Sustaining Patient Portal Continuous Use Intention and Enhancing Deep Structure Usage: Cognitive Dissonance Effects of Health Professional Encouragement and Security Concerns

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Abstract

Sustaining patient portal use is a major problem for many healthcare organizations and providers. If this problem can be successfully addressed, it could have a positive impact on various stakeholders. Through the lens of cognitive dissonance theory, this study investigates the role of health professional encouragement as well as patients' security concerns in influencing continuous use intention and deep structure usage among users of a patient portal. The analysis of data collected from 177 patients at a major medical center in the Midwestern region of the United States shows that health professional encouragement helps increase the continuous use intention and deep structure usage of the patient portal, while security concerns impede them. Interestingly, health professional encouragement not only has a direct positive influence on continuous use intention and deep structure usage but also lowers the negative impact of security concerns on them. The research model explains a substantial variance in continuous use intention (i.e., 40%) and deep structure usage (i.e., 32%). The paper provides theoretical implications as well as practical implications to healthcare managers and providers to improve patient portal deep structure usage and sustained use for user retention.

Keywords Patient portal · Health professional encouragement · Security concerns · Continuous use · Deep structure usage · Consumer health IT

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1 Introduction

Patient portals are defined as provider-tethered web-based applications that enable patients to access health information typically managed by a healthcare provider (Moqbel et al., 2020; Otte-Trojel et al., 2015). Evidence suggests that access to patient portals has tremendous benefits to healthcare providers (Fraccaro et al., 2018; O'Connor & O'Reilly, 2018; Schickedanz et al., 2013). It helps reduce costs by reducing the number of unnecessary patient visits that can be mitigated by the patient portal's secure messaging feature (Raghu et al., 2015). The benefits that patients receive from patient portal use include secure communications with health providers, convenience in scheduling appointments, ease of requesting prescription refills, online access and servicing of patient accounts, enhancement in patient self-management of chronic illnesses, and availability of educational resources to patients (Kruse et al., 2015a; Schickedanz et al., 2013; Serrano et al., 2020). Patients indicated that the benefits of using secure messaging include satisfaction, efficiency, improved visits, and access to data outside office visits (Wade-Vuturo et al., 2013; Wang et al., 2021).

Despite the Health Information Technology for Economic and Clinical Health (HITECH) Act that was passed more than a decade ago in which healthcare professionals are incentivized to adopt meaningful use of digital health (Rathert et al., 2019), 80% of patients are still reluctant to use patient portals (Heath, 2018a; Heath, 2018b). Barriers to enrolling in a patient portal include lack of information such as not knowing that the portal exists, failure to access the portal, negative attitudes toward the patient portal, preference for non-electronic communications, and technology-related issues such as lack of Internet access or computer proficiency (Goel et al., 2011a; Goel et al., 2011b). Security concerns have been major issues in the adoption of patient portals (Mukherjee & Nath, 2003; Sathye, 1999; Son et al., 2021). In comparison to similarly security-sensitive industries such as banking, in which almost 75% of Americans access their bank accounts online (Federal Reserve, 2016), merely 30% of American patients used patient portals in 2018 (Heath, 2018b). Evidence shows that patient portal use tapered off after first use and dropped from 77% in the first month to 30% in half a year (Weingart et al., 2006); however, the reasons that individuals were dropping from enrollment were unclear. In another study, Goel et al. (2011a) determined that 25% of 159 patients who participated in their survey indicated that security was a major concern when considering activating an account and using a patient portal. Anthony et al. (2018) determined that 22% of the people surveyed were not using patient portals due to security and privacy concerns. Hence, the exigency to find factors that impact patient portal continuous use is highly warranted because the full benefits of implementing digital health technologies (Thambusamy & Palvia, 2020) by healthcare organizations cannot be realized if continuous use by patients cannot be sustained.

Past research examined several factors that influence the adoption of patient portals, including personal factors (e.g., income, gender, and race), human-technology-factors (e.g., perceived ease of use and usefulness), and organizational factors (Abd-alrazaq et al., 2019; Ancker et al., 2011; Fowles et al., 2004; Goel et al., 2011a; Goel et al., 2011b; Hsu et al., 2005; Huvila et al., 2018; Li et al., 2014; Nicholas et al., 2003; Roblin et al., 2009; Sarkar et al., 2010; Sarkar et al., 2011; Weingart et al., 2006). However, despite the considerable merits of these studies in enhancing our understanding of the role of these factors in patient portal user behaviors, the existing literature largely overlooks the importance of continuous use and deep structure usage of patient portals among users (those who reported having an account) and the role of cognitive dissonance in sustaining continuous use and deep structure usage, such as weighing health professional encouragement against security concerns. Deep structure usage of a patient portal refers to the use of features supporting healthcare management.

In the context of patient portal use, health professional encouragement refers to giving support, recommendations, and confidence to patients in their use of patient portals. Health professional encouragement, a type of social influence that is also known as a normative belief or subjective norm, is rarely studied in the patient portal use context. Yet, social influence is widely studied in other contexts, including social media, enterprise resource planning, and wearable fitness (Ajzen, 1991; Hsu et al., 2013; Ifinedo, 2012; Lunney et al., 2016; Nah & Tan, 2015; Seethamraju et al., 2018). Scholars who examined technology adoption in various contexts found social influence impacted technology adoption. In this paper, we study a unique aspect of social influence by considering the role of health professional encouragement in the post-technology-adoption context (i.e., patient portal continuous use).

Due to an increasing trend in the number of security breaches, security has become a main concern for healthcare institutions and patients (Bodenheimer & Grumbach, 2003; Cantor, 2001; Collins et al., 2017). Security concerns in the healthcare context refer to concerns about the risks and vulnerabilities associated with patient health information and the protective actions taken against these threats. Individuals often rely on security perceptions in the decision-making process to adopt a certain behavior or technology (Angst & Agarwal, 2009; Archer & Cocosila, 2014; Dai & Chen, 2015; Featherman et al., 2010; Hsu et al., 2013; Zailani et al., 2015). As such, we contend that security concerns can play an important role in patient portal use.

Drawing on cognitive dissonance theory (CDT), we investigate the cognitive dissonance effects of health professional encouragement and security concerns on the continuous use intention and deep structure usage of a patient portal among its existing users. This study makes several key contributions to the field. First, the literature has, to some extent, ignored the examination of issues in sustaining continuous use of patient portals, especially given the high churn rates in patient portal use, thus creating a gap in an important stage of technology use (post-adoption) that is addressed in this study. Second, the literature has largely overlooked the role of cognitive dissonance in the post-adoption (continuous use) of health IT. Drawing on CDT, we identified an enabling factor (i.e., health professional encouragement) and a hindering factor (i.e., security concerns) to understand users' trade-off in resolving cognitive dissonance in the decisions on continuous use of a patient portal. Third, we argue that due to cognitive dissonance, health professional encouragement might help mitigate the negative effects of security concerns on the continuous use and deep structure usage of patient portals. Hence, we examine the moderating role of health professional encouragement on the relationships between security concerns and continuous use intentions as well as deep structure usage of patient portals. Understanding the interaction effect of health

professional encouragement and security concerns is important to provide health institutions with guidelines for boosting patient portal continuous use and the extent of structural usage.

The rest of the paper is organized as follows: Section 2 provides the literature review. Section 3 presents the theoretical foundation and hypotheses. Section 4 describes the research method, and section 5 presents the results. Section 6 discusses the findings, and section 7 concludes the paper.

2 Literature Review and Research Background

2.1 Patient Portals

Interest in the adoption and use of patient portals is widespread since patients' actual usage is quite low. For example, only roughly 16% (11,000) of close to 75,000 active adult patients of a major federally qualified healthcare network requested access codes for the patient portal, and a little less than 10% (7100) activated their accounts (Ancker et al., 2011). Byczkowski et al. (2014) found that 28% of 1900 families obtained an account for the patient portal; however, only half of them (i.e., those with an account) used the portal once, and only 7.5% continued to use the portal. In 2017, out of 52% of individuals nationwide that were offered online access to their medical record by a health care provider or insurer, only about half (54%) of them accessed their account within a year (Patel & Johnson, 2018).

Researchers have used different theories to examine the adoption of patient portals, such as theory of planned behavior (Emani et al., 2016), technology acceptance model (Kim & Park, 2012; Razmak & Bélanger, 2018), unified theory of acceptance and use of technology (Tavares & Oliveira, 2016), and diffusion of innovation (Emani et al., 2018; Wang et al., 2021). The findings from these studies have returned mixed results. While some studies have explored CDT in the context of pre-adoption of technology (Alhudaithy & Kitchen, 2009; Marikyan et al., 2020; Venkatesh & Goyal, 2010), we did not find any research that has explored CDT in examining the postadoption – continuous use and deep structure usage – of patient portals. This research will use CDT as a lens to examine opposing factors influencing the continuous use and structural extent of usage of a patient portal. We purport that users will perceive dissonance about using these systems due to security concerns in accessing their records through patient portals. However, if their physicians and other health professionals recommend using these systems, it could help them overcome the dissonance concerns.

2.2 Security Concerns

Security has become an increasing concern in technology adoption, particularly in the context of healthcare and finance. For example, Dai and Chen (2015) found that security concerns have a negative impact on attitudes toward mobile commerce. Featherman et al. (2010) found that security concerns negatively impacted individuals' intent to use e-services such as banking. A study by Zailani et al. (2015) indicated that security concerns decreased healthcare professionals' willingness to adopt RFIDs.

Since the implementation of the Health Insurance Portability and Accountability Act (HIPAA), protected health information breaches have increased (Terry, 2014). Individuals are often made aware of those breaches through media outlets. Subsequently, health information security is becoming a major concern for both healthcare professionals and patients (Bodenheimer & Grumbach, 2003; Cantor, 2001; Collins et al., 2017; Son, 2020). Concerns for security were mentioned in almost half (11 of 27) of the articles examining user adoption of patient portals to manage chronic diseases (Kruse et al., 2015a). Sakaguchi-Tang et al. (2017) also found that security was an issue for many who were asked to use a patient portal. More recently, patients expressed concerns over sharing information via a patient portal (Bajracharya et al., 2019; Collins et al., 2017).

Individuals expressed security concerns when they were considering using patient portals (Angst & Agarwal, 2009; Archer & Cocosila, 2014). Hsu et al. (2013) found that perceived security influenced individuals' intent to use a health information system even though the security threats were perceived to be low. Several systematic reviews indicated that security was a major concern when adopting patient portals (Irizarry et al., 2015; Kruse et al., 2015a; Li et al., 2014; Otte-Trojel et al., 2016; Wakefield et al., 2012). Liu and Zhang (2014) also indicated that security has a negative impact on intent to create a personal health record regardless of the access method and whether the system is networked or standalone.

2.3 Social Influence

Researchers often explore the use of social influence, also referred to as a normative belief or subjective norm, when identifying factors that influence an individual's behavior, including adopting or using new technology (Ajzen, 1991; Emani et al., 2016; Ifinedo, 2012; Lunney et al., 2016). Family, friends, colleagues, educators, and others of authority can exert influence on one's behavior. Many studies have found a positive relationship between social influence and technology adoption (e.g., Ifinedo, 2012; Lunney et al., 2016; Moqbel, 2012; Nah & Tan, 2015; Seethamraju et al., 2018).

While many are influenced by referent others when considering adopting a technology, some researchers did not find social influence to have an impact on individuals' decisions to use health IT (Bozan et al., 2015; Bozan et al., 2016). Tavares and Oliveira (2016) found that social influence did not impact the intention of individuals to adopt patient portals. Hoogenbosch et al. (2018) also reported that social influence did not affect intentions to use patient portals.

Individuals generally want to comply with experts' advice, including advice from their health professionals (Akareem et al., forthcoming; Emani et al., 2016). Health professionals are important referent others to encourage the use of patient portals. For example, Akareem et al. (forthcoming) and Emani et al. (2016) found that physicians can influence the use of patient portals. Hsu et al. (2013) found that individuals were affected by referent others when considering adopting health information systems; their social influence, however, did not include health professionals. Individuals encouraged by their physicians to use a patient portal were twice as likely to use it (Patel & Johnson, 2018). Emani et al. (2016) found that the strongest influencers to encourage patients to adopt patient portals are physicians and nurses. Crotty et al. (2019) found similar results; physicians influenced patients' adoption of portals. Although the above studies enrich our understanding of the role of health professionals' encouragement on the adoption of patient portals, less is known about its influence on post-adoption use.

3 Theoretical Framework and Hypothesis Development

3.1 Cognitive Dissonance Theory (CDT)

Festinger (1957) introduced CDT by identifying the discomfort or cognitive dissonance that individuals experience when two or more elements of knowledge are inconsistent or in conflict with their goals. In other words, cognitive dissonance refers to an uncomfortable feeling induced by simultaneously holding two contradictory cognitions. Cognitions or thoughts may include beliefs, attitudes, and behaviors. Individuals feel disharmony and mental discomfort when facing conflicting attitudes, beliefs, or behaviors (Cooper, 2007). They also feel cognitive dissonance when they do not follow directions or suggestions from important others and subsequently take actions to maintain internal consistency (Figl et al., 2019). CDT suggests that individuals take action to change and eradicate dissonance to achieve cognitive consistency. For example, when people recognize that behaviors such as smoking causes ill health but continue to smoke, they experience cognitive dissonance (Fotuhi et al., 2013; McMaster & Lee, 1991). Therefore, in order to achieve cognitive consistency, they will make efforts to quit smoking.

3.2 Social Influence: Health Professional Encouragement and CDT

Fishbein and colleagues (i.e., Ajzen & Fishbein, 1972; Fishbein, 1979; Fishbein & Ajzen, 1977) proposed that people are often swayed toward action or behavior when referent others influence them toward it. Individuals are often encouraged by referent others (e.g., physicians) to adopt and use a system regardless of whether they were referring to a health information system (Bozan et al., 2015; Bozan et al., 2016) or patient portal (Hoogenbosch et al., 2018). Akareem et al. (forthcoming), Detmer et al. (2008), and Emani et al. (2016) found support for physicians' influence on patient portal use.

Drawing on CDT and in the context of healthcare, we believe that an individual will strive to maintain harmony and a consistent mindset in their cognition resulting from social influence (health professional encouragement) and their behavior (patient portal use). Since patient portal use is believed to help patients manage their health, encouragement from health professionals will increase patients' continuous use of the portal to preserve the harmonious state of their cognition due to social influence and their behavior. Furthermore, encouragement from health professionals to use a variety of features in the portal will increase patients' structural depth of usage of the portal in managing their health. Thus, health professional encouragement will help increase the continuous use intention and deep structure usage of patient portals. Hence, we propose the following hypotheses:

> **H1a:** *Health professional encouragement increases patient portal continuous use intention.*
> **H1b:** *Health professional encouragement increases patient portal deep structure usage.*

3.3 Security Concerns and Patient Portal Use

Similar to the context of online banking (Miyazaki & Fernandez, 2001) and online shopping (Lian & Lin, 2008), security concerns have threatened the use of patient portals (Angst & Agarwal, 2009; Archer & Cocosila, 2014; Hsu et al., 2013; Irizarry et al., 2015; Kruse et al., 2015b; Otte-Trojel et al., 2016; Sakaguchi-Tang et al., 2017; Wakefield et al., 2020). CDT proposes that people can reduce dissonance by changing their beliefs, attitudes, and behaviors or by justifying them (Festinger, 1962). Based on CDT, dissonance, induced by security concerns, triggers the psychological state associated with discomfort, which influences the motivation of individuals to resolve the aroused dissonance (Festinger, 1962) by deciding not to continue to use patient portals or limiting the

extent of structural usage of the portals to mimimize security concerns associated with their personal information and medical records. As such, we have the following hypotheses:

> **H2a:** *Security concerns reduce patient portal continuous use intention.*
> **H2b:** *Security concerns reduce patient portal deep structure usage.*

3.4 Moderation Effect of Health Professional Encouragement

Individuals may experience cognitive dissonance when a referent other's recommendation conflicts with their own decisions, concerns, or desires. For example, individuals often express concerns when considering undergoing genetic testing as it might reveal a gene trait for a disease or negative information about their ancestry. Even though they might have this concern and may perceive a dilemma or conflict associated with genetic testing, individuals would consider undergoing testing if their physician recommends it (Turrietta, 2020). Similarly, many smokers have a hard time giving up smoking even when they are aware of the health issues related to their addiction. However, individuals are more likely to adhere to a smoking cessation plan to help them quit smoking when encouraged by their physicians (Butler et al., 2006; Fagerström, 1984; Pederson et al., 1982).

We believe that individuals with security concerns will experience a conflict when health professionals encourage them to use the patient portal. Evidence shows that the higher the social influence, the smaller the negative relationship between perceived risk and usage intention (Chi et al., 2012). Based on CDT, when such a cognitive dissonance arises where opposing cognitions are generated, patients will reduce dissonance by downplaying their security concern beliefs and justifying the change using information from persons of health authority (i.e., health professionals) that reassure them about the concerns. Hence, we believe that health professional encouragement will reduce the negative effects of security concerns on the continuous use intention and deep structure usage of patient portals. Thus, the following hypotheses are proposed:

> **H3a:** *Health professional encouragement weakens the negative effect of security concerns on patient portal continuous use intention.*
> **H3b:** *Health professional encouragement weakens the negative effect of security concerns on patient portal deep structure usage.*

4 Research Method

Our research model was empirically tested with data collected using an online survey. Participants were recruited using an announcement link to the research study located in the institution's patient portal.

4.1 Respondents

Table 1 summarizes the participant's demographic characteristics.

4.2 Measures

To maximize construct validity, we adopted most construct items from prior studies in extant literature. Items for measuring security concerns were adopted from Dinev and Hart (2006). Health professional encouragement items were adapted from Zhou and George (2001). Continuous use intention scales were adapted from extant studies (Davis et al., 1992; Kock et al., 2016; Lowry et al., 2015; Venkatesh et al., 2012). The items for deep structure usage were adapted from Burton-Jones and Straub Jr. (2006). A five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree was used for all constructs. Age, IT experience, exercise, gender, education level, race, and tenure were included as control variables to exclude variance explained by potential confounding factors. The items for the construct measurement are provided in Appendix 1.

4.3 Measurement Model Assessment

We used partial least squares structural equation modeling (PLS-SEM) as our statistical method, as it is preferred for exploratory research and when the normal distribution is not met, which is the case in this study – see Table 2 (Hair et al., 2010; Hair et al., 2011). We used the software WarpPLS 7.0 (Kock, 2015) to assess the structural model and the measurement model. Table 2 presents the measurement model reliability, validity, and common method bias analyses. For the measurement model, we assessed the measurement properties in terms of reliability, convergent validity, and discriminant validity. For reliability, we report composite reliability and Cronbach's alpha coefficients in which all values exceeded the suggested threshold of 0.7 (Chin, 1998), indicating that the scales are internally consistent. Convergent validity was assessed by the item loadings for the three factors (i.e., HPE, SC, and CUI in Table 2), which exceeded the suggested threshold of 0.6 (Gefen & Straub, 2005), indicating that our measurement instrument has acceptable convergent validity. Table 2 shows that all constructs have adequate reliability and validity.

Table 1 Demographic characteristics

	Category	N	[%]	Mean	SD
Age				49.39	13.19
IT Experience				23.61	8.79
Gender	Female	137	77.40		
	Male	40	22.60		
Residential Area	Urban	151	85.31		
	Non-urban	26	14.69		
Race	American Indian or Alaska Native	1	0.56		
	Asian	4	2.26		
	Black or African American	11	6.21		
	Hispanic or Latino	4	2.26		
	Native Hawaiian or Other Pacific Islander	0	0		
	White	157	88.70		
Education	High School	22	12.43		
	Associate Degree	31	17.51		
	Bachelor Degree	57	32.20		
	Masters Degree	43	24.29		
	Doctoral Degree or J.D.	21	11. 86		

Discriminant validity was assessed by observing whether the square root of the average variance extracted (AVE) (shaded diagonal values in Table 3) (Fornell & Larcker, 1981) is larger than the inter-construct correlations (off-diagonal elements) in the model. Table 3 shows that this criterion is met, indicating that our measurement instrument has acceptable discriminant validity.

Formative measures are indicators that cause a construct (Bollen, 1984). Therefore, unlike reflective constructs, formative constructs do not go through the reliability and validity assessments (Chin, 1998). Instead, formative constructs can be assessed by examining their indicator weights. As such, we assessed the formative deep structure usage construct using the p values of the weights of their indicators and the indicator variance inflation factors (VIFs) to rule out redundancy (Kock, 2014; Kock & Mayfield, 2015). All indicators' weights are significant. Potential redundancy in the indicators of the deep structure usage construct is not a concern given that the highest VIF is 2.77, which is lower than the recommended threshold of 5 (Hair et al., 2010). Hence, the patient portal deep structure usage construct was adequately measured in a formative way.

We examined multivariate normality based on Bera and Jarque (1981) and Gel and Gastwirth (2008), as shown in Table 2, indicating that none of our model's constructs met the normal distribution criteria, thus further justifying the use of PLS-based SEM.

Having collected our study data through a survey method (i.e., only one method), common method bias was evaluated by using an approach advised by Kock (2015), which is

Table 2 Construct reliability and validity

Constructs	Item	HPE	SC	CUI	CR	CA	FVIF	Normal
Health Professional Encouragement	HPE1	(0.928)	−0.026	−0.079	0.956	0.931	1.434	No
	HPE2	(0.955)	0.033	−0.042				
	HPE3	(0.927)	−0.029	0.013				
Security Concerns	SC1	0.082	(0.818)	−0.014	0.901	0.835	1.207	No
	SC2	−0.015	(0.877)	0.043				
	SC3	−0.089	(0.905)	0.084				
Continuous Use Intention	CUI1	0.035	−0.133	(0.771)	0.872	0.782	1.656	No
	CUI2	−0.085	0.173	(0.813)				
	CUB	−0.111	0.076	(0.912)				

Note: All loadmgs significant at $p < 0.001$; CR = composite reliability; CA = Cronbach's alpha; FVIF = full collinearity variance information factor; Normal = normal distribution (robust Jarque-Bera). HPE = health professional encouragement; SC = security concerns; CUI = conti nuous use intention

Table 3 Inter-construct correlation matrix

	HPE	SC	CUI
HPE	(0.937)		
SC	−0.103	(0.867)	
CUI	0.492	−0.382	(0.834)

Note: Square roots of average variances extracted (AVE) shown on the diagonal within parentheses; HPE = health professional encouragement; SC = security concerns; CUI = continuous use intention

contingent on model-wide collinearity evaluation (Kock & Lynn, 2012). As recommended, all variance inflation factors (FVIF recorded in Table 2) were lower than the threshold of 5 (Hair et al., 2010). Thus, common method bias is not a threat in this study.

5 Results

The results for H1a, H2a and H3a are presented in Fig. 1, where 40% of the variance in patient portal continuous use intention is explained by the model. Because of the use of a cross-sectional survey, the dependent variable in H1a, H2a, and H3a is continuous use intention rather than actual continuous use of the portal, and hence, intention is used as a proxy of continuous use (Ajzen, 2020). The dependent variable in H1b, H2b, and H3b is deep structure actual usage, which was measured in terms of the diversity of features that were used in the portal. The results for H1b, H2b, and H3b are presented in Fig. 2, where 32% of the variance in patient portal deep structure usage is explained by the model.

All of the hypotheses were supported. Health professional encouragement has a significant effect on patient portal continuous use intention (H1a) (β = .49, p < .001). Security concerns also have a significant effect on patient portal continuous use intention (H2a) (β = −.34, p < .001). As hypothesized, health professional encouragement significantly weakens the negative relationship between security concerns and patient portal continuous use intention (H3a) (β = .14, p = 0.030 < .05), as presented in Fig. 3. Similarly, health professional encouragement has a significant effect on patient portal deep structure actual usage (H1b) (β = .41, p < .001). Security concerns have a significant effect on patient portal deep structure usage (H2b) (β = −.36, p < .001). Health professional encouragement also significantly decreases the negative relationship between security concerns and patient portal deep structure actual usage (H3b) (β = .15, p = 0.023 < .05). None of the control variables in both models has a significant effect on the dependent variables, except for gender in the continuous use intention model, in which females were less likely to continue to use patient portals (Fig. 1: β = −.13, p = 0.035 < .05) and age in the deep structure actual use mode, in which older patients use it more Fig. 2: β = .13, p = .038 < .05). We believe the gender difference arises because men may have more positve attitudes and higher self-efficacy toward technology, which result in more frequent use of technology (Kay, 2008). We believe that older patients are more likely to use patient portal features due to higher comorobidities. Evidence in the literature suggests that higher number of comorbidities is associated with patient portal adoption (Elston Lafata et al., 2018). Table 4 summarizes the results of hypothesis testing.

Fig. 1 Model 1: H1a, H2a, and H3a with related coefficients. Note: * P < 0.05; *** P < 0.001
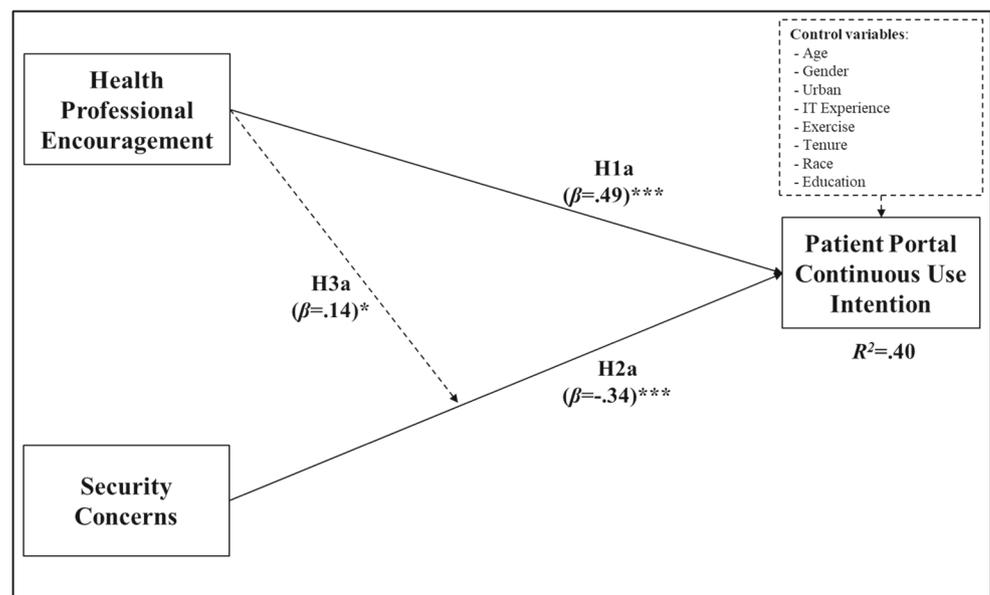
Note: * P<0.05; *** P<0.001

Fig. 2 Model 2: H1b, H2b, and H3b with related coefficients. Note: * P < 0.05; *** P < 0.001

Note: * P<0.05; *** P<0.001
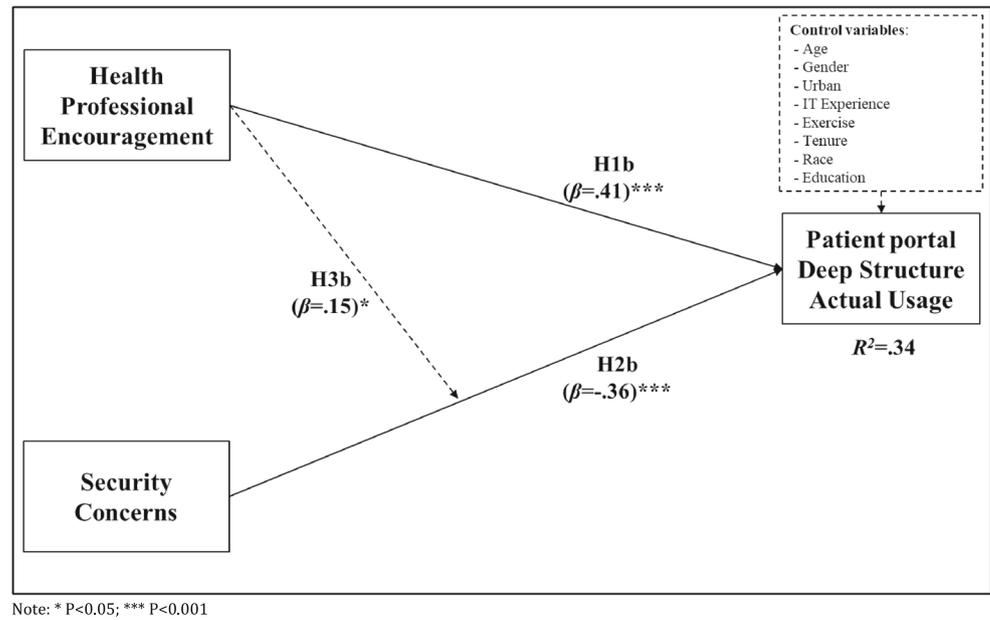
6 Discussion of Findings

This research examined cognitive dissonance that gave rise to a moderating effect between factors that encouraged and dissuaded individuals from continuing to use a patient portal and pursuing a deep structure usage through a variety of features in the portal. Specifically, we examined how consonance created by social influence through health professional encouragement increased an individual's decision to not only continue to use a patient portal but also more fully utilize the different features in the portal. We also examined how dissonance created by security concerns negatively impacted an individual's decision to pursue deeper structural usage and continuous use of the patient portal while this negative relationship is further moderated by health professional encouragement.

Hypotheses 1a and 1b examined the positive effect of social influence, represented by health professional encouragement, on individuals' decisions to continue to use and to pursue deep structural usage of a patient portal. This finding is consistent with the literature (Ancker et al., 2011; Angst & Agarwal, 2009; Irizarry et al., 2015; Wakefield et al., 2012),

which indicates that health professionals positively influence adoption decisions to use a patient portal. Thus, steps should be made to ensure that physicians and other health professionals encourage their patients to use patient portals in order to sustain continuous use and achieve deep structure usage of patient portals. Hence, the result suggests that health professional encouragement needs to extend beyond initial adoption to post-adoption use.

Hypotheses 2a and 2b focused on the effect of security concerns on patient portals' continuous use decisions and deep structure usage. Individuals who avoid adopting and using patient portals often cite security concerns as a hindrance to their decision to use the portal. In other words, individuals feel dissonance about using patient portals due to the fear that their medical record might be exposed by a security breach or other unwanted access, as indicated by the strong negative effect we found for security concerns on patient portal continuous use and deep structure usage. These findings are similar to results regarding technology pre-adoption (Bajracharya et al., 2019; Bodenheimer & Grumbach, 2003; Cantor, 2001; Collins et al., 2017; Kruse

Table 4 Summary of results of hypothesis testing

Hypothesis	Hypothesized Relationship	Support?
H1a	Health professional encouragement increases continuous use intention	Yes
H2a	Security concerns reduce continuous use intention	Yes
H3a	Health professional encouragement weakens the negative effect of security concerns on continuous use intention	Yes
H1b	Health professional encouragement increases deep structure usage	Yes
H2b	Security concerns reduce deep structure usage	Yes
H3b	Health professional encouragement weakens the negative effect of security concerns on deep structure usage	Yes

Fig. 3 Health professional encouragement moderation for continuous use intention as the dependent variable

Focused graph with low-high values of moderating variable (unstandardized scales)

(Low Encourage)
(Hight Encourage)

Y-axis: Continuous Use Intention, Mean=3.70, SD=1.06
X-axis: Security Concerns, Mean=2.35, SD=1.14
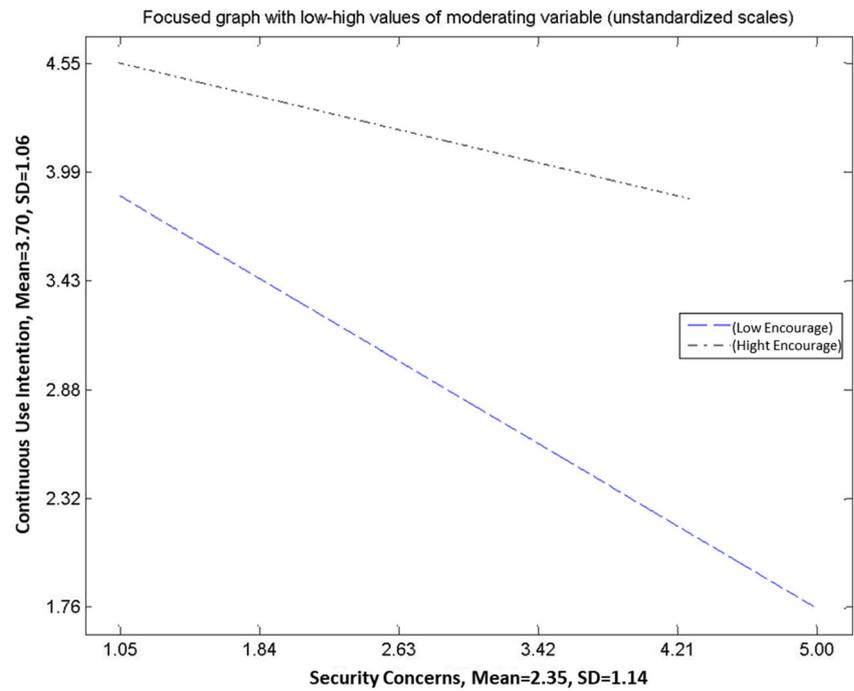
et al., 2015a; Sakaguchi-Tang et al., 2017; Son, 2020). Thus, to increase the deep structure and sustained use of patient portals, mechanisms must be conveyed that alleviate those fears.

Hypotheses 3a and 3b tested the moderating effect of health professional encouragement on the relationship between security concerns and patient portal deep structure usage and continuous use decisions. Based on CDT, it is possible for one or more factors to counteract an individual's concerns or discomfort about completing a task or making a decision. Social influence is a factor that increases patients' willingness to continue to use the patient portal even when they are concerned about system security. In other words, when patients are experiencing cognitive dissonance in the continuous use and deep structure usage of a patient portal, physicians and other health professionals are often most influential to their decision making (Akareem et al., forthcoming; Emani et al., 2016; Otte-Trojel et al., 2016; Patel et al., 2015). In this study, we found support that health professional encouragement reduces and mitigates the negative influence of security concerns on the continuous use and deep structure usage of the patient portal.

In summary, the theoretical models explain a significant percentage of the variance in continuous use of the patient portal (40%) and deep structure usage of the patient portal (34%). The findings indicate that CDT can be used to create a better understanding of the post-adoption use of patient portals. Using CDT to explore how security concerns impact the continuous use of patient portals is important during the COVID-19 pandemic, with many physician offices shuttering their doors and requesting that their patients use the portal for

access to their medical records (Heath, 2020). Based on health professionals' encouragement, patients are also increasing their deep structure usage of patient portals in light of COVID-19 to submit the medical power of attorneys and advanced directives (Portz et al., 2020).

6.1 Theoretical Implications

First, prior research in health IT has examined antecedents that explain the adoption of patient portals, but, to the best knowledge of the authors, this is the first study that has drawn on CDT to examine cognitive dissonance faced by patients in deciding whether to continue using patient portalsand to pursue deeper structural usage. Hence, this research presents empirical support and a theoretical explanation for the effect of enabling and hindering factors on patient portal post-adoption use. Second, this research contributes to theory by investigating the moderation role of social influence in the form of health professional encouragement on the relationship between security concerns and patient portal continuous use and deep structure usage. The finding suggests that, through the lens of CDT, social influence helps reduce the negative impact of security concerns on post-adoption use.

While some researchers have used CDT in prior research on technology pre-adoption, our findings show that it helps us understand the relative significance and role of two key enabling and hindering factors, particularly in studies that explore the post-adoption continuous use and deep structure usage. For instance, even though patient portal usage is not mandatory, its role has increased in importance during the COVID-19 pandemic, when many physicians are requesting

that their patients use the portal to access their medical records and manage the communication with health professionals instead of physically visiting the healthcare facility.

6.2 Managerial Implications

The findings of this research present important implications for practitioners. The results provide evidence that health professionals' encouragement can lessen the adverse impact of security concerns when a patient is considering whether to continue using a patient portal and engage in deeper structural usage of the portal, similar to those concerns expressed by individuals regarding online banking and online shopping (Lian & Lin, 2008; Miyazaki & Fernandez, 2001). Whether the social influence is encouragement from a physician or a healthcare staff member, prior research provides support that individuals receiving such encouragement are more likely to adopt the portal (Crotty et al., 2019; Emani et al., 2016; Hsu et al., 2013; Otte-Trojel et al., 2016; Patel & Johnson, 2018). Emani et al. (2016) found that the strongest influencers that encourage patients to adopt patient portals were physicians and nurses, while our study demonstrates that health professionals, which include physicians and nurses, have persuasive power over patients' post-adoption use of the portal in terms of continuous use and deep structure usage.

By having health professionals encourage individuals to use patient portals, organizations can lessen the negative impact of hindering factors that created dissonance. For example, patients could be shown short videos by health professionals while they are waiting for their turn to enter the exam room or while being attended to in the treatment room. Their physicians could also speak to them about the importance of using the patient portal in managing their health information. It could be helpful for health professionals to provide information assurance about the system's security instead of just endorsing the system, i.e., similar to trust building in the online banking industry (Merhi et al., 2019; Yu et al., 2015). Physician offices and healthcare facilities could also offer kiosks with added security measures for patients when creating patient portal accounts. The clinics could provide information about the benefits of using a patient portal, the different features available, and ways to protect one's private information when accessing the portal.

An ideal futuristic vision for healthcare providers, system vendors, and policy-makers is the ability to detect and treat diseases before they ravage the body or bankrupt families. There are a few breakthroughs that need to occur before this can happen, and we believe our research is an important step in that direction. This vision can become a reality through better utilization of patient data as well as better healthcare services arising from continuous use and deeper structural usage of patient portals. Continuous use of patient portals can be achieved by (1) having the patient portal developers produce or develop software that patients want to use (i.e., reducing security concerns) or (2) getting the health community to encourage patients to use patient portals (i.e., health professional encouragement) or (3) some of both. If patients are willing to use their patient portal on a continuous and deeper structural basis, the portal can function like software that reads the diagnostic codes of one's car and manages services associated with the car but applied to the realm of healthcare. The marriage of technology and patients is an important stepping stone to a better healthcare and medical system in the future.

6.3 Limitations and Future Research

One limitation is that the study included patients from only one healthcare facility, and thus, the degree of generalizability of the findings may be limited. Future research and replications of the study are needed to assess the generalizability of the findings. Although the two key factors in this study explain a large proportion of the variance in patient portal continuous use and deep structure usage (i.e., 40% and 34% respectively), future research could explore other factors that may influence the post-adoption use of patient portals such as social influence from other referents and concerns for one's health and privacy. Additionally, although the respondents in this study may indicate their willingness to continue using the patient portal, future research needs to assess if such intentions translate into actual continuous use.

7 Conclusion

In this study, health professional encouragement and security concerns are identified as antecedents of continuous use and deep structure usage of patient portals by users through the lens of CDT. The findings indicate that social influence through health professional encouragement augments post-adoption use of patient portals. The results also indicate that security concerns impede an individual's decision to continue using a patient portal and engage in deeper structural usage. Interestingly, the positive influence of encouragement to use the patient portal by health professionals explains more variance in post-adoption use (i.e., continuous use and deep structure usage) than security concerns. The negative impact of security concerns on post-adoption use is moderated or reduced when patients receive health professional encouragement. Therefore, health professional encouragement not only has a positive effect on patients' continuous use and deep structure usage of the portal but also helps mitigate the threat of security concerns on post-adoption use. Thus, the findings of this research are substantial for enhancing our understanding of the relationship between cognitive dissonance and post-adoption use of patient portals.

Appendix 1 Measurement instrument

Construct	Items	Source
Health Professional Encouragement	Usage of MyChart is encouraged by my healthcare professional team (e.g., healthcare provider/doctor, office staff, practice administrators). My healthcare professional team endorses MyChart usage. My healthcare professional team supports involvement in MyChart usage.	Zhou and George (2001)
Security Concerns	I am concerned about submitting information on MyChart because of the potential for security breaches. I am concerned that information on MyChart could be accessed by unauthorized parties who hack into the system. I am concerned about submitting information on MyChart because others might hack into the system.	Dinev and Hart (2006)
Continuous Use Intention	I intend to continue using MyChart in the future. I will always try to use MyChart in my daily life. I plan to continue to use MyChart frequently.	Kock et al. (2016); Lowry et al. (2015)
Deep Structure Usage	When I was using MyChart, I used features that helped me to see my lab results. When I was using MyChart, I used features that helped me to request a refill. When I was using MyChart, I used features that helped me to send a message to my provider. When I was using my MyChart, I used features that helped me to track my health progress over time. When I was using my MyChart, I used features that helped me to learn more about my medical condition. When I was using my MyChart, I used features that helped me to manage my healthcare.	Burton-Jones and Straub Jr. (2006)

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