Age, years of experience, and professional role were tested as moderators. The moderating effect of age has been studied in other technology acceptance studies.^{34,38,40,41} Venkatesh et al found that the relationship between performance expectancy and behavioral intention was stronger for younger employees because they give greater weight to perceived usefulness.³⁸ Similarly, this research will use age with the expectation that the influence of performance expectancy will be moderated by age, so the effect will be stronger for younger HCPs since older professionals are less adaptable and willing to use new technology.⁴² For all other relationships between the main constructs and behavioral intention, age will act as a moderator with a stronger effect expected for older HCPs.

An indirect relationship between the number of years since graduating medical school and support for HIT use among physicians has been reported.⁴³ As the number of years out of medical school increases, support for HIT decreases. Problems using technology that are evident when experience is limited diminish over time and process issues drive used at later stages.⁴⁴ Years of experience were expected to moderate the relationships between behavioral intention and effort expectancy, social influence, facilitating conditions, and attitudes.

Finally, professional role was expected to moderate the relationships between performance expectancy, social influence, attitude and behavioral intention. In a study evaluating factors associated with HCP adoption of eHealth, physician role was an important characteristic.⁴⁵ Physicians used more advanced features than nonphysicians, and specialists (e.g., obstetrician–gynecologists) were less likely to use EHRs. Other studies showed the threat of loss of autonomy weakens physicians' behavioral intention to support the use of the PHR as compared with other HCPs.^{46,47}

Methods

Study Design

In this cross-sectional study, a survey to assess acceptance of a secure messaging functionality was administered to HCPs across a large health care organization in the Kingdom of Saudi Arabia. The study was approved by the institutional review boards at the Virginia Commonwealth University and King Abdullah International Medical Research Center.

Setting and Participants

Health services in the Kingdom of Saudi Arabia are provided by the Ministry of Health, other government health providers (e.g., Ministry of National Guard Health Affairs [MNGHA], Ministry of Defense, and Aramco), and providers in the private sector.³¹

MNGHA is a multispecialty accountable health care system established in 1983 and a well-recognized government health care system and leader in eHealth who received the Middle East Excellence Award in 2010 for EHR implementation.³³ The organization employs 27,361 staff including 4,653 medical staff, 7,565 nursing staff, and 6,046 allied health staff. In 2018, there were five medical cities, specialist hospitals, and 71 Family Medicine and Primary Health Care clinics.⁴⁸ A unified electronic medical record system and paperless environment was implemented in 2016 with the BESTCare health information management system.

The MNGHA Care PHR has been available since 2018 and is integrated with the BESTCare system. We were unable to secure objective data on PHR adoption, but our previous research showed 70% adoption by patients across the organization with the majority of patients reporting that they learned about the PHR from HCPs or hospital staff.⁴⁹ Patients are able to access the PHR through a web browser or by downloading a mobile phone application after registering with their medical record number and creating a password. The following features are available: checking laboratory results, requesting medical reports and prescription refills, viewing radiology reports, receiving vaccination reminders, and scheduling appointments.⁴⁸ Personal health information (i.e., weight, blood pressure, blood sugar, and exercise details) can be uploaded. MNGHA Care also contains a self-assessment feature permitting patients to enter information related to pain control, performance status, and quality of life, and links to health education information.⁵⁰ Currently, patients and their HCPs do not communicate using secure messaging through the PHR.

The target sample size for this study was 200 HCPs which has been considered a fair sample size for statistical analysis with structural equation modeling.⁵¹ It was hoped that this would ensure a large enough sample to be representative across categories of interest (i.e., professional role, age, and years of experience). HCPs were selected from MNGHA hospitals and primary health care centers in Dammam, Riyadh, Jeddah, Madinah, Al Ahsa, and Qassim, including physicians, dentists, pharmacists, nurses, physical and occupational therapists, optometrists, technicians (pharmacy, medical imaging, medical and pathology laboratory, dental),

paramedics, and dietitians. Secure messaging has been used in diverse settings and in various ways by teams of HCPs.^{13,52} For this reason, we chose to focus on all HCPs rather than any particular group. However, we had no data on the distribution of HCPs by hospital.

Instrument

Data were collected using an anonymous self-administered online survey between April and May 2021. The initial version of the survey included 63 items adapted from previously published technology acceptance surveys.^{38,41,53–56} The survey consisted of three parts. Part 1 included demographic characteristics, namely, age, gender, region, facility type, profession, specialty area for physicians, years in profession, years at MNGHA, and nationality. Part 2 contained four general PHR questions as follows: (1) have you heard of MNGHA Care; (2) do you have an MNGHA Care account; (3) have you used MNGHA Care yourself; and (4) have you recommended patients use MNGHA. There were also the Likert-scale statements associated with PHR acceptance, one open-ended question, and a checklist. Part 3 pertained to acceptance of secure messaging and included the Likert-scale statements, one open-ended question, and a checklist. The open-ended question and checklist were to examine barriers. The checklists asked respondents to select the three main challenges to PHR acceptance and secure messaging. The open-ended questions were used to solicit additional comments and concerns about the PHR and secure messaging.

The instrument was created on and disseminated via QuestionPro.⁵⁷ It was pilot tested with seven HCPs (two physicians, three pharmacists, and two nurses) working within MNGHA. The survey link and a cover letter explaining the purpose of the study were emailed to the HCPs to obtain feedback regarding survey length, clarity, and flow of the questionnaire. After comments were compiled, 12 items were removed, and some were modified to improve clarity and to decrease survey length. The final version of the survey included 51 items.

Previous analysis on HCP acceptance of the PHR was published elsewhere.⁵⁸ The current study focuses on acceptance of secure messaging (part 3). However, analysis of the open-ended question and the checklist from this section will be reported separately. Responses to the secure messaging acceptance items were provided on a 5-point Likert's scale from strongly disagree (1) to strongly agree (5).

Acceptance was the dependent variable and was operationalized as the intention to recommend patients use the PHR using the single statement: "I would endorse secure messaging between patients and health care providers."^{34,38,53,59} The intention to endorse secure message is expected to lead to the adoption of secure messaging by HCPs. Behavioral intention is frequently a proxy for actual technology adoption in the literature.^{60–62}

The independent variables were performance expectancy, effort expectancy, social influence, facilitating conditions, and attitude. Performance expectancy was defined as the degree to which the HCPs believe secure messaging

will be beneficial in the health care delivery process.³⁸ It was measured with the following four items:

1. "Adding secure messaging to MNGHA Care can likely enhance the efficiency in health care."^{34,38,53,54,59,63}
2. "I believe secure messaging will promote positive health outcomes."^{34,38,53,54,59,63}
3. "Secure messaging will help patients to better manage their health."^{34,38,53,54,59,63}
4. "I think secure messaging will be a useful extension to existing treatment."^{34,38,53,54,59,63}

Effort expectancy is the degree of ease expected with using secure messaging.³⁸ It was measured with the following three items:

1. "I think secure messaging would be easy to use."^{34,38,53,59}
2. "I believe most patients could easily learn to use secure messaging."^{34,38,53,59}
3. "Learning to use secure messaging will be easy for me."^{34,38,53,59}

Social influence is the degree to which an individual perceives important others' believe that secure messaging should be used.³⁸ It was measured with the following two items:

1. "I believe our patients will use secure messaging."⁵⁴
2. "The organization would support the use of secure messaging."⁵⁴

Facilitating conditions were defined as the degree to which an individual believes an organizational and technical infrastructure exists to support the use of secure messaging.³⁸ It was measured with the following three items:

1. "The organization has the resources to support the use of secure messaging."^{38,54,59}
2. "Technical help would be available to assist health care providers and patients with using secure messaging."^{38,54,59}
3. "I think secure messaging fits well with the mission of the organization."^{38,54,59}

Attitude was defined as positive feelings related to patients using secure messaging.³⁸ It was measured with the following four items:

1. "Secure messaging is a valuable tool."^{53,64}
2. "It is a good idea for patients to use secure messaging."^{38,53,64}
3. "Secure messaging is a positive advancement in this digital age."^{53,64}
4. "I believe secure messaging will be used by many patients."^{53,64}

Recruitment

HCPs were first recruited through convenience sampling using the hospital's e-mail list in combination with WhatsApp, since it is a widely used social media platform for professional communication. They were asked to forward the survey to other HCPs using snowball sampling.

The first page of the survey contained information about the study and enabled participants to provide informed consent. Follow-up reminders were also sent out up to three times. A random drawing of 37.5 Saudi Arabian Riyals (US \$10) for 25 Amazon gift cards was used as an incentive to encourage participation.

Data Analysis

Descriptive statistics were obtained using SPSS version 25.⁶⁵ Partial least squares structural equation modeling (PLS) was used to test the research model using SmartPLS Version 3.0.⁶⁶ PLS is a robust statistical technique widely used in empirical studies of technology acceptance including with UTAUT^{38,44,59} and with PHR acceptance.^{41,67} PLS supports using single-item measures,⁶⁸ particularly relevant in this study since the behavioral intention and social influence constructs include less than three items, and earlier research using PLS has used less than three items for measuring constructs.^{69,70}

The reliability of the measurement model was evaluated with the composite reliability (CR). A CR greater than 0.708 was indicative of construct reliability. The factor loadings and average variance extracted (AVE) were examined to determine convergent validity. Indicator loadings were required to be greater than 0.7 and AVE values greater than 0.5.⁷¹ The Fornell–Larcker criterion, wherein the square root of the AVE of each construct should be greater than its highest correlation with any other construct, was used to evaluate discriminant validity.⁷¹ Indicators were removed if the variance inflation factor was more than five, indicating collinearity, or if the weight and the loading were insignificant.

The structural model was assessed after evaluation of the measurement model. Predictive accuracy was determined with the coefficient of determination (R^2), indicating the extent to which the exogenous constructs (i.e., performance expectancy, effort expectancy, social influence, facilitating conditions, and attitude) explained the endogenous construct (i.e., behavioral intention). The effect sizes (f^2) were also measured. Path coefficients were interpreted as regression coefficients with the t -statistic calculated using bootstrapping, a nonparametric technique for estimating the precision of the partial least squares estimates. Finally, the significance of the path coefficients was examined.

Results

Demographic Characteristics and Personal Health Records Use

The characteristics of the 224 respondents are shown in **Table 1**. Most participants were female (66.5%), 40 to 49 years of age (39.9%), and non-Saudi (56.5%). Nurses represented the largest group of HCPs (45.1%). The majority of the HCPs had greater than 10 years' experience (68.8%), and had greater than 10 years at MNGHA (52.2%), and were hospital-based (95.1%). More than 80% of HCPs had a PHR account, used it, and had recommended it to patients.

Table 1 Demographic and PHR use characteristics ($n = 224$)

| Variable | n (%) |
|---|------------|
| Gender | |
| Male | 75 (33.5) |
| Female | 149 (66.5) |
| Age (y) | |
| 20–29 | 31 (13.9) |
| 30–39 | 70 (31.4) |
| 40–49 | 89 (39.9) |
| 50 and above | 33 (14.8) |
| Nationality | |
| Saudi | 97 (43.5) |
| Non-Saudi | 126 (56.5) |
| Years in profession | |
| < 5 | 27 (12.1) |
| 5–10 | 43 (19.2) |
| > 10 | 154 (68.8) |
| Years working at MNGHA | |
| < 1 | 12 (5.4) |
| 1–4 | 34 (15.2) |
| 5–10 | 61 (27.2) |
| > 10 | 117 (52.2) |
| Health care provider | |
| Physician | 35 (15.6) |
| Pharmacist | 50 (22.3) |
| Nurse | 101 (45.1) |
| Technician | 29 (12.9) |
| Other | 9 (4.0) |
| Health care facility | |
| Dammam | 40 (17.9) |
| Madinah | 30 (13.4) |
| Al Ahsa | 46 (20.5) |
| Jeddah | 29 (12.9) |
| Riyadh | 79 (35.3) |
| Have you heard of MNGHA Care? | 208 (92.9) |
| Do you have an MNGHA Care account? | 195 (88.2) |
| Have you used MNGHA Care? | 186 (83.0) |
| Have you recommended patients use MNGHA Care? | 179 (79.9) |

Abbreviations: MNGHA, Ministry of National Guard Health Affairs; PHR, personal health record.

Measurement Model

The measurement model testing results are shown in **Table 2**. Item loadings of all the items were in the range of 0.83 to 0.95, and CR was above the threshold of 0.5. The average variance

Table 2 Measurement model statistics

| Construct | Items | Mean | SD | VIF | Loadings | CR | AVE |
|------------------------------|-------|------|------|-------|----------|------|------|
| Performance expectancy (PE) | | 3.99 | 0.71 | | | 0.95 | 0.87 |
| | PE1 | | | 3.518 | 0.92 | | |
| | PE2 | | | 6.198 | 0.95 | | |
| | PE3 | | | 4.737 | 0.95 | | |
| | PE4 | | | 3.417 | 0.93 | | |
| Effort expectancy (EE) | | 3.85 | 0.64 | | | 0.89 | 0.74 |
| | EE1 | | | 2.452 | 0.91 | | |
| | EE2 | | | 1.862 | 0.83 | | |
| | EE3 | | | 1.753 | 0.84 | | |
| Facilitating conditions (FC) | | 3.87 | 0.73 | | | 0.93 | 0.86 |
| | FC1 | | | 2.104 | 0.91 | | |
| | FC2 | | | 2.104 | 0.94 | | |
| Social influence (SI) | | 3.81 | 0.69 | | | 0.89 | 0.81 |
| | SI1 | | | 1.602 | 0.90 | | |
| | SI2 | | | 1.602 | 0.90 | | |
| Attitude (ATT) | | 3.93 | 0.69 | | | 0.95 | 0.82 |
| | ATT1 | | | 4.522 | 0.93 | | |
| | ATT2 | | | 4.65 | 0.94 | | |
| | ATT3 | | | 4.587 | 0.94 | | |
| | ATT4 | | | 2.192 | 0.83 | | |
| Behavioral intention (BI) | BI | 3.95 | 0.78 | | 1 | 1 | 1 |

Abbreviations: AVE, average variance extracted; CR, composite reliability; SD, standard deviation; VIF, variance inflation factor.

extracted of the constructs was in the range of 0.74 to 0.87. However, one item from performance expectancy (PE2) had a variance inflation factor value higher than 5, indicating multicollinearity. This item was removed from further analysis. The discriminant validity was tested using the Fornell–Larcker criterion. The results are shown **►Appendix A**.

The square root of the corresponding average variance extracted is shown in bold. Since the Fornell–Larcker criterion was met, there was discriminant validity for all constructs.

Structural Model

Of the five independent variables, only performance expectancy ($\beta = 0.21$, $p = 0.01$) and attitude ($\beta = 0.50$, $p < 0.01$) had a significant relationship with the intention to endorse secure messaging in PHR (**►Table 3** and **►Fig. 1**). Attitude had a medium effect size, whereas performance expectancy

had a small effect size. The two independent variables—performance expectancy and attitude—accounted for 73% of variance in the intention to support secure messaging service in PHR among HCPs.

None of the proposed moderators—age, experience, and professional role—moderated the relationships between performance expectancy, effort expectancy, social influence, facilitating conditions, and attitude, and intention to endorse secure messaging in PHR (**►Table 4**).

Discussion

This is the first study examining predictors of HCPs' acceptance of a secure messaging functionality within an existing PHR in this context to our knowledge. Despite the potential benefits of this technology, the successful implementation

Table 3 Structural model results

| | β | t-Statistics | p-Value | f^2 |
|--|---------|--------------|---------|-------|
| Performance expectancy → behavioral intention | 0.21 | 2.486 | 0.01 | 0.04 |
| Effort expectancy → behavioral intention | 0.02 | 0.218 | 0.83 | 0 |
| Social influence → behavioral intention | 0.10 | 0.902 | 0.37 | 0.009 |
| Facilitating conditions → behavioral intention | 0.08 | 0.585 | 0.56 | 0.005 |
| Attitude → behavioral intention | 0.50 | 3.551 | <0.01 | 0.144 |

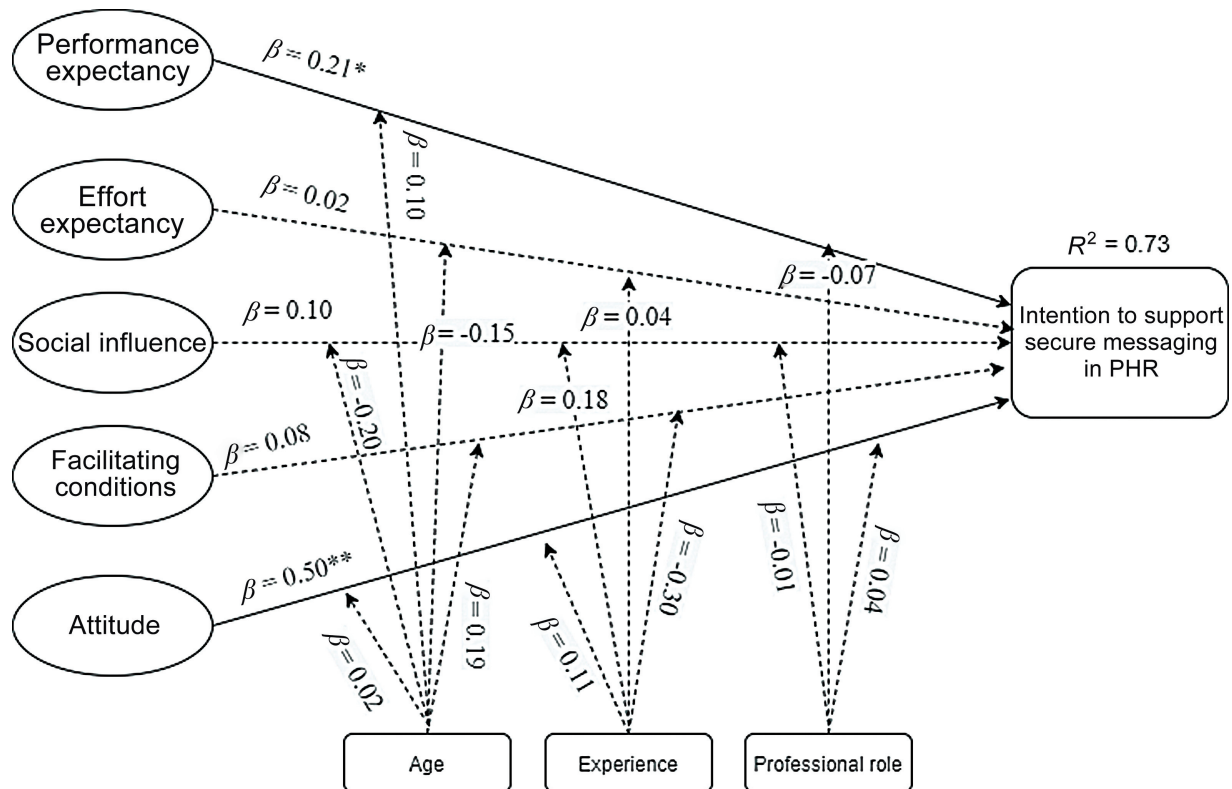


Fig. 1 Structural model. PHR, personal health record (**p-Value < 0.05).

Table 4 Moderation analysis results

| | β | t-Statistics | p-Value | f^2 |
|--------------------------|---------|--------------|---------|-------|
| Moderation of age | | | | |
| PE × AGE → BI | 0.10 | 1.194 | 0.233 | 0.01 |
| EE × AGE → BI | -0.15 | 0.998 | 0.319 | 0.01 |
| SI × AGE → BI | -0.20 | 1.19 | 0.235 | 0.02 |
| FC × AGE → BI | 0.19 | 1.056 | 0.291 | 0.014 |
| ATT × AGE → BI | 0.02 | 0.162 | 0.871 | 0 |
| Moderation of experience | | | | |
| EE × EXP → BI | 0.04 | 0.277 | 0.782 | 0.001 |
| SI × EXP → BI | 0.18 | 0.966 | 0.335 | 0.014 |
| FC × EXP → BI | -0.30 | 1.580 | 0.115 | 0.026 |
| ATT × EXP → BI | 0.11 | 0.492 | 0.623 | 0.003 |
| Moderation of profession | | | | |
| PE × HCP → BI | -0.07 | 0.732 | 0.465 | 0.006 |
| SI × HCP → BI | -0.01 | 0.021 | 0.983 | 0 |
| ATT × HCP → BI | 0.04 | 0.330 | 0.741 | 0.002 |

Abbreviations: AGE, age; ATT, attitude; BI, intention to support secure messaging; EE, effort expectancy; EXP, experience; FC, facilitating conditions; HCP, profession; PE, performance expectancy; SI, social influence.

and widespread adoption depend on the users' acceptance. An adapted UTAUT model was used to predict the acceptance of a secure messaging feature among HCPs. To our knowledge, this is also the first study to use a theoretical framework to evaluate the acceptance of secure messaging preimplementation. Our results provide support for the

proposed theoretical model which explained 73% of the variance in the dependent variable.

Attitude toward acceptance of secure messaging was positively associated with HCPs' behavioral intention to accept secure messaging, having the strongest impact on behavioral intention. Other researchers found that attitude

was an important individual factor in HCPs accepting eHealth technologies.^{45,72,73} As HCPs learn about the value of secure messaging for themselves and their patients, they will develop positive attitudes about this feature.⁷⁴ In the study by Ibrahim et al, attitude had a positive relationship with behavioral intention to use an electronic documentation system.⁷⁵ Similar to our study, Chung et al found attitude to be the strongest predictor of nurses' behavioral intention to adopt PHRs.⁵³ In the systematic review by Alanazi et al, a positive attitude by HCPs was correlated with EHR adoption.⁷⁶

Our finding that performance expectancy was a significant predictor of acceptance of secure messaging aligns with other studies where perceived usefulness had a strong impact on HCPs' behavioral intention to use secure messaging.⁴⁵ In PHR adoption research, performance expectancy has also been a significant predictor of behavioral intention to use PHRs.^{40,41,64,77,78}

Individual characteristics such as age, years of experience, and professional role may not be associated with technology adoption but rather moderate relationships between the main constructs and behavioral intention.^{45,79} Venkatesh et al found a stronger relationship between performance expectancy and behavioral intention in younger employees since there is greater weight on perceived usefulness.³⁸ Older professionals are believed to be less adaptable and willing to use new technology.⁴² Our results, however, did not show any moderating effects of these variables, even though our sample included relatively older professionals with most aged 40 to 49 years (39.9%). This is similar to a study on acceptance of a PHR application among health experts and health workers where age did not have moderating effects.⁷⁸ It is also consistent with the findings of a study on electronic medical record adoption by physicians.⁴⁴ In addition, we did not find moderating effects of professional role in our sample which consisted mainly of nurses (45.1%). This is in contrast to a study on telemedicine adoption where professional role was a moderator.⁸⁰ Finally, years of experience was not a moderator, whereas the majority (68.8%) had greater than 10 years of experience.

This study contributes to the existing literature on PHRs, securing messaging, and UTAUT by providing a better understanding of important factors that may affect the intention to use and, subsequently, adopt secure messaging in the context of the Kingdom of Saudi Arabia. It is important to note that the authors are not aware of any organizational plans with regard to secure messaging. Nonetheless, HCPs are a driving force behind patient acceptance of secure messaging.¹³ Acceptance factors are context sensitive, indicating studies should be conducted in the health care settings where the technology will be implemented.⁴⁵ Understanding the factors that affect HCPs' behavioral intention to accept secure messaging will reduce barriers and facilitate the uptake of this innovation. HCP resistance is a barrier to patients using PHRs and the secure message functionality.¹³

Our research extended UTAUT using the construct of positive attitude and moderators found to be relevant to

eHealth adoption in HCPs. Even though the model had a high predictive power, further extending UTAUT in this context with privacy and security constructs and other specific facilitating or inhibiting factors (e.g., time cost, eHealth and business process alignment, and professional autonomy) may be enlightening. It is also possible that performance expectancy is an antecedent of attitude.⁸¹ While age, professional role, and years of experience did not moderate the relationships between the independent variables and behavioral intention, there may be direct or mediating effects. Other moderators, such as HCP experience with using mobile applications, may be important for future research.

During the pandemic, several hospitals in the Kingdom of Saudi Arabia used WhatsApp for group messaging to assist patients with various health care processes (e.g., routine follow-ups, inquiries, and refill requests).⁸² Secure messaging through a PHR is a viable alternative to WhatsApp and can be useful in improving many clinical processes. Our findings provide evidence that positive attitudes exert a significant positive effect on HCPs' behavioral intention to accept a secure messaging feature. Therefore, in the early phases of planning and implementation, HCPs should be included in the discussions to select the clinical processes and population that will be best served. Haun et al highlighted the importance of developing a secure messaging culture in their study involving clinical care team members from various disciplines in the Veterans Integrated Service Networks.⁵² With a secure messaging culture and good communication, HCPs will develop a favorable attitude toward it, increasing provider buy-in and leading to successful implementation.^{46,52,83,84}

Therefore, health care organizations should engage HCPs and inform them of the benefits of secure messaging to strengthen support. Although most of the research on secure messaging has been conducted in the outpatient setting, recent studies have evaluated use in the inpatient environment.^{17,20,22,85} However, it is important for each organization to decide on a use case for the environment to encourage utilization.⁵² For example, Tsega et al chose discharge planning as their use case and targeted the internal medicine and social work departments.⁸⁶ Once the used cases, type of care, and targeted HCP departments are identified, training sessions and departmental champions can be used to educate HCPs about the secure messaging feature with a focus on benefits and integration into the workflow and, hopefully, increase the perceived benefits of secure messaging.

In August 2020, the Riyadh Global Digital Summit was held, and the Riyadh Declaration on Digital Health was formulated, outlining seven key priorities and nine recommendations to effectively address the challenges of the novel coronavirus disease 2019 (COVID-19) pandemic with digital health.⁸⁷ The recommendation of the Riyadh Declaration was to "cultivate a health and care workforce with the knowledge, skills, and training in data and digital technologies required to address current and future public health challenges."⁸⁷ With the COVID-19 pandemic, there has been an acceleration of the digital health transformation. As we anticipate that secure messaging functionality within PHRs

becomes more important in the health care delivery process to improve patient-centered communication in the Kingdom of Saudi Arabia, HCPs will be expected to play a crucial role in their use and endorsement.

Limitations

There are several limitations to this study. First, the cross-sectional design allows for the detection of association but not causal relationships. Next, the results may not be generalizable as nonprobability sampling methods were used, and the study was limited to HCPs working within MNGHA. Most of the participants were hospital-based as opposed to primary care, and perceptions may differ. Demographic data on HCPs was not available, so we could not perform stratified sampling by specialty. We also were unable to determine a response rate using convenience and snowball sampling. Therefore, both nonresponse and selection bias are possible. Even though the instrument was pilot tested in HCPs, there is the possibility that misinterpretation of questions was not detected. Self-administered online surveys are associated with various biases, including social desirability response bias, self-selection, and nonresponse bias.⁷⁵ To minimize social desirability response bias, participants had the option of not answering any question that made them uncomfortable. To minimize nonresponse bias, HCPs were contacted multiple times and offered an incentive to encourage participation.

Conclusion

Performance expectancy and attitude were significant predictors of HCPs' intention to support the addition of secure messaging in the Kingdom of Saudi Arabia. Future research should explore other predictors to develop successful interventions to implement this PHR functionality and contribute to patient-centered communication. Furthermore, health care organizations should focus on strategies to prepare HCPs and patients for secure messaging in the Kingdom of Saudi Arabia. There should be adequate knowledge and familiarity by both parties to promote patient-centered care and patient centered communication. Another area of future research is identifying ways to optimally use secure messaging in the organization by selecting specific categories of patients and focusing on achieving positive health outcomes, particularly in chronic diseases. To gain a deeper understanding, in-depth interviews with patients and HCPs would be useful.

Clinical Relevance Statement

Many organizations include a secure messaging feature through their personal health records to provide patient-centered communication. However, HCPs are frequently reticent to add this feature. Using an adapted UTAUT model, performance expectancy and attitude predicted health care providers' intention to support a secure messaging feature. The findings from this study are of interest to organizations planning implementation of a secure messaging feature.

Multiple Choice Questions

- When implementing secure messaging between health care providers and patients, which of the following are important strategies to encourage support from the health care providers?
 - Health care providers should be provided with education on the benefits of secure messaging for patients and the health care organization
 - Health care organizations should provide training to health care providers on secure messaging
 - The use of secure messaging must be mandated for all patients and by all health care providers in the organization
 - a and b
 - All of the above

Correct Answer: The correct choice is option d. Using a quantitative, theory-based approach, we found evidence that successful implementation of a secure messaging feature requires an emphasis on strategies that increase perceived usefulness of secure messaging and promote a positive attitude. Using a stepwise approach to introduce this feature while providing the necessary training and education of health care providers should encourage their support and lead to patient-centered communication in a sustainable manner. All patients would not be candidates for secure messaging; therefore, it should not be mandated for everyone.

- Which are some of the benefits associated with secure messaging between patients and healthcare providers?
 - Improved communication between patients and healthcare providers
 - Better patient engagement
 - Positive health outcomes
 - All of the above

Correct Answer: The correct choice is option d. All of the above are benefits of secure messaging. Many benefits are achieved through patient-centered communication by fostering healing relationships, improving information exchange, managing uncertainty, enabling self-management along with responding to emotions, and encouraging decision-making.

Protection of Human and Animal Subjects

The study was performed in compliance with the Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects. All procedures involving human participants were approved by the institutional review boards of King Abdullah International Medical Research Center and Virginia Commonwealth University.

Conflict of Interest

None declared.

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Appendix A Discriminant validity of the constructs

| | 1 | 2 | 3 | 4 | 5 |
|----------------------------|--------------|--------------|--------------|--------------|--------------|
| 1. Attitude | 0.907 | | | | |
| 2. Effort expectancy | 0.809 | 0.860 | | | |
| 3. Facilitating conditions | 0.873 | 0.794 | 0.928 | | |
| 4. Performance expectancy | 0.834 | 0.792 | 0.783 | 0.935 | |
| 5. Social influence | 0.82 | 0.815 | 0.822 | 0.742 | 0.898 |

Note: Square root of the corresponding average variance extracted is shown in bold.