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Enhancing Healthcare Delivery: The Perception of Healthcare Professionals towards mHealth Applications in India

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ABSTRACT

The use of mobile phones, especially smartphones has changed the face of how humans access information and services online. One of the many applications of smartphones that changed the face of healthcare delivery is the development and usage of mobile health applications which are used by patients as well as HCPs to consult and communicate with each other online, without stepping into a physical facility, among many other functionalities and services offered. This study investigates the determinants that will aid the process of acceptance and adoption of such apps among HCPs in India, based on the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2). Data was collected by means of an online survey from HCPs registered on Health Professional Registry of India and already providing telemedicine services to their patients. Data was analyzed using PLS-SEM. All the constructs of the proposed model, except facilitating conditions were found to have a significant positive effect on the behavioural intention of HCPs to adopt mHealth apps, with a strong R-square value of 0.673.

INTRODUCTION

As the world is moving forward, more and more people are turning towards smart solutions to their problems, be it installing wi-fi connected lighting or smart-refrigerators, be it robot vacuum cleaners or AI-driven automated vehicles. A similar technological application of smartphones was also introduced in the healthcare sector in the form of mobile health (mHealth) applications. Stemming from telemedicine, mHealth apps are a step ahead as they provide more interactive feature along with varied functionalities for users with different interests.

mHealth apps can provide diverse services ranging from personalized diet plans and weight tracking to medical record management, from appointment booking online to online consultations with a Healthcare provider (HCP), from maintaining symptoms registry to medicine reminder or even dosage adjusters. These apps have managed to surpass space-time barriers, enabling patients as well as HCPs to stay connected with each other irrespective of where they are in the world. This initiative has also paved way to decongesting the medical facilities, i.e., hospitals, healthcare centres or public/private clinics as routine/follow-up consultations can be managed online, in real-time.

While mHealth apps have changed how healthcare services as well as information are delivered and disseminated across the world, the adoption of such apps still faces challenges across different nations. This resistance to the adoption of mHealth apps has been studied by a number of researchers from the perspectives of patients/care-givers as well as HCPs using different technology acceptance models to identify the barriers faced by them. With the global mHealth market value expected to surpass 50 billion USD by 2025 (Statista, 2020) and the government of India also emphasizing on the usage of telemedicine across the country, the adoption rates are expected to rise.

The usage of such apps has become more critical after the COVID-19 pandemic, especially in India where the HCP to patient ratio was 1:834 (Ghosh, 2022). Since these apps have the potential to minimize the footfall that a healthcare facility experiences, routine appointments, sharing of test reports, providing prescriptions, etc. can be managed remotely. While these functions and services may not seem enough for decongesting healthcare facilities, these small steps towards mHealth acceptance can lead to effective communication between the patients and HCPs significantly, contain infectious patients at their homes until and unless moving them becomes necessary, save time of part of the both user-groups involved; thus, improving patient outcomes and healthcare delivery.

Although mHealth research has seen a rise in the past decade across the world, the body of research literature viz-a-viz mHealth apps and online consultations in India is still lagging. This study aims at identifying and studying the determinants of behavioural intention of HCPs to adopt mHealth applications which provide the facility of online appointment booking as well as consultations in India.

MATERIAL AND METHODS

Research/Theoretical Background

mHealth apps adoption has gathered significant attention by researchers globally, especially after the COVID-19 pandemic, using different acceptance theories and models, Diffusion of Innovations theory (DOI), Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) to name a few. Some studies have also combined constructs from different theories and/or models to identify determinants of behavioural intention of a user-group.

For the purpose of this study UTAUT2 was chosen to develop the proposed model, since this model includes the previous eight technology acceptance theories/models, including UTAUT (Venkatesh et al., 2003). In addition to the constructs of UTAUT, i.e., performance expectancy, effort expectancy, facilitating conditions, social influence and behavioural intention, Venkatesh et al. (2012) included price value, habit and hedonic motivation as well to the model.

A review of literature was carried out to identify studies investigating the determinants of behavioural intention to adopt mHealth apps. The studies included in the review are presented in Table 1 for a comparative view of the methodologies used, sample, country where the research was conducted, theory/model used for proposed model development and software(s) used for analysis.

Table 1. Meta Analysis of Reviewed Studies

Source	**Methodology**	**Sample**	**Country**	**Framework/ Theory**	**Analysis software**
Payne et al. (2012)	Quantitative-PLS-SEM	257 medical students and 131 junior doctors	UK	-	SPSS
Zapata et al. (2015)	Quantitative-PLS-SEM	22 studies related to m-Health applications	-	Usability model	PRISMA flow diagram
Peng et al. (2016)	Quantitative-PLS-SEM	44 users/non-users of m-	USA	Consolidated criteria for	NVivo software

		health apps		reporting qualitative studies checklist	
Sezgin et al. (2017)	Quantitative-PLS-SEM	151 physicians	Turkey	TAM, UTAUT, DOI and other constructs	SPSS, Smart-PLS
Quaosar et al. (2017)	Quantitative-PLS-SEM	245 respondents	Bangladesh	UTAUT with perceived credibility	Smart-PLS
Ravangard et al. (2017)	Quantitative-PLS-SEM	170 patients	Iran	UTAUT2 with other constructs	SPSS and Smart-PLS
Azhar & Dhillon (2018)	Quantitative-PLS-SEM	203 responses	Malaysia	TAM, UTAUT and other constructs	SPSS, AMOS
Duarte & Pinho (2019)	Qualitative and quantitative-(PLS-SEM) and fuzzy-set qualitative comparative analysis (fsQCA)	120 users of mHealth devices and applications	Portugal	UTAUT2	Smart-PLS and fsQCA
Wang et al. (2020)	Systematic App Search	239 virtual hospital apps	China	-	-
Dahlhausen et al. (2021)	Quantitative-PLS-SEM	1308 responses	Germany	TAM and UTAUT	Smart-PLS

		from general practitioners, physicians and psychotherapists			
Gu et al. (2021)	Quantitative-PLS-SEM	353 patients	Pakistan	UTAUT2 with other constructs	Smart-PLS
Napitupulu et al. (2021)	Quantitative-PLS-SEM	118 telehealth users	Indonesia	UTAUT with other constructs	Smart-PLS
Sarradon-Eck et al. (2021)	Quantitative-PLS-SEM	36 general practitioners	France	-	MS Excel
Semiz & Semiz (2021)	Quantitative-PLS-SEM	354 individuals with prior experience	Turkey	UTAUT2 with perceived trust	SPSS, Smart-PLS

As seen in Table 1, researchers have used different softwares to analyze the quantitative data; among them, one of the most frequently used is Smart-PLS to carry out Partial Least Suares-Structural Equation Modelling analysis. As for the sample of each study, the demographic characteristics of respondents viz-a-viz age varied encompassing both younger and older users. It should also be noted that not all studies focused exclusively on healthcare professionals using mHealth services; the other user-group of the said apps has also been studied.

A significant finding from the reviewing the relevant body of literature was that no UTAUT variable was found to consistently demonstrate significant or non-significant impact on the behavioural intention, suggesting that none are individually necessary or sufficient for mHealth adoption—a conclusion also supported by Duarte and Pinho (2019).

Proposed Research Model

The proposed model for this study included the variables of UTAUT, except for habit and hedonic motivation. Since mHealth apps are used by patients as well as HCPs to consult and communicate with each other, these two constructs do not prove to be relevant as using the said apps is neither done for enjoyment nor is it done out of habit, but rather their adoption is driven by necessity and need of the users.

Proposed Hypotheses

H1: Performance expectancy (PE) significantly influences healthcare professionals' (HCPs) behavioural intention (BI) to adopt mHealth apps.

H2: Effort expectancy (EE) significantly influences HCPs' BI to adopt mHealth apps.

H3: Social influence (SI) significantly influences HCPs' BI to adopt mHealth apps.

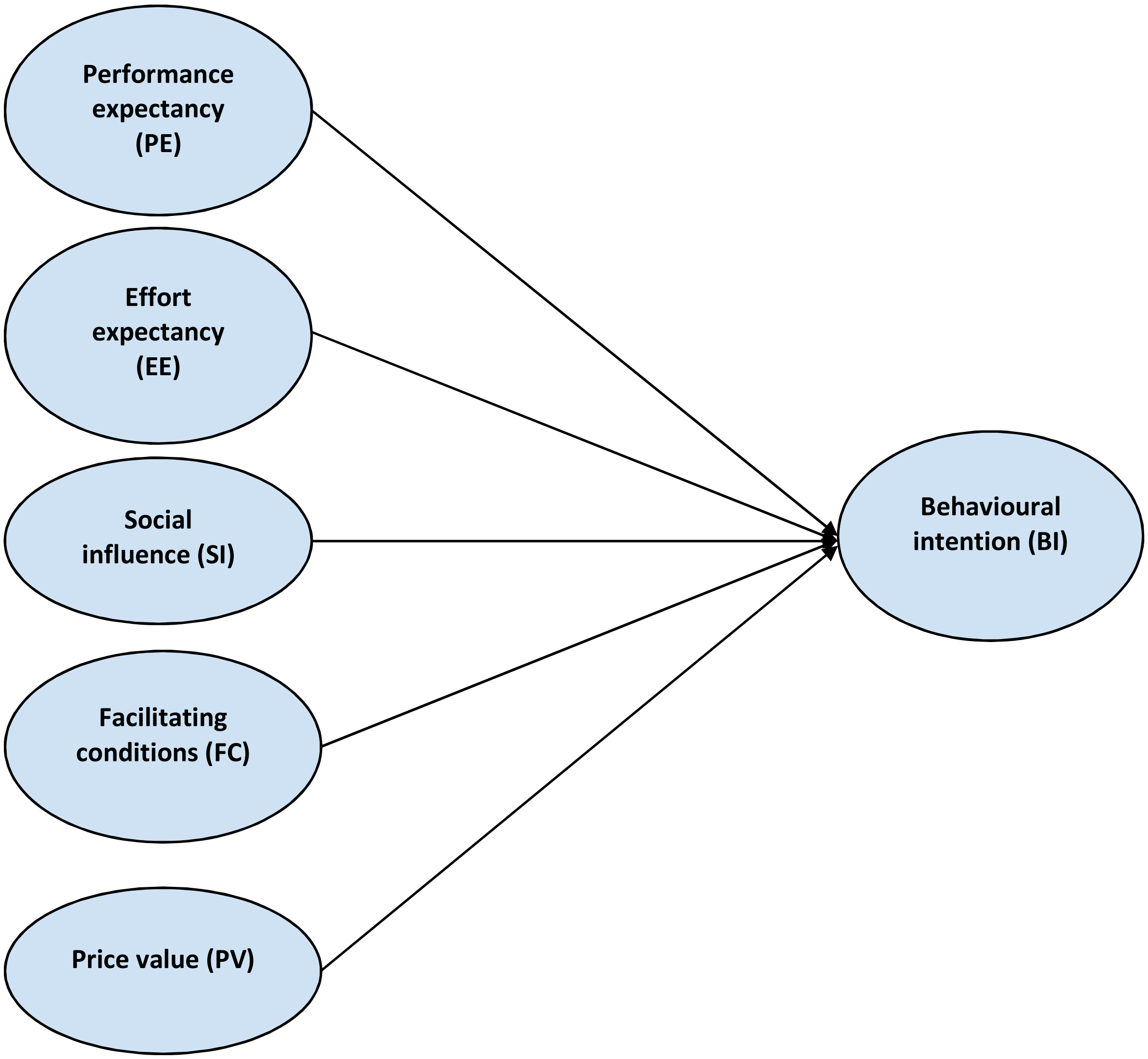
H4: Facilitating conditions (FC) significantly influence HCPs' BI to adopt mHealth apps.

H5: Price value (PV) significantly influences HCPs' BI to adopt mHealth apps.

Measurement Scale

A prior-validated measurement scale by Venkatesh et al. (2012) for UTAUT2 was used for the measuring instrument, with contextual changes to fit the HCPs perspective. The respondents rated statements on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree).

Fig 1. Research framework



Data Collection

The respondents, i.e. HCPs employed in the public healthcare sector in India, for this study were approached by means of convenience sampling, followed by snowball sampling. HCPs were contacted through their contact numbers provided on the Health Professional Registry website. A brief description was provided to the respondent to understand what the questionnaire aims to measure viz-a-viz mHealth apps and how these apps are different from telemedicine services. Following their consent, the link to the survey, hosted on Google Forms, was forwarded through their preferred mode of communication, like WhatsApp message, email or SMS.

Among the 413 contacted HCPs, 274 agreed to participate in the survey but only 214 responses were received. Of these, only 201 were found to be complete and were considered for final analysis. These responses included HCPs across diverse specialities ranging from surgery, intensive care to family medicine and hospital administration with 59% females and 41% males. These respondents held different positions starting from interns to post-graduate students to consultants and fellows.

RESULTS

The data analysis involved descriptive statistics and demographic analysis using MS Excel, followed by Partial Least Square-Structural Equation Modeling (PLS-SEM) in SmartPLS, consistent with previous research (Table 1). The analysis was divided into the assessment of the measurement model and the structural model.

Measurement Model Assessment

The measurement model evaluated the validity and reliability of questionnaire constructs. As shown in Table 2, factor loadings (≥ 0.7), Cronbach's alpha (α), and Composite Reliability (both > 0.7), along with average variance extracted (AVE > 0.5), all meet the thresholds recommended by Hair et al. (2011)., except for FC4 the factor loading for which came out to be 0.421. The said item was removed and the model was run once again. As no significant changes in the validity measures were recorded, the said item, i.e., FC4 was retained as it was considered important for the measurement instrument. The values thus, obtained in the assessment of measurement model confirm construct reliability and convergent validity of the measures involved, ensuring robust measurements.

Table 2. Measurement Model

Items		Loadings	α	CR	AVE
PE1	I would find m-Health app useful in my job for consulting routinely and communicating with the patients online.	0.913	0.899	0.937	0.831
PE2	Using m-Health app may enable me to accomplish tasks more quickly.	0.930			
PE3	Using m-Health app may increase my productivity.	0.893			
EE1	My interaction with m-Health app would be clear and understandable.	0.914	0.935	0.954	0.837

EE2	It would be easy for me to become skillful at using m-Health app.	0.910			
EE3	I would find m-Health app easy to use.	0.927			
EE4	Learning to operate m-Health app is easy for me.	0.888			
SI1	People who influence my behaviour think that I should use m-Health app.	0.945	0.939	0.961	0.891
SI2	People who are important to me think that I should use m-Health app.	0.949			
SI3	My organization (hospital, clinic, etc.) has supported and highlighted the use of m-Health apps among employed Health-care professionals for consulting with the patients.	0.937			
FC1	I have the resources (mobile device, internet connection, etc.) necessary to use m-Health app.	0.867	0.713	0.833	0.569
FC2	I have the knowledge (technical know-how with respect to using a mobile device as well as a mobile application) necessary to use m-Health app.	0.848			
FC3	Confidentiality of information is something I would consider before adopting m-Health app.	0.794			
FC4	I may need help from others while using m-Health app, in case of any difficulties.	0.421			
PV1	Reasonable fees/subscriptions for HCPs are something I would consider before adopting m-Health app.	0.920	0.780	0.891	0.804
PV2	I find using mobile health applications economical.	0.829			
BI1	I am determined to use m-Health app to consult with my patients.	0.905	0.930	0.964	0.869
BI2	I intend to use m-Health app for consulting with my patients.	0.948			
BI3	I predict I would use m-Health app for consulting with my	0.925			

	patients in the coming months.				
BI4	I am curious to use m-Health app in my daily routine.	0.950			

Following the confirmation of construct reliability and convergent validity, the discriminant validity of constructs is also assessed using the HTMT (Heterotrait-Monotrait) Ratio of Correlations and the Fornell and Larcker criterion (Table 3). The HTMT values below 0.90 (Henseler et al., 2015) indicated that constructs of the questionnaire measure distinct concepts. Additionally, the Fornell and Larcker criterion confirmed discriminant validity, with the square root of AVE for each construct exceeding its correlation with other constructs (Hair et al., 2011).

Structural Model Analysis

Once all the measures are found to be valid and reliable, the structural model is assessed to text the proposed hypotheses of the study, as per the procedure suggested by Hair et al. (2011) for conducting PLS-SEM in SmartPLS. By means of bootstrapping, path coefficients, t-statistics and significance of relationships hypothesized between constructs are obtained. These values are presented in Table 4 and aid in interpreting the effect of the variables of the proposed model on the behavioural intention of HCPs to adopt mHealth apps.

Table 3. Discriminant Validity Results

	HTMT ratio							**Fornell and Larcker Criterion**					
	BI	EE	FC	PE	PV	SI		BI	EE	FC	PE	PV	SI
BI								**0.932**					
EE	0.709							0.672	**0.915**				
FC	0.644	0.771						0.526	0.64	**0.755**			
PE	0.769	0.771	0.670					0.712	0.709	0.537	**0.912**		
PV	0.506	0.458	0.349	0.380				0.478	0.421	0.286	0.34	**0.897**	
SI	0.774	0.623	0.537	0.744	0.449			0.732	0.583	0.433	0.682	0.408	**0.944**

Note: The bold and italic values show square root of AVE for the Fornell and Larcker criterion.

Among the hypothesized relationships, H4 is rejected since the path coefficient is <0.10, i.e., facilitating conditions do not significantly affect behavioural intention of HCPs to adopt mHealth apps. In comparison, H1, H2, H3 and H5 are supported with path coefficients > 0.10 and p-values < 0.05.

Table 4. Hypotheses Testing

Hypothesis	Relationship	Path coefficient	t statistics	Significance (p value)	Results
H1	PE -> BI	0.246	3.72	0.00*	**Supported**
H2	EE -> BI	0.164	2.331	0.02	**Supported**
H3	SI -> BI	0.37	5.377	0.00	**Supported**
H4	FC -> BI	0.085	1.54	0.124	Not supported
H5	PV -> BI	0.15	3.559	0.00	**Supported**

Note: *point of significance p < 0.05.

In addition to hypothesis testing, the coefficient of determination or R-square is also calculated to evaluate model's feasibility. With a value of 0.673, the relationship between variables is found to be strong as suggested by Hair et al. (2013).

Table 5: R- square

	R-square	R-square adjusted
BI	0.673	0.665

DISCUSSION

As per the results obtained from SEM analysis, for HCPs, performance expectancy, effort expectancy, social influence and price value seem to be significantly affecting their behavioural intention to adopt mHealth apps. This implies that users, in this case HCPs, are more likely to adopt such an app whose features and functionalities positively affect their routine performance, are easy to use and navigate through, requiring less effort on their part and also, offer good value for the services rendered. Peer recommendations and opinions of significant people from their social circles also encourages them to make the leap from traditional consultations to online consultations.

CONCLUSION AND IMPLICATIONS

This study identifies the key factors, i.e., performance expectancy, effort expectancy, social influence and price value influencing behavioural intention of HCPs to adopt mHealth applications, with the model explaining 67.3% of the variance (R^2). These findings indicate that HCPs perceive usability and utility as well as justified subscription fees of the app as factors that encourage them to adopt the said apps.

For the app developers, these findings highlight the importance of user-friendly and intuitive designs, app accessibility and utility and incorporation of latest functionalities to compete in the market. Additionally, marketers can also focus on endorsements and social media marketing to enhance the effect of social influence on the behavioural intention of HCPs.

LIMITATIONS AND FUTURE RESEARCH

One of the limitations of this study is that the effect of behavioural intention on actual usage behaviour of HCPs was not studied. Additionally, this study was cross-sectional by design. The HCPs surveyed had prior experience with using telemedicine services, endorsed by the government but no or minimal experience with mHealth apps.

Future research can focus on conducting longitudinal studies in this area as well as gain access to registered HCPs of the said apps to gather responses of experienced users. Additional variables can also be introduced to enhance the total variance explained by the research model. Researchers can also take up comparative studies between two or more apps as well as nations to explore varying behaviour of adoption in the different populace.

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