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LEVELS AND DETERMINANTS OF OPENNESS TO USING TELEMEDICINE TECHNOLOGY AMONGFAMILY MEDICINE PHYSICIAN AT THE PRIMARY CARE

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Abstract:

The use of telemedicine technology (TMT) has been increasing in Saudi Arabia in the past few years. However, its effectiveness is limited by levels of use (LoU) and acceptance, notably among physicians. Furthermore, there is lack of data regarding the acceptance of TMT in primary healthcare (PHC).

***Objective:** To explore the acceptance of TMT among PHC family medicine physicians (FMP) using the technology acceptance model (TAM), and to analyze eventual external factors.*

***Method:** A cross-sectional study was conducted at the Ministry of Health (MoH) primary healthcare centers (PHCCs) in Riyadh city, Saudi Arabia, during June – October 2021. A cluster sampling method was used to recruit 150 FMPs. An electronic questionnaire was designed based on TAM, and comprised four subscales: current LoU, perceived usefulness or harmfulness (PUH) of TMT in primary care, perceived ease of use (PEoU), and behavioral intention to use TMT. All four subscales enabled calculation of scores.*

***Result:** All subscales showed good reliability. The mean (SD) PUH score was 61.17 (18.69) out of 100, and perceptions were significantly positive for 23 out of the 25 PUH items (mean score >0, p-value<0.05, [one-sample t-test]). The highest mean score was observed in the item related to physicians' rights (0.75 out of 2), followed by medical confidentiality (0.73), and equitable access to care (0.71). On the other hand, perception was lowest for diagnostic accuracy (0.05) and negative for medical student's training (-0.20). The multivariate model of PUH showed age category (B = -7.26; 95% CI = -13.47, -1.04; p=0.022) and PEoU score (B = 2.56; 95% CI = 1.93, 3.20; p<0.001) to be independently associated with PUH score, explaining 36.0% of the PUH score variance.*

Behavioral intention model sowed PEoU to be the sole independent factor for behavioral intention (B=0.65; 95% CI = 0.54, 0.75; p<0.001), explaining 62.5% of behavioral intention score variance. The mean (SD) PEoU was 17.66 (3.93) and the mean (SD) behavioral intention score was 14.32 (3.42).

***Conclusion:** FMPs in Riyadh have favorable perceptions towards TMT and its implementation in PHC. However, there are reservations with regards to quality care, training of healthcare professionals, financial, and social stability of the physicians.*

Keywords: *telemedicine technology, perceived usefulness of harmfulness, behavioral intention, medicalstudents, family medicine physicians, subscales*.

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INTRODUCTION:

Telemedicine, or telehealth, was defined by the American Telemedicine Association as the use of information and communication technology to deliver remote healthcare services. It revealed great usefulness for populations living in rural areas, enabling them access to better-quality healthcare services. [1] The term 'telemedicine' was coined in 1970s, [2] and since then, the use of telemedicine has been increasing internationally, with thoroughly documented effectiveness. [3] A WHO document gives a vivid account of developments and progress in this field. Both synchronous and asynchronous modes are utilized for data transmission as text, audio, video, or still images. Moreover, connectable biometric devices to monitor vitals (such as pulse, blood pressure, blood glucose, etc.) are increasingly engineered and integrated in telehealth, enabling more accurate diagnosis and management in both acute and chronic conditions. [4] This results in a huge market estimated in 2020 at more than $60.9 billion, of which North America's share stood at 60% and Europe's share at 27%. By 2027 this market is projected to reach $121.6 billion. [5] However, the effectiveness of telemedicine applications is limited by its levels of use (LoU) and implementation, which still encounter some resistance on various frontiers, including patients, politicians, and physicians. [6]

In Saudi Arabia, although the government has deployed considerable resources to pave the way for telemedicine, the LoU are reportedly low. Several studies have attempted to explore the issue, notably by focusing on knowledge and attitudes of physicians. A study conducted at four hospitals in Riyadh region, in 2019, reported that 46% of the physicians had inadequate knowledge about telemedicine, 53% were not familiar with its tools and 70% had low interest and rare attendance to conferences and meetings about telemedicine technology (TMT). This was combined with low levels of information and communication technology. [7] Another single center study in 2017 surveyed 101 physicians from 24 departments and showed that approximately 75% were favorable to and satisfied about telemedicine effectiveness, accessibility, and positive impact on patient's satisfaction. However, participants highlighted difficulties in dealing with technical, organizational and communicational aspects of telemedicine, as well as cultural barriers. [8]

These data suggest that perceived drawbacks and difficulties from the physician's view are important dimensions to be addressed in a comprehensive strategic approach for implementing such technology by health authorities. On the other hand, to the researchers' knowledge, no such studies were conducted in primary health cares in Saudi Arabia, so far. Therefore, we conducted the present study to explore the acceptance of TMT among primary care family physicians using the technology acceptance model (TAM). We analyzed the associations between the LoU, the perceived impact on clinical practice, perceived ease of use, and behavioral intention to use TMT, as well as the eventual external factors including demographic and professional factors.

METHODS:

Design and setting:

A cross-sectional study was conducted at the Ministry of Health (MoH) primary healthcare centers (PHCCs) in Riyadh city, Saudi Arabia, during June 2021– October 2021. The study protocol and tools were ethically reviewed and approved by the Directorate of Health Affairs, Ministry of Health, Riyadh. (21-001)

Participants:

The study targeted male and female graduates (total~500) and residents (total~500) in family medicine, who were on service in the MoH PHCCs or in one of the two referral centers, namely Al Shumeisy and King Fahad Hospital during the study period.

Sampling:

A cluster sampling method was used. In Riyadh City, PHCCs are divided into two clusters, each comprising a referral center and a number of attached PHCCs. Cluster one includes Al Shumaisy Hospital, the referral center, and 15 PHCCs from the Southern and Western sectors of Riyadh. Cluster two includes King Fahad medical city, the referral center, and 15 PHCCs from the Northern and Eastern sectors of Riyadh.

A convenience sampling method was used to include all eligible and consenting participants.

Tool:

Theoretical framework:

The study tool was designed according to the theoretical and conceptual framework based on the TAM, as proposed by Davis, Bagozzi and Warshaw (1989). The TAM consists of an explicative and predictive model for an individual's readiness and willingness to adopt information technologies. [9,10] The model is based on three major dimensions that determine and predict the effective use of a new technology, including: 1) perceived usefulness; 2) perceived ease of use (PEoU); and 3) attitudes towards use and intention to use, which were combined into behavioral intention in the final version of the TAM; in addition to external factors that may impact both perceived usefulness or PEoU. [11] In the present study, the perceived usefulness was represented by the perceived contribution of TMT in the clinical practice in PHC, and the external factors were represented by demographic and professional factors as well as the current LoU of TMT (**Figure 1**).

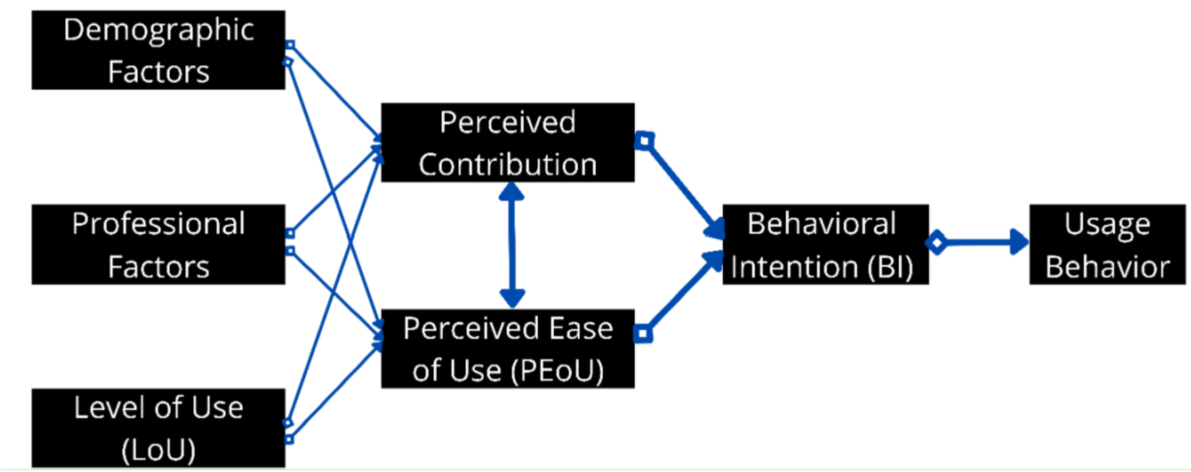

Figure 1: Final version of Technology Acceptance Model (TAM) used in the present study

Questionnaire design:
The study used a structured questionnaire divided into five parts. Part 1 collected demographic and professional data such as age, marital status, years of experience, etc. Part 2 explored participants' exposure to telemedicine and communication technology using an eight-item Likert-type scale including four options to answer (1= no experience; 2= small experience; 3= significant experience; 4= well experienced). Part 3 evaluated the participants' current level of use of TMT, using an adaptation of the LoU diagnostic dimension from the Concerns-Based Adoption Model, which was developed to evaluate the human factors that may interact with the successful implementation of an innovation. The Concerns-Based Adoption Model explores three dimensions including Innovation Configurations; Stages of Concern (SoC); and LoU. [12] In the present study, we adapted the eight-level scale of LoU to measure the current LoU of TMT among physicians from level zero (no experience and no significant knowledge or active interest in being involved) to level six (engaged use with critical view regarding the functionality and improvement possibilities of the system).

Part 4 explored the perceived contribution of TMT in primary care. The TAM model has been used by several studies that assessed the openness to using TMT in care; however, these studies explored the perceived usefulness dimension using generic items. [13–15] Considering the complexity of the healthcare process, the perceived usefulness of TMT may vary depending on the dimension of care. Based on this hypothesis, we have designed a multidimensional scale (Part 4) to measure the perceived usefulness or harmfulness of the implementation of telemedicine in major healthcare dimensions including: 1) legal framework (LF. four items); 2) care quality (CQ, four items); 3) patient's safety and engagement (PSE, five items); 4) job performance (JP, four items); 5) public health and health promotion (PHP, four items); 6) value and training (VT, four items). Each of the 25 items is a Likert-type scale measuring the perceived impact or contribution of TMT using five levels of impact: very negative impact (score= -2), negative impact (-1), mixed opinion or no impact (0), positive impact (+1), and very positive impact (+2). The internal consistency of the perceived usefulness or harmfulness (PUH) scale was measured in a pilot study involving 14 physicians, and showed very high reliability index with Cronbach's alpha=0.946.

Parts 5 and 6 assessed the PEoU and behavioral intention, using a five-item and a four-item Likert-type scale, respectively with five levels of agreement each.

Questionnaire validation:
The questionnaire underwent face and content validation by two family medicine consultants and

one methodologist. The internal consistency of the PUH scale was measured in a pilot study involving 14 physicians, and showed very high reliability index with Cronbach's alpha=0.946. The construct validity of the PUH scale was analyzed using Principal Component Analysis (PCA) followed by Varimax rotation; and the suitability of the dataset for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. Initial extraction criteria included an Eigenvalue ≥1 and an extraction value above 0.5. Initial extraction was followed by the analysis of the Scree plot as well as the comparison of the calculated Eigenvalues with those of the Monte Carlo PCA for parallel analysis by setting the number of replications to 100.

Data collection procedure:
The questionnaire was edited online using Google Forms. The online version was inaugurated with the presentation of the objectives and importance of the study, as well as the confidentiality terms, followed by a consent statement. Non-consenting participants were automatically directed to the end of the form. The survey link was disseminated by the investigator via professional networks and groups.

Statistical methods:
Statistical analysis was performed with the Statistical Package for Social Sciences version 21.0 for Windows (SPSS Inc., Chicago, IL, USA). Categorical variables are presented as frequency and percentage, while continuous variables are presented as mean ± standard deviation (SD). One-sample t-test was used to compare the mean scores of the 25 PUH items with the null value of 0. The reliability of the PUH scale and subscales as well as the PEoU and behavioral intention scales was analyzed by calculation of Cronbach's Alpha. The correlations between the PUH subscale scores were analyzed using Pearson's correlation. Independent t-test and One-Way ANOVA were used, as appropriate, to compare the mean PUH and PEoU scores across different categories of external factors (demographic and professional factors and LoU). Bivariate linear regression was used to analyze the correlation of PUH score with PEoU. The validity of TAM was analyzed using two multivariate linear regression models, by including PUH score and behavioral intention score as the dependent variables, respectively. Results are presented as the linear regression coefficient (B), with 95% CI. A *p*-value of <0.05 was considered to reject the null hypothesis.

RESULTS:

Participants' characteristics:
One hundred and fifty family medicine physicians (FMPs) participated in the study; of them, 72.0% were male, and mean (SD) age was 31.13 (5.41) years. Majority of the participants included residents (78.7%) and practitioners with less than five years of experience (69.3%). Other professional characteristics showed that 56.0% reported an average daily patient flow less than 20 minutes, and 60.0% reported an average consultation time of 10-20 minutes. Prior experience in telemedicine was deemed significant in 40.7% of the participants (**Table 1**).

Table 1. Participants' characteristics (N=150)

Parameter	Category	Frequency (n)	Percentage (%)
Gender	Male	108	72.0
	Female	42	28.0
Age (years)	Mean, SD (range=24-56)	31.13	5.41
Marital status	Single	61	40.7
	Married	86	57.3
	Divorced	3	2.0
No. children	None	73	48.7
	1-2	47	31.3
	3+	30	20.0
Years of practice	0-5	104	69.3
	5-10	32	21.3
	10+	14	9.3
Position	Resident	118	78.7
	Specialist	20	13.3
	Consultant	12	8.0

Academic degree	Bachelor	122	81.3
	Master	11	7.3
	PhD	17	11.3
Average daily patients' flow	<20	84	56.0
	20-40	59	39.3
	>40	7	4.7
Average consultation time (minutes)	≤10	47	31.3
	10-20	90	60.0
	>20	13	8.7
Experience in telemedicine prior COVID-19	Not significant	89	59.3
	Significant	61	40.7
COVID-19: Coronavirus disease-19; Values are frequency percentage, except where otherwise specified.			

Levels of use of TMT:
According to the LoU scale, participants can be divided into five categories: those with no experience or engagement (LoU 0, 24.0%), engagers (LoU 1, 23.3%), those with readiness (20.7%), beginners (LoU 3-4, 14.6%), and confirmed users (LoU 6, 17.3%). None of the participants was classified under LoU 5 (**Table 2**).

Table 2. Levels of use (LoU) of telemedicine technology (N=150)

Level	Item	Frequency (n)	Percentage (%)
0	I have no experience in TMT; I have no significant knowledge about it and I am doing nothing towards becoming involved in it	36	24.0
1	I have acquired or am acquiring information about TMT; I am exploring its value and its demands upon physicians and health institutions	35	23.3
2	I think I am ready for TMT implementation and am preparing for my first use	31	20.7
3	I have already made my first steps in TMT; I am using it superficially or whenever I need it	11	7.3
4a	I am using TMT in my routine practice but I have no idea about its impact on my patients or the quality of care	5	3.3
4b	I am using TMT and attempting to optimize my use to meet my patients' needs and or improve my clinical practice	6	4.0
5	I am using TMT and coordinating my efforts with other colleagues and health professionals for best effect on patient care	0	0.0
6	I am using TMT and I think there are some necessary modifications to the system to achieve increased impact of patients.	26	17.3
TMT: telemedicine technology			

Perceptions about telemedicine contribution in the clinical practice:
Overall, perceptions were significantly positive for 23 out of the 25 items of the perception scales (mean score >0, p-value<0.05, [one-sample t-test]). However, the highest mean score was 0.75 out of 2, which was observed in physicians' rights item, followed by medical confidentiality (0.73), and equitable access to care (0.71). On the other hand, the perception was lowest for diagnostic accuracy (mean score=0.05, p=0.571), whereas it was negative for medical student's training (-0.20) and the latter result was nearly statistically significant (p=0.052) (**Figure 2**).

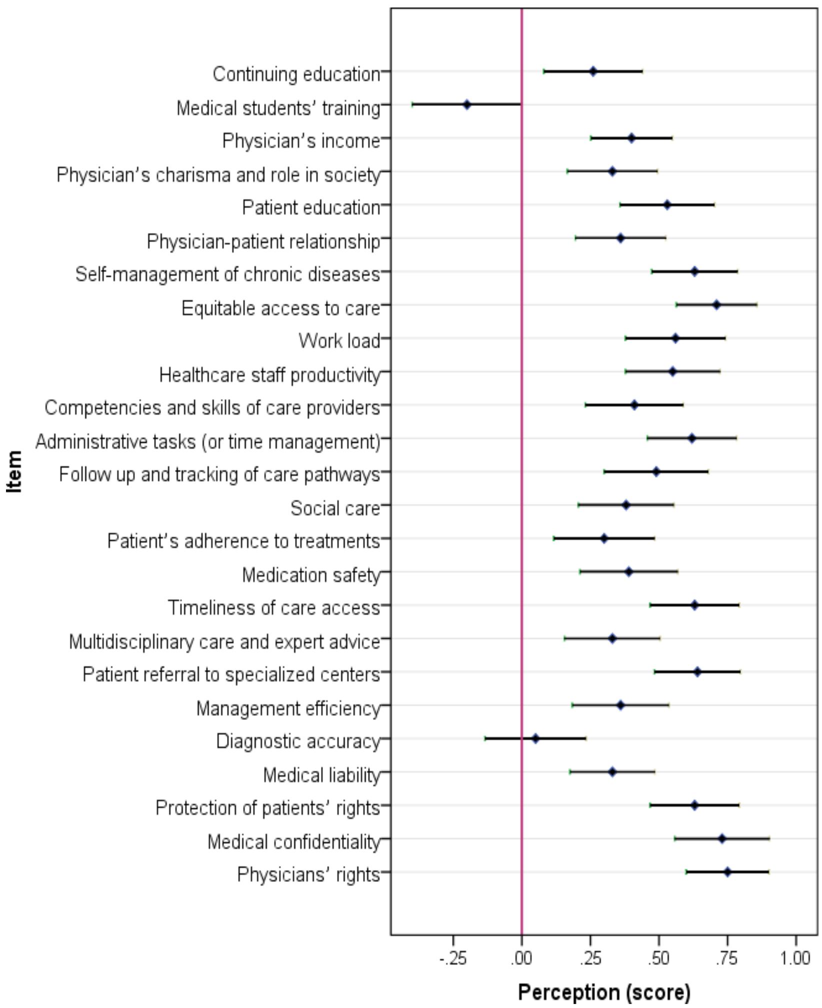

Figure 2. Means and 95% confidence intervals of perception scores about telemedicine impact on the 25 aspects of healthcare

Positive scores indicate positively perceived impact while negative scores indicate the opposite. The reference line indicates the null perception (neither positive nor negative)

Reliability and score statistics of the different scales:

PUH scale showed high level of reliability with a Cronbach's alpha = 0.957, and so did the PUH subscales with Cronbach's alpha values 0.794 – 0.871. Likewise, both PEoU and behavioral intention scales performed well in terms of internal consistency showing Cronbach's alpha 0.869 and 0.910, respectively. The mean (SD) PEoU was 17.66 (3.93) and the mean (SD) behavioral intention score was 14.32 (3.42).

PUH score was normally distributed in the study population, with Kolmogorov-Smirnov test (0.055, p=0.200) and Shapiro-Wilk test (0.999, p=0.263). The mean (SD) PUH score was 61.17 (18.69) out of 100 (**Table 3**).

Table 3. Reliability and score statistics of the study scales

Scale/subscale	No. items	Cronbach's alpha	Score statistics				
			Theoretical range	Mean	SD	Min.	Max.
Perceptions about Telemedicine contribution							
Overall scale	**25**	**0.957**	**0, 100**	**61.17**	**18.69**	**1**	**100**
Legal framework	4	0.856	-8, +8	2.43	3.35	-8	8
Care quality	4	0.840	-8, +8	1.39	3.56	-8	8
Patient's safety and engagement	5	0.871	-10, +10	2.19	4.52	-10	10
Job performance	4	0.817	-8, +8	2.14	3.50	-8	8
Public health and health promotion	4	0.794	-8, +8	2.22	3.15	-8	8
Value and training	4	0.834	-8, +8	0.79	3.57	-8	8
Other scales							
Experience in telemedicine and communication technology	8	0.894	8, 32	17.35	5.41	8	32
perceived ease of use	5	0.869	5, 25	17.66	3.93	5	25
Behavioral intention	4	0.910	4, 20	14.32	3.42	4	20

Analysis of the PUH subscales' scores showed bell-shaped distributions; however, none of them verified the criteria of normal distribution including Kolmogorov-Smirnov and Shapiro-Wilk tests. The distribution curves of all subscale scores were right-lateralized with reference to the neutral value (0), indicating overall positive opinions regarding the different dimensions (one-sample t-test for test value 0, statistics = 4.77 – 8.89; p<0.001). However, the distribution curve for value and training dimension was more centered around the neutral value (0) indicating more mixed opinions (one-sample t-test for test value 0, statistics =2.72; p=0.007) (**Figure 3**).

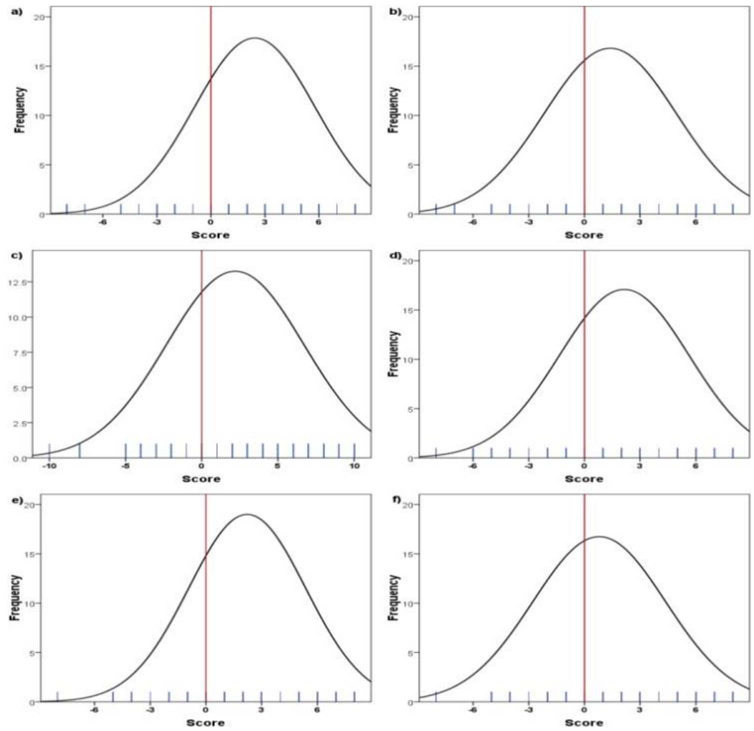

Figure 3. Distribution of the participants' levels of perception towards the contribution of telemedicine in different aspects of the healthcare including legal framework (a), care quality (b), patient's safety and engagement (c), job performance (d), public health and health promotion (e); value and training (f). Positive scores correspond to positive perceptions in the given dimension, while negative scores correspond to negative perceptions

Further, bivariate correlations between the subscale scores showed moderate-to-high positive relationships with Pearson's coefficient R: 0.588 – 0.768 (**Table 4**).

Table 4. Bivariate correlation between the scores of the perception subscales

Score	LF	CQ	PSE	JP	PHP	VT
LF	1	0.741**	0.609**	0.635**	0.630**	0.588**
CQ	0.741**	1	0.768**	0.755**	0.737**	0.748**
PSE	0.609**	0.768**	1	0.724**	0.768**	0.643**
JP	0.635**	0.755**	0.724**	1	0.734**	0.611**
PHP	0.630**	0.737**	0.768**	0.734**	1	0.691**
VT	0.588**	0.748**	0.643**	0.611**	0.691**	1

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

LF: Legal framework; **CQ**: Care quality; **PSE**: Patient's safety and engagement; **JP**: Job performance; **PHP**: public health and health promotion; **VT**: value and training.

Construct validity of the PUH scale:
Results for construct validity using PCA are not depicted in tables or figures. KMO measure of sampling adequacy was 0.912 and Bartlett's test of sphericity was significant (p<0.0001), indicating the suitability of the dataset for factor analysis. Four components met the initial criteria of Eigenvalue >1 and factor loading >0.5, explaining 65.8% of the scale variance. The first component showed an Eigenvalue=12.5 and accounted for 49.8% of the variance; while the second, third and fourth components had Eigenvalues of 1.51 and 1.45, and 1.04, respectively, and accounted for 16% of the model variance. The analysis of Scree plot as well as the comparison of calculated Eigenvalues with those of the Monte Carlo PCA for parallel analysis showed that the perception scale had a unidimensional construct. Hence, only the overall perception score was considered in further analysis.

Factors associated with perception and PEoU:
The PUH score were significantly higher in participants aged ≤30 years (mean [SD] = 64.79 [16.17] versus 55.89 [20.88], p=0.004), those with never married status (66.05 [16.32] versus 57.82 [19.54], p=0.008) and having no children (65.68 [16.88] versus 57.28 [18.60] and 56.27 [20.92], p=0.014), compared to their counterparts, respectively. Likewise, PUH was higher among participants with a bachelor degree (62.93 [17.89]) compared with master (58.45 [18.10]) and PhD (50.24 [21.74]), and the difference was statistically significant (p=0.027). Furthermore, PUH score was associated with PEoU scores with a regression coefficient B of 2.62 (95% CI = 1.97, 3.26) and a p value <0.001. On the other hand, PUH score showed no significant association with the prior experience in telemedicine (p=0.765) or current levels of TMT use (p=0.489). No further significant association was observed between PEoU score and demographic or professional factors.
Nevertheless, we observed an increasing trend of PEoU with the LoU with a significance level p=0.086(**Table 5**).

Table 5. Factors associated with perceptions and perceived ease of use of telemedicine (N=150)

Parameter	Level	Perceptions about TMT (score)			PEoU of TMT (score)		
		Mean	**SD**	**p-value**	**Mean**	**SD**	**p-value**
Gender	Male	62.05	18.85		17.65	4.24	
	Female	58.90	18.31	0.357	17.69	3.06	0.953
Age (years)	≤30 (median)	64.79	16.17		17.64	3.81	
	>30	55.89	20.88	0.004*	17.69	4.14	0.942
Marital status	Never married	66.05	16.32		18.21	3.68	
	Ever married	57.82	19.54	0.008*	17.28	4.08	0.155
No. children	None	65.68	16.88		17.71	3.91	
	1-2	57.28	18.60		17.64	4.00	
	3+	56.27	20.92	0.014*	17.57	4.03	0.985
Years of practice	0-5	63.54	16.89		17.55	3.54	
	5-10	56.66	22.36		18.56	4.55	
	10+	53.86	19.92	0.057	16.43	5.02	0.209
Position	Resident	62.27	17.70		17.64	3.78	
	Specialist	60.60	19.55		18.35	3.83	
	Consultant	51.25	24.83	0.149	16.67	5.52	0.504
Academic degree	Bachelor	62.93	17.89		17.89	3.81	
	Master	58.45	18.10		17.18	2.48	
	PhD	50.24	21.74	0.027*	16.35	5.33	0.297
	<20	63.02	19.66		17.65	4.17	

Average daily patients' flow	20-40	59.63	16.64		17.85	3.48	
	>40	51.86	21.87	0.228	16.14	4.91	0.559
Average consultation time (minute)	≤10	61.57	16.08		17.53	3.82	
	10-20	60.88	20.16		17.77	4.02	
	>20	61.69	18.14	0.974	17.38	4.05	0.915
Experience in TMT prior COVID-19	Not significant	60.79	17.25		17.67	4.13	
	Significant	61.72	20.75	0.765	17.64	3.66	0.958
LoU of TMT	0	62.03	17.53		16.86	4.03	
	1	56.49	17.28		16.69	3.97	
	2	64.58	16.29		18.90	3.45	
	3-4	62.68	21.49		18.64	4.54	
	5-6	60.92	22.15	0.489	17.77	3.39	0.086
Score		**B**	**95%CI**	**p-value**			
Age	Years	-0.64	-1.19, -0.09	0.023*	-	-	-
PEoU	(score)	2.62	1.97, 3.26	<0.001*	0.04	-0.08, 0.16	0.533

TMT: Telemedicine technology; PEoU: perceived ease; LoU: current level of use; B: linear regression coefficient; 95%CI: 95% confidence interval; COVID-19: Coronavirus disease-19.

Modeling perceptions about and behavioral intention to use TMT:
The multivariate model of PUH showed age category (B = -7.26; 95% CI = -13.47, -1.04; p=0.022) and PEoU score (B = 2.56; 95%CI = 1.93, 3.20; p<0.001) to be independently associated with PUH score, explaining 36.0% of the PUH score variance. However, marital status (B = -258; 95% CI = -8.06, 2.91; p=0.355) and academic degree (B = -1.05, 95% CI = -5.38, 3.29; p=0.634) were confounders. Behavioral intention model sowed PEoU to be the sole independent factor for behavioral intention with a regression coefficient B=0.65 (95% CI = 0.54, 0.75) and a p<0.001, explaining 62.5% of the behavioral intention score variance; while PUH score was not significant (B = 0.01; 95% CI = -0.01. 0.04; p=0.194). The outcome TAM model is depicted in **Figure 4**.

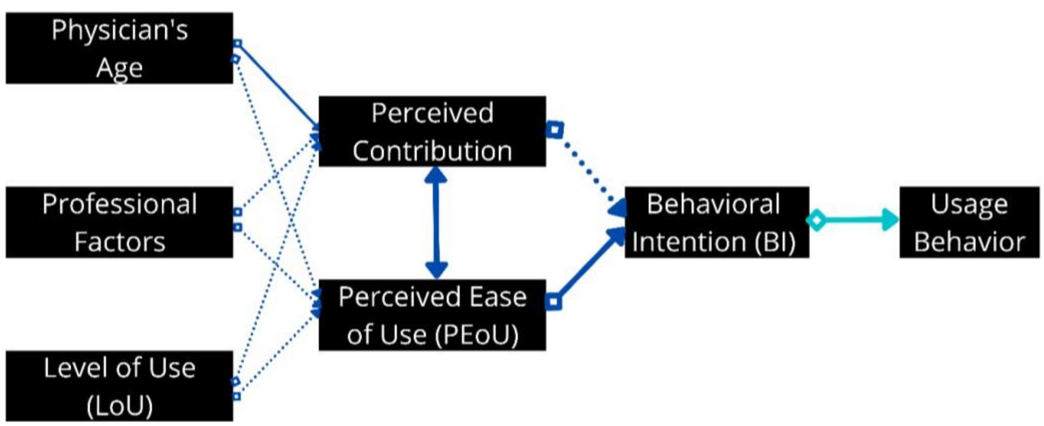

Figure 4. Summary of the Technology Acceptance Model (TAM) according to the study findings Solid-line arrows represented the supported hypotheses while dotted-line ones represent non-supported hypotheses, with respect of the study findings. The arrow between behavioral intention and usage behavior wasbeyond the scope of the present study.

DISCUSSION:

Prelude and summary of findings:
Telemedicine is emerging as a viable alternative to traditional healthcare delivery methods due to its convenience and cost-effectiveness, and thanks to its ability to enhance accessibility by overcoming geographical constraints. [16–18] It has been historically proven beneficial during times of crisis [19] and has been found valuable in the COVID-19 pandemic, with e-triage, e-consultations, remote

monitoring of the intensive care units, and patients being attended to remotely by health care providers. [20] The present study investigated the acceptance of TMT among primary care family physicians in Saudi Arabia using the TAM. It examined the associations between the LoU, the perceived impact on clinical practice, PEoU, behavioral intention to use TMT, and the eventual external factors, including demographic and professional characteristics.

Overall, FMPs had positive perceptions about TMT and its implementation in primary healthcare. The expected impact of TMT implementation was perceived to be positive in the majority of care dimensions explored, with the exception of items related to 'training and value'. Furthermore, we noted a generational effect, with higher perceptions among younger generations of physicians. This is probably due to greater familiarity with the information technology among the younger physicians. On the other hand, the TAM was not fully supported in the context of the present study, in that the perceptions about TMT did not predict the behavioral intention to use it. Nevertheless, PEoU was independently associated with perception, and also predicted the behavioral intention regardless of the perception.

Towards the implementation of TMT in primary care:

The participating family physicians were generally favorable to the implementation of TMT in PHC. This was demonstrated by the positive perceptions observed in all but 2 of the 25 dimensions of care. With the exception of previously mentioned generational effect, no significant difference in the perceptions was observed across the socio-demographic and professional factors or with previous experience or LoU of TMT. However, a relatively low perception score was observed in dimension related to care quality, which denotes concerns about the clinical performance of physicians that may result from the lack of physical examination and direct patient contact. These findings are in line with the international reports on physicians' satisfaction about TMT implementation in PHC. A qualitative study by Gomez et al. enumerated several aspects of improvement in care quality as a result of TMT, including care accessibility, convenience, counseling time, medication optimization, and enhanced connection of physicians with the patient's physical and social environment. On the other hand, PHC physicians raised concern about the potential marginalization of certain subgroups that are disadvantaged with regards to the possession or use of TMT. In addition, lack of physical examination and direct contact with the patient was perceived to impact the clinical performance and physician-patient relationship. [21] Another interesting study by Jetty et al. concluded that family physicians working in remote areas exhibited higher satisfaction about TMT and were more likely to use it, reporting enhanced connections with specialist expertise, enhanced professional opportunities and reduced isolation. [22] Interestingly, a Korean review article proposed a panel of 10 practical recommendations to use TMT, the first of which, considered to be a "primary priority" stated that "telemedicine cannot replace face-to-face treatment". The second recommendation encouraged using TMT among patients who benefited from prior direct contact with the physician. All other recommendations are relevant to the context and can be consulted in the original article. [23]

In the Saudi context, the patient-centered care vision adopted by the MoH tends to encourage the implementation and use of TMT in all healthcare settings, including PHCCs. During the COVID-19 crisis, the government has massively promoted the use of smart applications to reduce PHC visits, both to mitigate the spread of the virus and to optimize the health resources, while ensuring care continuity for the population. [24,25] Before the COVID-19 crisis, TMT was already implemented in nearly all governmental hospitals, including PHCCs and referral hospitals, using different types of communication technology, e.g., phone counseling, smart applications, video conferencing, etc. [26] Nevertheless, feedback data about TMT in primary care is scarce, while plentiful studies are published about TMT use and satisfaction in other settings, notably since the onset of the COVID-19 crisis. One of these studies conducted at a children specialist hospital in Riyadh, showed that 67% of the participating physicians have implemented TMT-based clinics, and 98% of them did since the COVID-19 onset. The participants showed high levels of satisfaction, and reported several benefits especially regarding the management of patients' appointments and reduction of waiting times, which enhanced patient satisfaction. However, participants reported the lack of physical examination as being the major drawback of TMT. [27] From these observations, it can be suggested that TMT implementation in PHC should be proposed as a complementary health service with specific indications, with the aim to improve performance and sustain the health care system, notably in health triage and the management of chronic diseases. This requires the clear definition of the legal and technological framework of TMT as well as the evidence-based scientific and organizational frameworks for a safer and more efficient implementation.

Impact of TMT on doctor's prestige:
The impact of TMT on the physicians' role model and social and economic prestige of the medical profession has long been a concern. The present study demonstrated that the dimension 'value and training' yielded the lowest perception score (0.79 on a scale from -8 to +8). This dimension included four items; two of them were related to physician's prestige including charisma and income. The two other items were related to skill acquisition including medical students training and continuing education. Regarding prestige, both items scored between 0.25 and 0.35 on a scale from -1 to +1, indicating near neutral levels of perception, i.e. neither positive nor negative. This indicates that physicians are uncertain of the impact TMT will have on their profession. By focusing on the income, a study analyzing data from a Chinese telemedicine platform showed that paid TMT consultation were associated with higher levels of physicians' engagement along with enhanced patient's choice, both reflecting care quality and patient satisfaction. [28] Another Spanish study demonstrated the importance, from the physicians' perspective, of financial incentives and funding to promote TMT among health professionals and enhance their performance. [29] Hence, the implementation of TMT should be based on a well-studied business model that ensures financial stability of the physicians, taking into account all the other parameters, such as health insurance systems, direct and indirect costs of technology use, and physicians' availability and quality of life. [30] Although not all of these considerations apply in the context of a governmental position, such as PHC, they remain determining for the career choice and expectations. The financial aspects should be defined and discussed with clarity to avoid both reticence and malpractice.

The future of clinical training with TMT:
Among 25 items of the perception scale, medical students' training was the only dimension that yielded frankly negative perceptions among family physicians. This observation probably translates a concern about the acquisition of clinical skills among trainees in a telehealth-based healthcare delivery system. On the other hand, advent of telehealth and its expanding use may indicate shift to a new era of medicine, where traditional clinical skills should be adapted to fit the new communication tool. In other terms, sooner or later, doctors will have to be trained for disciplines like tele-semeiology, telediagnosis and tele-treatment. The concept of tele-semeiology was not present in the internet while we were preparing the first version of this paper (i.e. in December 2021).

However, a few weeks later, while editing the paper in January 2022, Brizio et al. introduced the term '*telesemiotics*', defined as "a special branch of medical semiotics mostly centered on self-performed physical examination, improved physician-patient communication, and the use of computer facilities". Authors concluded that such a skill should be delivered in the training of healthcare professional. [31] This proposition was preceded by a publication, in 2021, by a telehealth advisory committee (TAC) missioned by the Association of American Medical Colleges (AAMC), which was mandated to determine the critical telemedicine skills for clinicians. The AAMC-TAC identified nine domains including "Using Telehealth: Patient and Practice Readiness and Impact", "Remote Clinical Evaluation and Care", "Communication Using Telehealth", etc. Each of these domains comprises a set of specific skills, with the vision to translate these into educational objectives for undergraduate and postgraduate medical trainees, as well as for physicians. [32] Not being that visionary, we are probably witnessing the birth of a new set of clinical skills in line with the expanding use of TMT, especiallyin the COVID-19 era. Another interesting tutorial published in 2021, by a medical extern and an intern at John Hopkins University School of Medicine, suggested incorporating medical trainees into PHC telemedicine visits. The two students summarized their respective experiences in telehealth visits during the 2-month suspension of clerkships for COVID-19 lockdown, and attempted to provide a practical guide to enable immersion of students in the efficient use of TMT. [33] That being said, training for traditional clinical skills remains compromised in majorly TMT-based settings.

Significance of the Technology Acceptance Model:
Findings from the present study did not fully support TAM. The perceptions about TMT did not predict the behavioral intention to use it. On the other hand, PEoU was independently associated with perception, and also predicted the behavioral intention regardless of the perception. This emphasized the significance of creating and implementing adaptable and user-friendly TMT to boost physicians' adoption. [34] The platform must be capable of acquiring information to aid accurate diagnosis, counsel appropriately, give therapeutic

instructions, and develop caring connections with patients, while optimizing the physician's communication and interpersonal skills, which will contribute to improved therapeutic outcomes and results. [35,36] Furthermore, decision-makers may implement simple communication strategies to enhance the PEoU of TMT.

Nonetheless, the current LoU and past experience with TMT were not significantly associated with PEoU indicate dissatisfaction about the TMT among current users. This emphasizes the need to assess the operability and satisfaction of the already implemented TMTs in PHCCs, and explore the room for improvement.

Validity of the Perception scale:

The PUH scale performed well in terms of reliability. However, the original six-subscale construct was not supported by the PCA; hence, it should be used as unidimensional scale. It still has the interest of exploring the perceived impact of TMT on several dimensions of healthcare. Further studies are warranted to analyze its validity.

Limitations:

The major limitation of this study is the sample size, reducing the statistical power of the analysis.

CONCLUSION:

FMPs in Riyadh have favorable perceptions towards TMT and its implementation in primary healthcare. However, there are reservations with regards to the potential of TMT to enable quality care, support the training of healthcare professionals, and ensure financial and social stability of the physicians. As such, we suggest that TMT services in primary care should be framed with a clearly defined legal and technological agenda and according to the evidence-based medical and operational requirements, to meet the requirements of both physicians and the served populations. To a broader horizon, medical education curricula should anticipate the needs in training for telehealth clinical skills, such as tele-semeiology, telediagnosis and tele-treatment; this constitutes the next urgent step to ensure sustainability of the future TMT-supported healthcare systems.

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