

# Investigating Health Managers' Perspectives of Factors Influencing Their Acceptance of eHealth Services in the Kingdom of Saudi Arabia: A Quantitative Study

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## Keywords

Kingdom of Saudi Arabia · eHealth · Health managers · Technology acceptance · Unified Theory of Acceptance and Use of Technology

## Abstract

**Background:** Kingdom of Saudi Arabia (KSA) is a country with one of the largest land masses and the most difficult geographical terrain in the Middle East. The accessibility of advanced health services, especially for people in rural areas, has been considered one of the main health challenges. To overcome this problem, many initiatives to embrace technology in healthcare were launched by the Ministry of Health (MOH). Despite the growth of utilizing eHealth interventions in the country, more research related to the end-users' acceptance of eHealth services remains needed. This study aimed to investigate the relative importance of factors that influence health managers' acceptance of eHealth services in KSA against behavioural intention (BI) and use behaviour (UB). **Methods:** An online questionnaire was designed based on two sources: first, the thirty-nine factors identified in a related systematic review to be relevant to eHealth acceptance in KSA, and second, the validated questionnaire ad-

opted from the Unified Theory of Acceptance and Use of Technology (UTAUT) model. Participants were asked to rate the relative importance of the factors. The questionnaire was available in both Arabic and English. Professionals in KSA with a health management role from different backgrounds such as health professions, Health Information Technology, and administration were invited to take part. Participation links were distributed across social media platforms. Ethical approval had been gained. **Results:** 385 responses were received. Findings highlighted the relative importance of the main determinants that health managers in the KSA thought were important to influence their acceptance of eHealth services. The top rated influential factors were (i) availability of operational resources, (ii) privacy and security of health information, (iii) Information and Communication Technology infrastructure and readiness, (iv) availability of qualified human resources, and (v) quality of eHealth systems and applications. Of the UTAUT constructs, performance expectancy (PE) and social influence, which encapsulate factors such as management support, change resistance, and stakeholders' voice that can play a crucial role in the acceptance of technology as part of daily work, showed significance to the BI, as well as facilitating conditions and PE to the UB. However, some results need further investigation to clarify ambiguity.

**Conclusion:** Findings from this study may help address the current challenges and barriers and prioritize the main areas to improve eHealth acceptance in the KSA. Further research is planned to explore the identified factors across KSA through in-depth interviews.

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## Introduction

The rapid advancement in the field of Information and Communication Technology (ICT) globally has impacted the growth of healthcare systems and expanded the means of healthcare delivery into eHealth. In 2003, Silber defined the term eHealth as “the application of ICT across the whole range of functions that help health. It is the means to deliver responsive healthcare tailored to the needs of the citizen” [1]. This definition is similar to the one given by the World Health Organization (WHO) “the use of ICT for health” [2]. These definitions encompass the two main areas (health and technology) in a broadly unique concept of eHealth. Eysenbach (2001) explained this concept as an umbrella term which covers all forms of healthcare services that use ICT in the delivery or the support of healthcare such as, but not limited to, electronic medical records, telemedicine, remote health, and teleconsultations [3]. Research in this area has shown a growing recognition of many benefits of utilizing eHealth interventions including enhanced access to advanced healthcare services in remote and rural areas [4–7]. Growth of technology involvement in all domains of life, including the healthcare sector, made it essential to embrace new interventions [8]. The literature has shown a wide range of benefits from eHealth solutions [9–11]. These include improving the quality of care, cost reduction, enhancing patient safety and avoiding medication errors, and finally, saving effort and time. However, there remain many barriers hindering the successful adoption of eHealth [11, 12].

To explain the rationale of the interaction between people and technology, many technology acceptance theories have been developed. Venkatesh et al. [12] introduced the Unified Theory of Acceptance and Use of Technology (UTAUT), which focused on “the intention” and “the usage” as dependent variables to explore individuals’ acceptance of technology. The UTAUT has been adopted as a theoretical framework in this study for many reasons. Firstly, from the literature, it has been clear that the model is widely used as a well-established and comprehensive framework. It was validated and tested in dif-

**Table 1.** Constructs of the UTAUT [11]

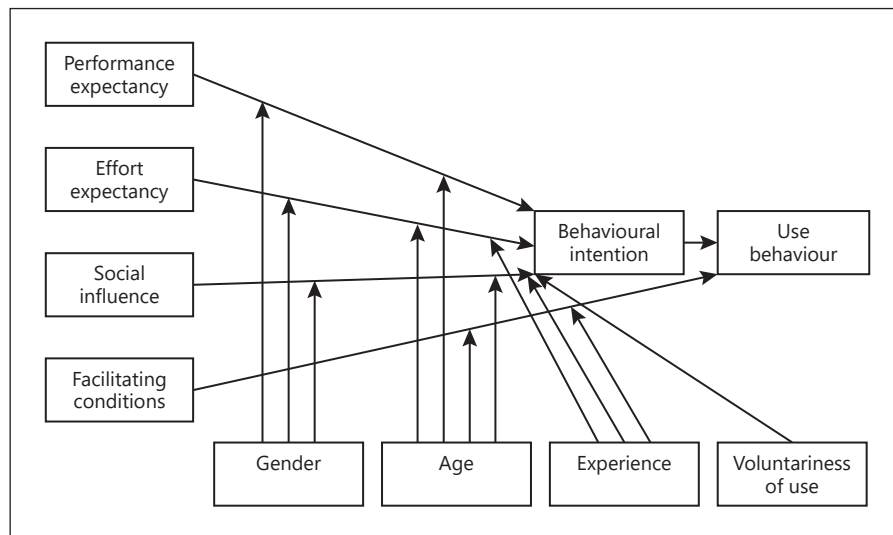
Construct	Definition
PE	“The degree to which an individual believes that using the system will help him or her attain gains in job performance”
EE	“The degree of ease associated with the use of the system”
SI	“The degree to which an individual perceives that important others believe he or she should use the new system”
FC	“The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system”

ferent contexts such as E-Commerce, E-Services, E-Learning, and E-Health to predict the users’ technology acceptance [13]. The utilization of the model in technology adoption research in different contexts has increased [14]. In addition, UTAUT has been referred to in the literature as the most predictive model of technology acceptance as it can explain up to 70% of the variance in technology acceptance [15]. While UTAUT continues to be one of the dominant theoretical models for exploring eHealth, at the time of conducting this study, there was scarce literature applying this model to eHealth studies in the Saudi healthcare context [16].

The UTAUT is a combination of eight technology theories, namely (i) Social Cognitive Theory (SCT) [17]; (ii) Innovation Diffusion Theory (IDT) [18]; (iii) Model of Personnel Computer Utilization (MPCU) [19]; (iv) Theory of Planned Behaviour (TPB) [20]; (v) Technology Acceptance Model (TAM) [21]; (vi) Motivational Model (MM) [22]; (vii) Combined TAM-TPB [23]; and, (viii) Theory of Reasoned Action (TRA) [24]. Figure 1 shows the structure of the UTAUT, which consists of four constructs: performance expectancy (PE); effort expectancy; social influence (SI); and, facilitating conditions (FC). These constructs are to predict the behavioural intention (BI) and actual use behaviour (UB) of technology. It also encompasses four moderators: gender, age, experience, and voluntariness of use.

Table 1 gives the definition of the four constructs from the literature. The UTAUT model has been adopted globally in different contexts [16]. For example, in the Kingdom of Saudi Arabia (KSA), it has been used in the context of: eLearning [25], eGovernment [26], and mobile banking [27].

**Fig. 1.** The UTAUT. In 2003, Venkatesh et al. [12] introduced the UTAUT which focused on “the intention” and “the usage” as dependent variables to explore individuals’ acceptance of technology. The UTAUT is a combination of eight technology theories namely: (i) SCT; (ii) IDT; (iii) MPCU; (iv) TPB; (v) TAM; (vi) MM; (vii) Combined TAM-TPB; and, (viii) TRA. The structure of the UTAUT which consists of four constructs: PE, EE, SI, and FC. These constructs are to predict the BI and actual UB of technology. SCT, Social Cognitive Theory; IDT, Innovation Diffusion Theory; MPCU, Model of Personnel Computer Utilization; TPB, Theory of Planned Behaviour; TAM, Technology Acceptance Model; MM, Motivational Model; TRA, Theory of Reasoned Action



KSA is one of the biggest countries in the Middle East by land area and population. It has a wide range of difficult geographical terrain, making accessibility to advanced healthcare services, especially from remote areas, challenging; thus, eHealth has been proposed as a potential solution [28]. In the Saudi healthcare context, a systematic review was conducted by the authors of the status of eHealth acceptance in the country [29]. It set out to critically appraise, synthesize, and present the available evidence on the status of eHealth adoption, acceptance, facilitators, and barriers from the perspectives of multiple stakeholders [29]. This included health professionals, health managers, and health information technology (IT) professionals. Thirty-nine influencing factors for eHealth adoption and acceptance were identified in that systematic review. Despite findings that showed the significant growth of eHealth publications in KSA, little was known about the perspectives of health managers on the acceptance of eHealth in the country [29]. The term “health managers” was defined by Egger et al. [30] as “professionals with primary responsibility for services, resources, and partnership,” suggesting a key role in influencing adoption of eHealth. They may come from a variety of health, social, technical, or management backgrounds, and many of them are clinicians that are also working as health managers without a recognized management qualification [30].

This lack of literature has driven the aim of this study, which focuses on investigating the relative importance of factors that influence health managers’ acceptance of eHealth services in KSA [29]. To do so, the UTAUT mod-

el [12] was adopted as a theoretical framework applied to three research questions:

1. What are the top rated factors that influence health managers’ acceptance of eHealth services in KSA?
2. What UTAUT constructs are of greatest significance to the health manager’s BI to utilize eHealth services in the KSA?
3. What UTAUT constructs are of greatest significance to the health manager’s actual use of eHealth services in the KSA?

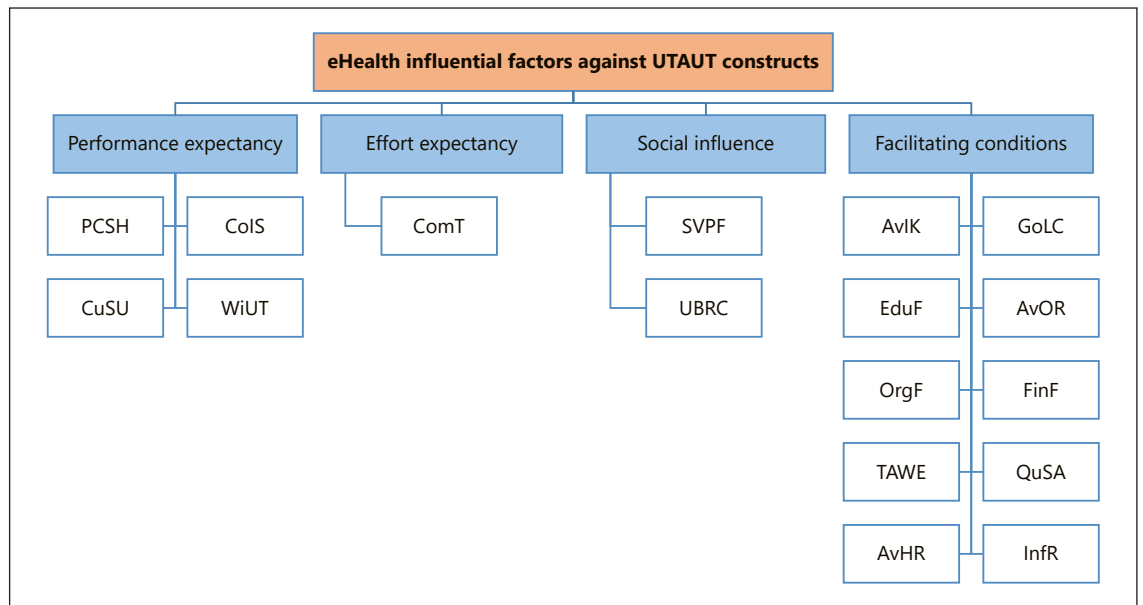
## Methods

### Study Design

A quantitative cross-sectional survey methodology was adopted. An online questionnaire was developed based on two sources. The first source was the 39 factors found in a systematic review, conducted by the authors, to be relevant to eHealth acceptance in KSA from the perspectives of multiple stakeholders [29]. The second was the validated questionnaire adopted from the UTAUT model [12]. To determine which of the 39 identified factors could be of significance to health managers, a technique of grouping factors into a reduced number of 17 themes was agreed within the research team and applied. Factors of the same nature were placed together under a main theme to shorten the list of factors without losing the clarity of meaning. For example, lack of technical training, computer literacy, and English language proficiency were grouped under an Educational Factors theme. The grouping helped to reduce the length of the questionnaire to pose fewer questions hence encourage greater participation amongst health managers. This procedure showed consistency with studies previously conducted [9, 31–33]. Table 2 shows the seventeen themes finalized with a study code and literature-based definition.

**Table 2.** 39 Factors identified in the systematic review grouped to 17 themes [29]

Theme	Theme code	Meaning in the literature	Studies identified in the systematic review [29]
Availability of operational resources	AvOR	Operational resources are the tools that are used to handle daily work such as computers, laptops, printers, print papers, and ink	[32, 42, 46]
Availability of adequate qualified human resources	AvHR	Human resources are skilled professionals that manage systems and provide technical support	[31, 32, 42]
Educational factors	EduF	Educational factors are those related to the level of education, training and proficiency required to feel confidence in performing the job	[35, 36, 39–45]
Organizational factors	OrgF	Organizational factors are those factors that influence behaviour of work such as the mission, vision, size and type of the healthcare facility	[31–34, 36, 42–45]
Financial factors	FinF	Financial resources are the funds secured to establish, operate, and maintain infrastructure, systems and applications	[32–34, 36, 38, 45, 46]
Government legislation and constraints	GoLC	Government legislation and constraints are the plans, laws, rules, and regulations imposed by governmental bodies such as the national eHealth strategy	[31–34, 42, 45]
ICT infrastructure and readiness	Infr	Infrastructure is the physical structure of the healthcare facility including buildings, internet connection, network points, and power supplies	[32, 38, 45]
Privacy, confidentiality, and security of health information	PCSH	Privacy, confidentiality, security are major concepts of protection in which access to personal information are controlled	[31, 33, 37, 39, 40, 42, 44, 45]
Stakeholders' voice upon planning and feedback on preferences	SVPF	Stakeholders' voice refers to the active participation and involvement of stakeholders in planning the necessary services	[34, 35]
Quality of eHealth systems and applications	QuSA	Quality of eHealth systems and applications means smooth and efficient performance with no technical crashes, failures or hanging up difficulties	[32]
Customisability of systems functions according to users' needs	CuSU	Customisability of systems functions means adjusting them to give the best available experience to meet the needs of end-users	[39, 40]
Connectivity of information systems	CoIS	Connectivity of information systems usually describes the communication between devices, systems, and applications either within the healthcare facility or with outside entities and facilities	[39–41, 44]
Availability of information and knowledge about eHealth services	AvIK	Availability of information and knowledge refers to the awareness of eHealth services information which include plans of implementations, strategy, and policies and procedures of the practice	[38, 42, 44]
Uncooperative behaviour and resistance to change	UBRC	Uncooperative behaviour and resistance to change is the actions taken by some employees when they perceive that technology can be a threat to them	[34, 36–38]
Willingness to utilize technology	WiUT	Willingness to utilize technology is the positive engagement of individuals in using technology once they perceive its advantages	[32, 38]
Technical ability and work experience	TAWE	Technical ability and work experience refer to the competency in carrying out the technical tasks without help from others such as using eHealth systems and applications	[33, 35, 36, 39, 40, 42, 46]
Complexity of technology	ComT	Complexity of technology is the degree in which systems and applications are difficult and complicated to operate without prior experience or training	[39, 40, 42]



**Fig. 2.** Seventeen themes of factors presented under UTAUT main constructs. Mapping the factors against UTAUT constructs. The seventeen factors were clustered against the four main UTAUT constructs: PE, EE, SI, and FC, that may potentially influence both the BI and UB of the UTAUT model. The clustering of these factors prior to conducting the statistical analysis enabled identification of the key constructs.

#### Questionnaire Design

English was the primary language for the questionnaire with a translated version in Arabic language to allow optional preferences to all participants. To ensure accuracy of translation, the questionnaire was back-translated by an independent health professional. The questionnaire consisted of four parts: demographics (gender, age, managerial level, years of managerial experience, and geographical location); attitudinal scales to establish the level of importance of each of the seventeen themes (scale from 5 = most important to 1 = least important); modification version from the UTAUT validated items in which five-point Likert scales were used where 1 = strongly disagree and 5 = strongly agree [12]; and, finally, an open space for any additional suggestions for factors or comments.

#### Validation and Piloting

To measure the face and content validity of the data collection instrument, a panel of three experts in eHealth from KSA was invited to assess the questionnaire items for clarity and whether or not they covered the concepts being studied. This resulted in minor changes prior to inviting eleven health managers from different healthcare settings in KSA to pilot the questionnaire. Eight responses were received with comments mainly related to being more concise with the introduction as well as the clarity of some language. Comments were taken into consideration and changes made.

#### Inclusion and Exclusion Criteria

All professionals from multiple disciplines such as health professions, health management, and health IT across the KSA were

eligible to participate if currently or previously involved in a managerial role at any healthcare facility in the country. IT professionals who did not have a direct role in health management were excluded.

#### Sample Size Representation

In 2015, the General Authority for Statistics in KSA determined the total number of healthcare workforce in KSA as 384,636 with high growth due to the expansion of health services and the continuous need for specialist professionals [47]. However, the number of professionals that self-identify as health managers cannot be estimated. To apply caution on calculating the representative sample size, the total number of all healthcare workforces was considered a target population in this study. A sample size calculation formula was used at confidence interval 95% and margin of error 5%, giving a sample size of 384 [48].

#### Recruitment of Participants

Due to the lack of access to the email database in healthcare authorities in the KSA, as well as the difficulty in identifying health managers, social media platforms were adopted as a rapid and wide-reaching solution. To avoid online surveys contamination, it was clearly pointed in the questionnaire that only professionals who are currently or previously involved in a managerial role at any healthcare facility are eligible to participate. The questionnaire was launched online in June 2018. Links to both English and Arabic versions were distributed across Twitter, Facebook, and WhatsApp with support from Saudi Arabian Health Informatics groups and some influential health professionals. Links were reposted online twice, after 15 days and after 30 days.

**Table 3.** Demographics of participants ( $n = 385$ )

Variables	$n$ (%)
Gender	
Male	325 (84.5)
Female	56 (14.6)
Prefer not to say	4 (1.0)
Age, years	
Under 25	2 (0.5)
25–34	145 (37.7)
35–44	162 (42.1)
45–54	65 (16.9)
55 and over	11 (2.9)
Managerial level	
Lower level	116 (30.1)
Middle level	229 (59.5)
Top level	40 (10.4)
Managerial experience, years	
Less than 5	65 (16.9)
5–9	54 (14.0)
10–14	178 (46.2)
15–19	66 (17.1)
20 and above	22 (5.7)
Geographical location	
City	289 (75.1)
Urban governorate	67 (17.4)
Rural governorate	17 (4.4)
Village	12 (3.1)

#### Data Analysis

The data analysis was conducted in three steps. The first step was to determine the relative importance of the 17 factors influencing health managers' acceptance of eHealth services in KSA. The Relative Importance Index (RII) tool was used. Tam et al. [49] introduced the RII method as the mean score given to each factor, which ranges between 0 and 1. This method is used to identify the importance of factors under investigation [49]. The result suggests that the closer the value to 1, the higher the importance of the factor from the perspective of respondents. This method has been employed by many researchers to quantitatively estimate relative importance in different contexts such as: construction and infrastructure [50], education [51], and healthcare clients' context [52]. The formula of the RII is as follows:

$$RII = \frac{\sum W}{A \times N}$$

$$RII = \frac{W5 \times (n5) + W4 \times (n4) + W3 \times (n3) + W2 \times (n2) + W1 \times (n1)}{A \times N}$$

$W$  = weights given to each factor by the respondents, ranging from 5 to 1 where "5" is most important and "1" least important.

$A$  = highest weight (i.e., 5).

$N$  = total number of respondents

$n$  = number of respondents who selected an answer ranging from 5 to 1.

The second step was informed by the findings from the first step. It focused on mapping the factors against UTAUT constructs for further analysis. The seventeen themes were clustered against the four main constructs that may potentially influence both the BI and UB of the UTAUT model (Fig. 2).

The third step involved statistical analyses (using IBM SPSS, v25) to determine means, standard deviations; Principal Component Analysis (PCA) was conducted in order to reduce the large number of variables to a smaller number of interrelated variables. Finally, ordinal regression analysis was conducted to discover possible determinants of BI and UB.

## Results

### Respondents' Profile

A total of 385 responses were received. Table 3 summarizes the demographics of respondents. The percentage of male participants was 84.4% ( $n = 325$ ). Of the total sample, 42% ( $n = 162$ ) were aged between 35 and 44 years old. Nearly 60% ( $n = 229$ ) of all health managers were at the middle management level. Nearly half, 46% ( $n = 178$ ), had managerial experience of between 10 and 14 years. Three-quarters ( $n = 289$ ) of all participants across the KSA worked in city-located healthcare facilities.

### RII Analysis Results

The overall RII analysis showed that all factors identified by multiple stakeholders were of significance at different levels to the group of health managers. The RII values ranged between the most important theme which was the Availability of Operational Resources (AvOR; 0.889) and, the least important theme, which was the Complexity of Technology (ComT; 0.725) (Table 4).

### UTAUT Analysis Results

PCA was applied first to reduce the initial number of variables to a smaller number that captures the same information in the larger data set. The total variance explained for the UTAUT constructs after applying the PCA is shown in Table 5. In the social sciences, where information is often less precise, it is not uncommon to consider a solution that accounts for 60 percent of the total variance (and in some instances even less) as satisfactory [50, 53].

Cronbach's alpha, which is a test of reliability that ranges between 0 and 1, was used to calculate the internal consistency of the UTAUT constructs. Mallery and George (2003) explained that the closer the value is to 1, the greater the internal consistency of the item, therefore, 0.9 and above is excellent and 0.7 and above is acceptable

[54]. Table 6 illustrates the level of internal consistency of all constructs ranging between 0.949 (excellent) and 0.734 (acceptable).

The correlation among UTAUT constructs was examined (Table 7) with a positive correlation established based on  $p < 0.01$  significance level. The strongest correlation was between FC and SI at ( $r = 0.507, p < 0.01$ ).

Tests of normality of the extracted principal components (PC) revealed significant departures from normality. The original intention to utilize multiple regression in order to develop a predictive model for BI and UB was, therefore, revised in favour of ordinal regression, using a three-fold ordinal scaling (low, medium, and high) of the PC scores. Each PC score range (i.e., maximum–minimum) was simply divided into three equal intervals to provide ordinal equivalents of the scores. Ordinal regression was then deployed in order to model BI and UB. Using ordinal regression also has the advantage of meaningful interpretation of the final PC scores, whereas coefficients from multiple regression using the original PC scores, while providing an indication of association of a given independent variable, does not, in this case, provide an easy interpretation of what the suggested changes in the dependent variables might be. Ordinal regression coefficients on the other hand provide a probabilistic interpretation of the likelihood of movement between the three ordinal scale values. Table 8 below shows the distributional spread of the ordinal groups for each of the constructs.

A holistic view of the regression analysis results showed that two constructs, SI and PE, moderated by Age were of significance to the BI. SI was the best predictor of BI to accept eHealth from the perspectives of health managers in KSA ( $p < 0.05$  [low group] and  $p = 0.014$  [medium group]) followed by PE which showed significance [ $p = 0.041$  (low group) and  $p = 0.011$  (medium group)] (Table 9).

The Statistical Package for Social Sciences (SPSS) was used for analysis and ordinal regression was chosen to be statistically appropriate to give a meaningful interpretation of the final PC scores. Ordinal regression coefficients provide a probabilistic interpretation of the likelihood of movement between the three ordinal scale values. The results of the ordinal regression of actual UB on the two independent variables (FC, BI) showed FC was a significant construct to influence the actual use of eHealth services in KSA from a health manager’s perspectives. The medium group also showed significance ( $n = 161, p = 0.012$ ). However, the low group showed no significance. This can be attributed to the small number of the sample

**Table 4.** Overall rank and significance of factors

Themes	Responses, $n$ ( $N = 385$ ) On the scale of importance where 5 = most important and 1 = least important					Overall RII	Rank
	5 $n$ (%)	4 $n$ (%)	3 $n$ (%)	2 $n$ (%)	1 $n$ (%)		
Availability of operational resources	292 (75.8)	33 (8.6)	23 (6.0)	15 (3.9)	22 (5.7)	0.889	1
Privacy, confidentiality, and security of health information	270 (70.1)	45 (11.7)	28 (7.3)	25 (6.5)	17 (4.4)	0.873	2
ICT infrastructure and readiness	260 (67.5)	59 (15.3)	27 (7.0)	17 (4.4)	22 (5.7)	0.869	3
Availability of adequate qualified human resources	265 (68.8)	42 (10.9)	38 (9.9)	21 (5.5)	19 (4.9)	0.866	4
Quality of eHealth systems and applications	254 (66.0)	57 (14.8)	32 (8.3)	21 (5.5)	21 (5.5)	0.860	5
Availability of information and knowledge about eHealth services	230 (59.7)	77 (20.0)	37 (9.6)	23 (6.0)	18 (4.7)	0.848	6
Educational factors	237 (61.6)	68 (17.7)	35 (9.1)	23 (6.0)	22 (5.7)	0.846	7
Government legislation and constraints	231 (60.0)	68 (17.7)	44 (11.4)	23 (6.0)	19 (4.9)	0.8436	8
Connectivity of information systems	239 (62.1)	60 (15.6)	36 (9.4)	30 (7.8)	20 (5.2)	0.8431	9
Customisability of systems functions according to users' needs	226 (58.7)	74 (19.2)	44 (11.4)	21 (5.5)	20 (5.2)	0.8415	10
Financial factors	243 (63.1)	59 (15.3)	32 (8.3)	21 (5.5)	30 (7.8)	0.8410	11
Willingness to utilize technology	225 (58.4)	77 (20.0)	40 (10.4)	20 (5.2)	23 (6.0)	0.839	12
Technical ability and work experience	213 (55.3)	84 (21.8)	45 (11.7)	21 (5.5)	22 (5.7)	0.831	13
Organizational factors	213 (55.3)	77 (20.0)	48 (12.5)	23 (6.0)	24 (6.2)	0.824	14
Stakeholders' voice upon planning and feedback on preferences	193 (50.1)	87 (22.6)	61 (15.8)	25 (6.5)	19 (4.9)	0.812	15
Uncooperative behaviour and resistance to change	171 (44.4)	92 (23.9)	65 (16.9)	25 (6.5)	32 (8.3)	0.779	16
Complexity of technology	141 (36.6)	87 (22.6)	73 (19.0)	41 (10.6)	43 (11.2)	0.725	17

**Table 5.** Total variance explained for UTAUT constructs

Constructs	Initial items, <i>n</i>	Extracted items, <i>n</i>	Variance explained, %
PE	4	1	72.991
EE	4	1	77.544
SI	4	1	69.077
FC	4	1	56.077
BI	3	1	90.826

**Table 6.** Internal Consistency of UTAUT constructs

Constructs	Cronbach's alpha	Internal consistency
PE	0.849	Good
EE	0.902	Excellent
SI	0.849	Good
FC	0.734	Acceptable
BI	0.949	Excellent

**Table 7.** UTAUT constructs correlation

Constructs	Mean	SD	BI	PE	EE	SI	FC
BI	2.6545	0.62719	1.000				
PE	2.8545	0.42651	0.391**	1.000			
EE	2.7013	0.55116	0.334**	0.464**	1.000		
SI	2.6052	0.60808	0.360**	0.380**	0.401**	1.000	
FC	2.4182	0.63671	0.311**	0.368**	0.452**	0.507**	1.000

\*\* Correlation is significant at the 0.01 level (2-tailed).

**Table 8.** Ordinal groups for UTAUT constructs

Constructs	Ordinal groups	Participants, <i>n</i>	Marginal percentage, %
PE	1.00 low	10	2.6
	2.00 medium	34	8.9
	3.00 high	337	88.5
EE	1.00 low	17	4.5
	2.00 medium	77	20.2
	3.00 high	287	75.3
SI	1.00 low	24	6.3
	2.00 medium	101	26.5
	3.00 high	256	67.2
FC	1.00 low	30	7.9
	2.00 medium	161	42.3
	3.00 high	190	49.9
BI	1.00 low	30	7.9
	2.00 medium	68	17.8
	3.00 high	283	74.3
Valid: 381			
Missing: 4			
Total: 385			

in the FC low group ( $n = 30$ ) when compared to the high group ( $n = 190$ ). BI showed no significance to influence the actual use (Table 10).

Another round of ordinal regression analysis was conducted separately on constructs without sociodemographic variables to check if any of them would have in-

fluence on the UB. Results showed that PE is of significance in the medium group ( $n = 34$ ,  $p = 0.045$ ). However, the low group showed no significance. This can be attributed to the small number of the sample in the PE low group ( $n = 10$ ) when compared to the high group ( $n = 337$ ) (Table 11).



**Table 9.** Ordinal regression analysis for the BI

Construct	Estimate	Std. error	Sig.	95% confidence interval	
				lower bound	upper bound
BI = [low]	-2.650	1.216	0.029	-5.033	-0.268
BI = [medium]	-0.701	1.198	0.558	-3.049	1.647
[Gender = male]	-0.119	0.392	0.760	-0.887	0.648
[Gender = female]	0 <sup>a</sup>				
[Age = under 25 years]	1.635	1.909	0.392	-2.107	5.377
[Age = 25–34 years]	1.780	0.684	<b>0.009</b>	0.440	3.120
[Age = 35–44 years]	1.183	0.659	0.073	-0.108	2.474
[Age = 45–55 years]	0.977	0.693	0.159	-0.382	2.336
[Age = 55 years and over]	0 <sup>a</sup>				
[Managerial level = lower]	0.656	0.459	0.153	-0.243	1.556
[Managerial level = middle]	0.696	0.411	0.090	-0.109	1.502
[Managerial level = top]	0 <sup>a</sup>				
[Managerial experience = less than 5 years]	0.255	0.614	0.678	-0.949	1.459
[Managerial experience = 5–9 years]	0.499	0.664	0.452	-0.801	1.800
[Managerial experience = 10–14 years]	0.137	0.557	0.805	-0.955	1.230
[Managerial experience = 15–19 years]	0.269	0.588	0.647	-0.883	1.422
[Managerial experience = 20 years and above]	0 <sup>a</sup>				
[Geographical location = city]	-0.140	0.771	0.856	-1.652	1.372
[Geographical location = urban governorate]	-0.522	0.801	0.515	-2.092	1.048
[Geographical location = rural governorate]	-0.402	0.948	0.672	-2.260	1.456
[Geographical location = village]	0 <sup>a</sup>				
PE = [low]	-2.856	1.394	<b>0.041</b>	-5.588	-0.124
PE = [medium]	-1.057	0.414	<b>0.011</b>	-1.869	-0.245
PE = [high]	0 <sup>a</sup>				
EE = [low]	-1.064	0.824	0.196	-2.679	0.550
EE = [medium]	-0.536	0.321	0.095	-1.166	0.093
EE = [high]	0 <sup>a</sup>				
SI = [low]	-2.445	0.579	<b>0.000</b>	-3.579	-1.310
SI = [medium]	-0.744	0.302	<b>0.014</b>	-1.337	-0.152
SI = [high]	0 <sup>a</sup>				

Dependent variable (BI). Independent variables (PE, EE, and SI). <sup>a</sup> This parameter is set to zero because it is redundant.

## Discussion

The aim of this study was to extend our previous work by investigating the relative importance of factors and UTAUT constructs that influence health managers' acceptance of eHealth services in KSA [29]. By adopting the well-used theoretical UTAUT model, we were able to determine the factors which were most influential for both BI and technology UB among health managers while recognizing the UTAUTs previous applications in the research area of eHealth [7, 16, 31, 55]. In 2020, a study conducted by a group of researchers concluded that UTAUT model has relevance and applicability in understanding the ICT adoption in healthcare sector [56]. This provided the opportunity for comparison of data analysis approach and findings with other UTAUT based studies [25–27].

The findings from this study demonstrate that all 17 identified factors were of potential significance for health managers. This is in keeping with results from a study which examined the main barriers and challenges in the Saudi Telemedicine Network (STN) from the perspectives of health decision makers [29]. By applying the UTAUT, healthcare facility sector, type, and location were found to be the main moderators [32]. However, in this current study, three different dimensions were explored within the Saudi Arabian health managers' context: gender, managerial level, and managerial experience.

The clustering of the 17 factors against the UTAUT constructs prior to conducting the statistical analysis enabled identification of the key constructs: first, SI. SI encapsulates factors such as management support, change

**Table 10.** Ordinal regression analysis for UB

Construct	Estimate	Std. error	Sig.	95% confidence interval	
				lower bound	upper bound
UB = [low]	-3.664	1.295	0.005	-6.203	-1.126
UB = [medium]	-2.093	1.281	0.102	-4.605	0.418
[Gender = male]	0.064	0.336	0.850	-0.596	0.723
[Gender = female]	0 <sup>a</sup>				
[Age = under 25 years]	-1.693	1.537	0.271	-4.705	1.319
[Age = 25–34 years]	-0.205	0.744	0.783	-1.664	1.253
[Age = 35–44 years]	0.250	0.744	0.737	-1.208	1.708
[Age = 45–55 years]	0.022	0.780	0.978	-1.507	1.551
[Age = 55 years and over]	0 <sup>a</sup>				
[Managerial level = lower]	-0.277	0.481	0.565	-1.219	0.665
[Managerial level = middle]	0.137	0.455	0.764	-0.755	1.028
[Managerial level = top]	0 <sup>a</sup>				
[Managerial experience = less than 5 years]	-0.919	0.719	0.201	-2.328	0.491
[Managerial experience = 5–9 years]	-0.447	0.739	0.546	-1.895	1.001
[Managerial experience = 10–14 years]	-0.916	0.679	0.177	-2.247	0.415
[Managerial experience = 15–19 years]	-0.313	0.724	0.666	-1.732	1.107
[Managerial experience = 20 years and above]	0 <sup>a</sup>				
[Geographical location = city]	-0.368	0.716	0.608	-1.771	1.036
[Geographical location = urban governorate]	-0.382	0.750	0.611	-1.853	1.088
[Geographical location = rural governorate]	-0.229	0.893	0.797	-1.979	1.520
[Geographical location = village]	0 <sup>a</sup>				
FC = [low]	-0.238	0.525	0.650	-1.267	0.790
FC = [medium]	-0.663	0.264	<b>0.012</b>	-1.180	-0.146
FC = [high]	0 <sup>a</sup>				
BI = [low]	0.855	0.569	0.133	-0.261	1.971
BI = [medium]	0.248	0.339	0.465	-0.417	0.913
BI = [high]	0 <sup>a</sup>				

Dependent variable (UB). Independent variables (FC and BI). <sup>a</sup>This parameter is set to zero because it is redundant.

**Table 11.** Ordinal regression analysis for UB

Construct	Estimate	Std. error	Sig.	95% confidence interval	
				lower bound	upper bound
UB = [low]	-2.752	0.215	0.000	-3.172	-2.331
UB = [medium]	-1.217	0.129	0.000	-1.470	-0.964
PE = [low]	0.107	0.747	0.887	-1.358	1.571
PE = [medium]	-0.738	0.368	<b>0.045</b>	-1.459	-0.017
PE = [high]	0 <sup>a</sup>				

Dependent variable (UB). Independent variables (PE). <sup>a</sup>This parameter is set to zero because it is redundant.

resistance, and stakeholders' voice which can play a crucial role in acceptance of technology as part of daily work. Importantly, for the second most notable construct, more participants perceived management and colleagues as supportive, the higher the BI to utilize eHealth ser-

vices. These conclusions are consistent with other studies conducted in the KSA health context but have not previously been explored with health managers [31, 32, 34–36, 38]. Furthermore, a study conducted in a developing country in Asia concluded that SI is the most significant

variable to influence end-users acceptance of eHealth [57]. PE has also been shown to be of significance to the health managers BI which confirms the importance of benefits that technology can bring to the job performance such as the privacy and connectivity of health information. Again, the more participants perceived help to be available and the potential for perceived benefits, the higher the BI of health managers to utilize eHealth services. This showed consistency with the findings from several studies with other populations [39–41, 44]. FC showed significance to the actual UB. This demonstrated that existence of infrastructure, availability of financial support, knowledge support base, and related resources are all of significance to influence health managers' actual use of technology as was concluded in other studies [32, 38, 42, 45, 46]. In addition, it was evidenced in the international literature that the intentions to use online health services were influenced by the FC such as the availability of operational resources and IT knowledge [58]. As shown in Table 10, some FC nonsignificant results were justified; however, further investigation is recommended to confirm or deny the ambiguity of significance of the FC for health managers. PE also showed significance to the actual UB. Some PE nonsignificance results also indicate further research is required. One moderator showed significance: health managers' age, which has been shown in some studies to lead to technology acceptance resistance [34, 36, 37, 57, 58] as age increases.

Overall findings from this study draw a holistic, multifactorial image of challenges facing eHealth acceptance in KSA from the perspectives of health managers, a largely under researched population. This theoretically based study is specifically of importance to health decision-makers and policymakers to map out the directions of technology acceptance in the healthcare sector in KSA and add to the national eHealth strategy by focusing on the key issues and challenges in the field of eHealth. These findings can help to prioritize the main areas for eHealth improvement to support delivery of eHealth services in KSA. Impact of this study extends to embrace health managers, healthcare providers, and health policy-makers. Understanding the factors that influence eHealth acceptance has the potential to give health managers confidence to deal with the challenges of implementing eHealth and plan more effectively for future work.

#### *Strengths and Limitations*

Strengths of this study include utilizing one of the most dominant theoretical technology acceptance

models, the UTAUT, to explain the results in a meaningful way [16]. Many authors changed the original UTAUT instrument and added new constructs [59]. Indeed, it has been suggested there is still a need to carry out more research investigating whether adding external constructs to the theory, reducing the current constructs, or modifying the moderators could make a difference to the overall picture the theory is trying to explain [60]. Since this study has been conducted, several research teams have adopted the UTAUT in eHealth studies, including in KSA but none with health managers [61–63].

Another strength of this study was that it was conducted by a multidisciplinary team (a health manager, a Chartered Statistician, a technologist) with different experience and skill sets which has enriched the outcomes. Given the challenging nature of the statistical analysis, having a Chartered Statistician on the team was indeed a strength as there was no definitive literature on exact steps to be followed.

However, like every study, there were some limitations. Although some international literature discussed the role of health leaders in supporting the technology adoption in which a strong association between obtaining technical skills and motivation to adopt technology interventions at work was evidenced [64, 65], it has yet to be established how influential health managers in the KSA are in encouraging eHealth adoption. Also, other health profession groups were not included and, therefore, we suggest applying caution on generalizing the results as they do not represent all of the KSA health workforce.

Another limitation is that the data were only collected by one method which was an online questionnaire shared via social media. A risk of online surveys contamination may occur in which noneligible participants fill in the survey. However, the eligibility criteria were clarified in the information sheet of participation and the target population, like the majority of KSA citizens, over 75%, are known to be prolific users of social media [66]. Potential bias in sampling was also considered as a limitation. Also, although the target sample size was achieved, having greater participation would have increased confidence in the results.

#### **Conclusion**

This study has highlighted the relative importance of the main determinants that health managers in the KSA thought were important to influence their acceptance of

eHealth services. The main contributions which make this study stand out are the theoretically based approach, using the well-recognized UTAUT model, and the unique focus on health managers perspectives of eHealth acceptance. Being cognizant of the target populations' inclination towards social media platforms meant the approach to recruitment reflected their daily practices. SI and PE factors showed greatest significance so should be the focus for decision makers and policy makers when engaging health managers in eHealth implementation projects. However, the FC significance was ambiguous, thus further research is indicated.

While a qualitative extension to this study to explore identified factors in more depth with health managers is planned, the research using the UTAUT model in Saudi Arabia continues to expand [16, 61–63]. Indeed in the interim, UTAUT has been adopted to consider eHealth literacy and personal EHR [58], eGovernment health applications [62], pandemic surveillance during the COVID-19 outbreak in KSA [63]. Clearly the UTAUT model resonates with practitioners and policy makers in KSA, so this is an opportune time to share the findings of this study.

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## Statement of Ethics

Ethical approval to conduct the study was gained from both the Ethical Review Panel, School of Pharmacy and Life Sciences, Robert Gordon University, Aberdeen, UK with reference number: S72, 2017, and the Ethics Committee, Ministry of Health (MOH), KSA with an approval code IRB 18-259E. Written consent to participate in the study was not required.

## Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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## Author Contributions

This paper was designed and written by Abdullah Alshahrani. Abdullah Alshahrani and Katie MacLure conducted the study design including the questionnaire design, validation, piloting, and distributing. Abdullah Alshahrani performed the data collection. Hector Williams advised with statistical analysis. Katie MacLure and Hector Williams contributed to the methods, results, and discussion sections.

## Data Availability Statement

Data generated and analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

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