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Factors Affecting the Behavior to Use Healthcare Application on Smartphones in Vietnam during and After Covid-19 Pandemic

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Abstract

This study proposes a theoretical model based on Theory of Planned Behavior (TPB) to help understand the intention as well as the behavior of the consumer which leads to the further decision of utilizing healthcare applications on smartphones in Vietnam. The testing hypothesis process was made on the basis of survey data collected from consumers who experienced smartphone healthcare applications mainly in Hanoi and Ho Chi Minh - the 2 biggest cities in Vietnam. During the study, besides five original variables from the TPB model, the research team attached two new independent variables namely Personal Innovativeness in IT and Trust, which represent the main drives leading to the upcoming trend of healthcare application usage. The result indicates that Trust, Attitude and Perceived Behavioral Control (which is formed by Attitude and Perceived Behavioral Control after measuring data validity), Subjective Norm, Personal Innovativeness in IT are the four factors that have a tremendously positive effect on both the selection and practice in smartphone healthcare applications. The research not only contributes to the literature by investigating the influence of the compatibilities on consumption intention and behavior but its findings also provide valuable insights for government and enterprises to have suitable strategies to reach more users and improve their experience.

Keywords: TPB, smartphone healthcare applications, Trust, Personal Innovativeness in IT

1. Introduction

Technology is showing a great influence in all socio-economic aspects these days. Digital transformation is rapidly becoming a trend in the 4.0 era, and the healthcare sector is no exception.

Digital transformation in disease prevention and health care, digital transformation in medical examination and treatment are 2 of the 4 main areas of Vietnam's National Health

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Digital Transformation Program implemented by the Ministry of Health. Digital healthcare is an issue of great concern as Vietnamese people are paying more attention to their health, especially when the Covid-19 pandemic makes them more aware of the importance of healthcare. In addition, the convenience of using applications on smartphones thanks to the improvement in both quantity and quality of application vendors and developers also promotes the trend of installing life-supporting applications, including health care ones.

Digital transformation in healthcare is of great importance. Though being a growing trend, the use of smartphone healthcare applications (SHAs) has not been widely spread. In addition, there are still many inadequacies in the process of using. Moreover, managing and adjusting the speed of deploying a new application or upgrading existing applications to keep up with societal requirements is a significant problem for application publishers, as well as the government and regulatory agencies. These challenges have made understanding the consumer behavior of this sort of application product is more important than ever. To overcome the aforementioned issues and promote the convenient application of technology to personal health care and health control, it is crucial to change people's awareness and make them use SHAs as a long-term habit.

In this study, we will classify and focus on 2 groups of SHAs, which are tools to support medical practice and public health through smartphones. The first group is Guide/ Control/ Support exercise applications, including those to Monitor basic health indicators (Heart rate, Blood pressure; Cholesterol; Height; Weight...); Control schedule, personal activities; Provide guided exercises or regimen regimens; and combine with other exercise equipment (treadmill; bicycle machine...). The second group is medical care applications, including Monitor advanced health indicators (Oxygen Saturation...); Healthcare and medical insurance; and Online health consultation (linking hospitals, clinics...).

Besides applying the TPB theoretical model, this research uses the new variable Trust (TR) to analyze the influence of users' trust in the application vendors on the intention and behaviors to use SHAs. Personal Innovativeness in IT (PIIT) was also added as we believe that individuals' psychological state of willingness to try out innovation and differences in the adoption of new technology are closely linked with their behavior while using mobile applications.

With the proposed model, this research proposes solutions for SHAs' providers and vendors, and state management agencies to develop policies to promote more users. Plus, the study also contributes to raising awareness of Vietnamese people to promote the decision to use SHAs thanks to this behavior's benefits and ease of use.

2. Literature review

2.1. Theory of Planned Behavior (TPB)

Theory of Planned Behavior (Ajzen, 1991) is one of the simple and competent frameworks built on the Theory of Reasoned Action (TRA). Yet, it is added "Perceived Behavioral Control" as a third component in order to examine the individual's intent to perform context-specific actions (Russo, 2015). TRA model, developed by Ajzen and Fishbein in 1975, is considered a pioneer in the field of social psychology research (Eagly & Chaiken, 1993; Olson & Zanna, 1993; Sheppard, Hartwick, & Warshaw, 1988, quoted in Mark, C. & Christopher JA, 1998, pg. 1430). The TRA model shows that behavior is determined by the intention to perform that behavior. The relationship between intention and behavior has been suggested and empirically verified in

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numerous studies in many fields (Ajzen, 1988; Ajzen & Fishbein, 1980; Canary & Seibold, 1984; Sheppard, Hartwick, & Warshaw, 1988, quoted in Ajzen, 1991, pg. 186). The two main factors influencing intention are personal attitudes toward behavior and subjective norms. In it, an individual's attitude is measured by beliefs and judgments about the results of that behavior. Ajzen (1991, pg. 188) defines a subjective norm as the perception that influencers will think that an individual should or should not perform a behavior.

According to Ajzen (1991), the birth of the TPB model comes from the limitation of behavior over which people have little control. The third factor that Ajzen thinks has an influence on human intentions is the Perceived Behavioral Control factor. Perceived Behavioral Control reflects the ease or difficulty of performing the behavior and whether the performance of the behavior is controlled or restricted.

The TPB model has been applied to study a variety of health-related behaviors, with Attitude and Perceived Behavioral Control having the strongest association with intentions and behavior (Armitage, C. J., & Conner, M., 2001). Wu, I.-L., Li, J.-Y., & Fu, C.-Y. (2011) used the theory of intended behavior to explain how healthcare professionals adopt mobile services to support their work. Intentional behavior theory was also used in research by Mangkunegara, C. N., Azzahro, F., & Handayani, P. W. (2018) to evaluate essential factors that affect user's behavioral intention in using Halodoc, a mobile health application. In addition, in studies by Downs (2005) and Hausenblas (1997), the effectiveness of the TPB model has also been reported to explain physical activity, whereas Conner (2002) and Sjoberg (2004) have reported the effectiveness of TPB to explain diet activities. Blue (2007), on the other hand, applies TPB to investigate the cognitive factors relevant to physical activity and healthy eating intentions or behaviors of the diabetic patient population.

2.2. Trend of using smartphone healthcare application

With an increasingly richer material life, more and more people are suffering from high blood pressure, hyperglycemia, obesity and other diseases caused by lifestyle habits, and the COVID-19 epidemic has certainly made this situation became worse (Freudendal-Pedersen, M.; Kesselring, S, 2021). As a result, people around the world are paying more and more attention to their health than ever before and trying to improve their 'self-care', which is defined as the ability of individuals, families and communities to promote health, prevent disease, maintain health, and cope with illness and disability with or without the support of a health worker (WHO, 2021). Besides, the fast-paced lifestyle in modern society has also made digital innovation in the Healthcare Industry inevitable because busy consumers have a high demand in using digital healthcare services. Healthcare applications integrated on smart devices, which help users monitor their personal health by recording blood pressure, heart rate, sleep time and other data, are produced and developed at a rapid pace, and then achieve massive market growth (Ates, HC; Yetisen, AK; Güder, F.; Dincer, C, 2021). The latest Gartner statistics show that the smart medical device market - healthcare technology generates $81.5 billion in 2021 and is expected to reach $93.8 billion by 2022.

While mobile healthcare applications are attractive to people worldwide, the industry is facing serious sustainability challenges. For example, research conducted by Ledger and McCaffrey (2014) indicated that the continued use of wearable medical devices decreased by 70% in six

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months after initial adoption and to 55% a year later. Research by Lee et al. (2016) obtained similar findings and found that one in three users stopped using the device within six months. Therefore, the research team believes that it is necessary to find out what factors really influence the decision and behavior of customers to use healthcare applications on smartphones, so that an assessment of consumer intent and behavior can be made to provide an overview for individuals, organizations and governments about a new dimension of users' characteristic in this potential market.

2.3. Research gap

Much prior research has been conducted to investigate the primary elements influencing the acceptability, intention, and behavior of using mobile healthcare applications. The study gap, however, is that there are few studies revealing critical characteristics that might impact the behaviors of individuals who are aware of this sort of application to utilize health care apps on mobile devices. In the research paper of Wu et al. (2011), the author solely discusses expert acceptability of usage, not general public acceptance. Mangkunegara et al. (2018) focuses on analyzing each individual's intentions when using a specific application, here Halodoc. Exercise behaviors are examined using TPB model in the study of Hausenblas (1997) and Downs (2005), however, there is no mention of platforms accessing to such workouts. The majority of prior studies focused on the factors influencing the intention to use, without analysis of user's usage behavior and generalization of the types of healthcare applications.

Learning about the subject of digital health care, it appears that there is still few research in Vietnam that delve extensively into the variables influencing the behavior of using health care apps on mobile phones. While discussing digital health challenges, the features of Vietnam's conditions have not been adequately explored. As a result, the study team also employed two additional factors that are thought to be acceptable for Vietnamese features in order to address the gap in digital health care in this country.

2.4. Selection for further development

Realizing that the original and extended model has been used in studies on factors affecting the behavior of using health care applications on smartphones, as mentioned above, giving inconsistent results. Moreover, after a thorough analysis of more than 20 previous studies, this study builds on a solid foundation and objectively selects other important factors added to the original TPB model. From there, increase the accuracy in model testing so that it can be practically applied in observing the behavior of using healthcare applications on smartphones. Specifically, the case studies with additional factors presented below are interesting results. Therefore, ideas are formed to develop new research directions.

According to Rakibul Hoque (2016), Trust plays an important and positive role in the process leading to Intention to Use. With the outstanding results of testing the statistical hypothesis in the study, Rakibul Hoque (2016) commented that Trust is also considered as a premise of the user's intention to use when using healthcare applications on smartphones.

Furthermore, a study from Weisheng Chiu (2020) found that Personal Innovation in IT can have an impact on Intention to use healthcare applications on smartphones. Because healthcare

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applications are a new sort of technology, it will be difficult to exploit its features without prior understanding.

The two studies above are demonstrations for the addition of prominent factors to the original TPB model. Since then, the combination of two new factors, corresponding to two independent variables, Personal Innovativeness in information technology (PI) and Trust (TR) was decided to add to the original TPB model for research.

3. Hypothesis development and research model

3.1. Hypothesis development

We prepared our research model of factors affecting the decision to use healthcare applications on smartphones in Vietnam (**Figure 1.**) based on the theoretical framework and summary of previous research. Beside testing three factors from the available TPB model, we add two more variables namely Trust (TR) and Personal Innovativeness in IT (PIIT) after examining Vietnam conditions.

In other words, we argue that there are six potential linkages (stated below), which need to be constructed in order to examine the impact of independent variables (Attitude, Subjective Norm, Perceived Behavioral Control, Trust, and Personal Innovativeness in IT) in the usage context of SHAs.

Perceived behavioral control (PBC)

Perceived behavioral control represents the control belief in the TPB model. The PBC framework, introduced to address the TRA model's weaknesses, is used when people are not adequately controlled by several owned resources to conduct a specific behavior (Ajzen, 1991). Azjen defines PBC as an individual's perception of the ease or the difficulty in performing a specific behavior. In other words, within the TPB model, the stronger one's perceived behavioral control is, the more likely he would conduct the behavior (Ajzen, 1991). Consequently, the behavior performance is correlated with one's confidence in their ability to conduct the behavior (Sheeran, Trafimow, & Armitage, 2003).

Based on previous empirical studies combined with expert in-depth interviews, the research team determined that belief about resource autonomy, knowledge and ability to control the use of health care applications on smartphones is an important factor affecting users' intention to use. Therefore, within this study, the hypothesis was defined as:

> *H1: Perceived behavioral control has a positive effect on the intention to use smartphone healthcare applications.*

Attitude (ATT)

Attitude towards the behavior refers to the degree to which a person has a favorable or unfavorable evaluation of planned behavior. Most definitions agree that the characteristic attribute of attitude is its evaluative (positive-negative) dimension (Ajzen, 1991). In the TPB, attitude is seen as a determinant of behavioral intention. According to it, beliefs influence attitude, which in turn shapes intention that subsequently guides or dictates behavior (Chau & Hu, 2002). Within the scope of the topic, attitude is defined as the user's emotional state to

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aspects when using health care applications on smartphones, including appearance, features, experience. This study hypothesizes:

H2: Attitude has a positive effect on the intention to use smartphone healthcare applications.

Subjective norm (SN)

One of the two initial TRA concepts is the subjective norm. It incorporates people's perception of whether the rest of others feel their actions to be essential or not. SN describes how social pressure from external parties (important to an individual) matters for individual behavior decisions (Elliott & Ainsworth, 2012). They let others' opinions influence their actions (Fishbein & Ajzen, 1975). According to TPB, if someone discovers that those who are important to him or her feel they should be behaving, they will most likely do so (Mardiyati & Rosalina, 2017). In other words, SN can be defined as pressure felt by someone and potentially determine behavior in the form of intention. Therefore, the hypothesis was constructed as:

H3: Subjective norm has a positive effect on the intention to use smartphone healthcare applications.

Personal Innovativeness in IT (PIIT)

Innovativeness is defined as a degree to which an individual relatively adopts innovation earlier than another individual as a member of the social system (Rogers & Shoemaker, 1971). After Agarwal & Prasad conducted a study to define Personal Innovativeness in the Domain of Information Technology or Personality Innovativeness of Information Technology (PIIT) in 1998, a number of studies in different fields have been explored, typically studies in mobile advertising (Boateng, Okoe, & Omane, 2016), online purchasing intent (Boyle & Ruppel, 2006; Chao, Reid, & Hung, 2016), mobile payment (Thakur & Srivastava, 2014), entrepreneur value creation (Stauffer, 2016), and healthcare field (Park & Kim, 2010).

From the study of Agarwal and Prasad (1998), a hypothesis is raised about whether PIIT really has a relationship with behavioral intentions to use a new IT. In 2005, a study conducted by Rosen hypothesized that behavioral intention had a positive effect on five different time periods. However, the results showed that time periods 2, 3, and 5 supported the hypothesis while time periods 1 and 4 were not supported. Collaborating the above arguments and evidence, our group decide to state one hypothesis to test the link between Personal Innovativeness in IT (PIIT) and intention to use smartphone healthcare applications:

H4: Personal Innovativeness in IT has a positive effect on the intention to use smartphone healthcare applications.

Trust (TR)

Studies about the relationship between trust and continuance intention are numerous. Hsu et al. (2015) suggested that trust can affect repurchase behavior and this relationship is moderated by habit. Zhou (2012) proposed that trust could both directly and indirectly affect continuance usage through resistance to change. Then, no matter whether by direct or indirect effect, it is widely accepted that trust is an antecedent of continuance intention. In the e-health environment, trust represents the attitude of users to both the smartphone healthcare application they are using and its provider. Thus, the present study illustrates the below hypothesis:

H5: Trust has a positive effect on the intention to use smartphone healthcare applications.

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Intention and behavior

Many researchers had considered the relation between intention and behavior. It is widely believed that usage intention is an intermediary factor affecting consumption behavior. In detail, one of the most striking features in "Theory of reasoned action" (TRA) - Fishbein and Icek Ajzen (1967) and "Theory of planned behavior" (TPB) – Ajzen (1985, 1991) lies on the major impact of intention to behavior. According to Ajzen, the intention is the recapitulation of all emotional factors having effects on behavior, showing a person's desire to experience as well as persistence to perform the behavior. Intention is assumed as an intermediary premise of behavior that greater intention is established, the higher possibility in performing the behavior. Thus, factors affecting consumption intention do have an impact on consumer behavior. Therefore, the last hypothesis is developed as follows:

H6: Intention has a positive effect on behavior of smartphone healthcare application usage.

3.2. Research model

Based on the theoretical framework and summary of previous literature, our research model of factors affecting the decision to use healthcare applications on smartphones in Vietnam is illustrated in **Figure 1**. Along with defined factors, there were a total of six hypotheses constructed to examine the impact of independent variables (Perceived Behavioral Control, Attitude, Subjective Norm, Personal Innovativeness in IT, Trust) to dependent variables (Intention and Behavior to use).

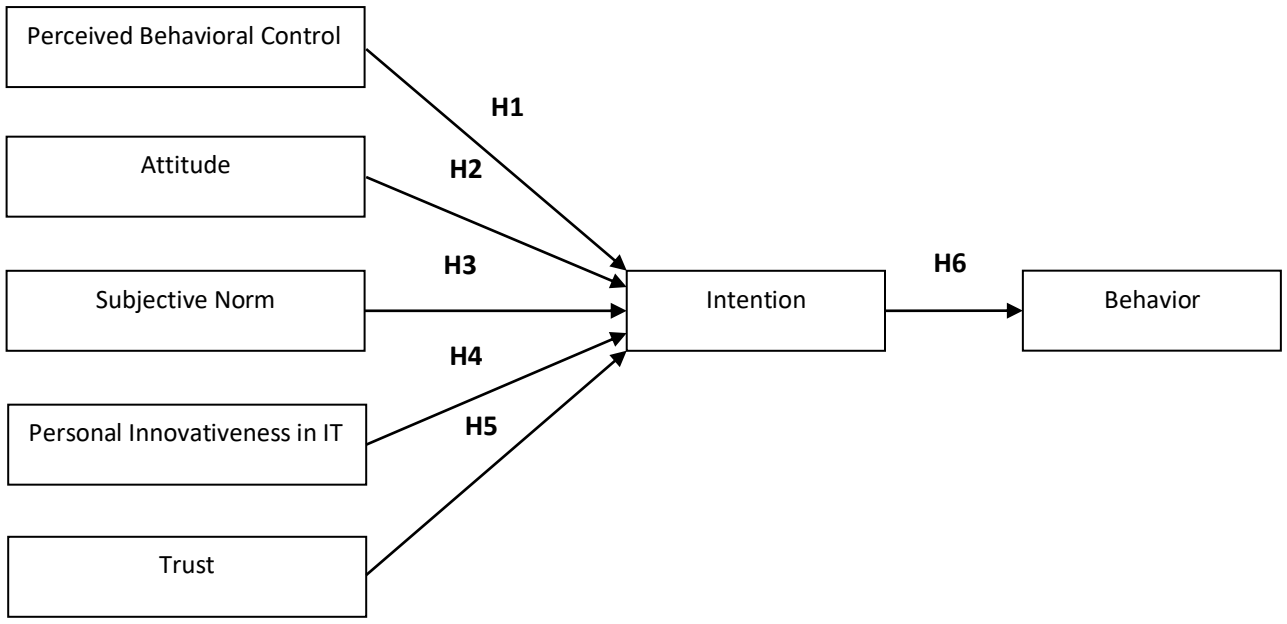

Figure 1. Model of factors affecting Vietnamese people's behaviour of using healthcare applications on smartphones

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4. Research Methodology

4.1 Instrument development

Questionnaire is utilized to collect data by measuring 7 variables that examined in this research, namely, Perceived Behavioral Control, Attitude, Subjective Norm, Personal Innovativeness in IT, Trust, Intention, and Behavior. Each variable's indicators are produced based on previous research and then translated into Vietnamese. To reflect the respondent's degree of agreement or disagreement with each statement, five-point Likert scales are used. Scales for 7 variables are presented in detail in **Appendix 2.**

4.2 Data Collection

This study's sample consisted of Vietnamese individuals who use personal healthcare applications. The data was collected online using an official online survey form called Google Forms, as well as personally from surveyees by handing them hardcopy questionnaires. Popular social networking platforms such as Facebook, Instagram, Twitter, and Linkedln were used to recruit online participants. To encourage participation, a limited number of presents were distributed. After removing duplicates and incomplete replies, there were 617 legitimate surveys left. In addition to a questionnaire, this study collects qualitative data through interviews with medical specialists. **Table 1.** highlights a part of the demographics of the interviewees and **Table 2.** depicts a portion of the interview results.

Table 1. Demography of respondents

Demographic	**Category**	**Frequency**	**%**
Group of applications used	Group 1	242	39.2
	Group 2	162	26.3
	Both	213	34.5
Gender	Male	217	35.2
	Female	400	64.8
Age	18 - 25 years	381	61.8
	26 – 30 years	101	16.4
	31 – 40 years	71	11.5
	41 – 50 years	41	6.6
	Over 50 years	23	3.7
Literacy	Below college	20	3.2
	College	26	4.2
	Under - Graduate	516	83.6
	Post - Graduate	55	8.9

(Source: Summary of research results)

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Table 2. Interview summary

Questions	Interview quotation	Classification
Q1: What factors are considered when using SHAs?	"User emotion, attitude towards the importance of healthcare and influences of family, friends"	Preliminary basis
Q2: How do experts evaluate the use of SHAs?	"SHAs help conveniently monitor personal health, as smartphones are now inseparable"	
Q3: Is it simple to choose the favorite SHA?	"It is very important to clearly classify the features of each app as there are many SHAs floating on the mobile app market currently"	
Q4: Expert opinion on user expectations about features?	"High confidentiality is essential, and so is personal innovation in IT as it facilitates user"	Additional factors

(Source: Research team)

5. Data Analysis and Research Results

5.1 Reliability Analysis

The research team used Cronbach's Alpha to evaluate the reliability for 7 potential factors, including 5 independent variables and 2 dependent variables with a total of 31 observed variables used (see **Appendix 2.**). A measure is considered satisfactory if the corrected item–total correlation value of the observable variable is greater than or equal to 0.3 (Nunnally, J., 1978). The scale for the potential factor is considered good if the Cronbach's Alpha coefficient is between 0.7 and 0.8 and preeminent if it is between 0.8 and 1 (Trong, H., & Ngoc, C. N. M., 2008). After having processed the data, the authors obtained results that met all the requirements. All values of the corrected item–total correlation exceed the required level of 0.3, and the values of all Cronbach's Alpha values are in the range 0.783 to 0.873, indicating that all 7 potential factors have a good to preeminent set of values. The analytical results of the scale reliability are shown in **Table 3**.

Table 3. Reliability analysis results

Code	Factor's name	Number of observed variables		Cronbach's Alpha	Corrected Item - Total Correlation minimum
		Before	After		
PBC	Perceived Behavioral Control	4	4	0.812	0.539
ATT	Attitude	4	4	0.841	0.659
SN	Subjective Norm	5	5	0.871	0.584
PIIT	Personal Innovativeness in IT	4	4	0.783	0.555
TR	Trust	5	5	0.865	0.657
INT	Intention	4	4	0.873	0.690
BE	Behavior	5	5	0.826	0.536

(Source: Quantitative research results)

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5.2 Validity measurement

As a next step, scale validity was examined by employing exploratory factor analysis (EFA), using the method Principal components analysis and Varimax rotation. The research team firstly tested validity for 5 factors, including Perceived Behavioral Control, Attitude, Subjective Norm, Personal Innovativeness in IT, and Trust. The KMO test = 0.94, the Bartlett's Test has the result Sig. = 0.000, which indicates both the values are in the acceptance range ($0.5 \leq KMO \leq 1$ and sig Bartlett's Test < 0.05). The analysis results showed that there are 4 factors extracted at Eigenvalue = 1.19 > 1, explaining 62.31% of the data variation of 22 observed variables participating in the first EFA test. More specifically, all observed variables of Attitude factor and Perceived Behavioral Control factor were lumped together, which means that these two potential factors will become only one major factor in the regression analysis model. The loading factors of all the observed variables put in were above 0.5, explaining that no items were rejected (Hair et al., 2014). Hence, the authors decided to combine the 2 potential factors above (Attitude and Perceived Behavioral Control), and then turned this variable combination into "Attitude and Perceived Behavioral Control" after running exploratory factor analysis.

Continuing with the second EFA test for the two remaining factors: Intention and Behavior, the results revealed that the two scales of Intention and Behavior fell into one group, therefore the team checked again the answer of Vietnamese respondents. The authors discovered that there was essentially no difference between the intention of using SHAs and the behavior of using SHAs in the field of healthcare technology. As a result, the group of authors decided to eliminate the Intention scale from the proposed research model.

Following the modifications, the final research model includes 4 independent variables and 1 dependent variable:

Independent variables: Attitude and Perceived Behavioral Control (APBC), Subjective Norm (SN), Personal Innovativeness in IT (PIIT), Trust (TR).

Dependent variables: Behavior (BE).

5.3 Hypothesis testing

Pearson's correlation analysis reveals a linear relationship between the dependent variable BE and the independent variables APBC, SN, PIIT and TR.

After conducting two exploratory factor analyses and correlation, the study team identified 5 variables that would be used to run regression models. The result of linear regression for the relationship among the independent factors and behavior of using SHAs in **Table 4.** with a 5% significance indicates the relationship of 4 independent variables (APBC) Attitude and perceived behavioral control (Sig.= 0.000), (SN) Subjective Norm (Sig.= 0.000), (PIIT) Personal Innovativeness in IT (Sig.= 0.000) and (TR) Trust (Sig.= 0.000) to dependent variable Behavior. The coefficient R^2 adjusted to 0.672 illustrates that the linear regression model was built in accordance with the data set at 67.2%. The VIF coefficient of the independent variables is less than 2, therefore no collinearity phenomenon occurs.

Table 4. Regression results

Coefficients[a]

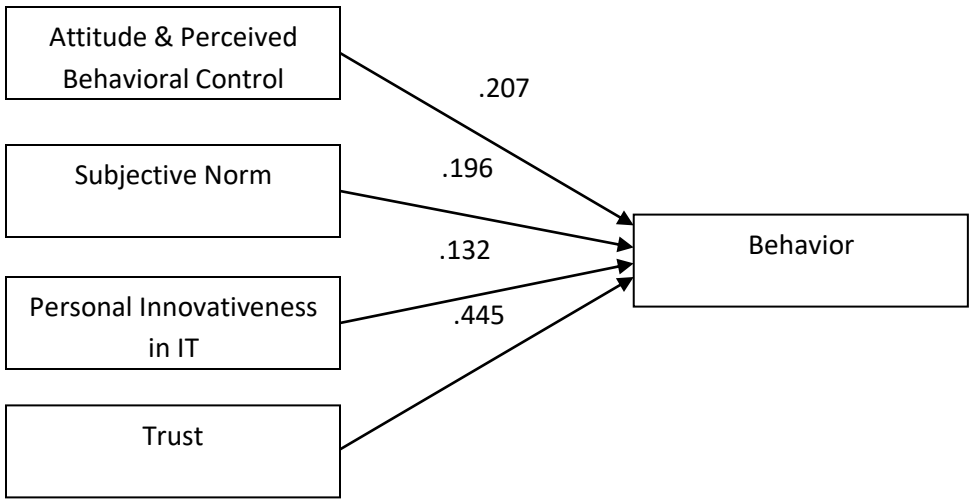
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.134	0.111		1.209	0.227		
	APBC	0.227	0.034	**0.207**	6.673	0.000	0.555	1.803
	SN	0.169	0.026	**0.196**	6.517	0.000	0.587	1.703
	PIIT	0.113	0.024	**0.132**	4.604	0.000	0.650	1.538
	TR	0.449	0.034	**0.445**	13.266	0.000	0.473	1.975
Dependent Variable: BE - Behavior								

(Source: Quantitative research results)

The study team developed one regression models to examine the influence of independent factors on dependent variables, which is as follows:

BE = 0.207 (APBC) + 0.196 (SN) + 0.132 (PIIT) + 0.445 (TR)

Figure 2. Factors affecting the decision to use health care applications in Vietnam



With the significance level of 5%, there are 4 elements that impact on the behavior of using SHAs. The four factors, in descending order of impact, are as follows:

(1) Trust (TR) with β = 0.445, (2) Attitude and perceived behavioral control (APBC) with β = 0.207, (3) Subjective Norm (SN) with β = 0.196, (4) Personal Innovativeness in IT (PIIT) with β = 0.132, in which the standardized coefficients Beta > 0 indicate that the independent factors and the dependent variable Behavior have a positive relationship. Noticeably, the factor Trust is

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assessed to have the strongest impact on the behavior using SHAs, while the weakest factor is Personal Innovativeness in IT.

5.4 The influence of factors on the behavior of using health care applications on smartphone

Attitude and Perceived Behavioral Control (APBC)

This compound factor influences the usage behavior of SHAs with Standardized Coefficients β = 0.207. This finding is consistent with the findings of Chau and Hu (2002), who investigated the factors influencing medical professionals' acceptance of telemedicine technology. This is appropriate since, in general, medical technology activities in general, and health care apps on mobile phones in particular, may not be very sophisticated, especially when considering the overall capacity of the people being surveyed having a university degree or above.

Subjective Norm (SN)

Subjective norms indicate the impact of the user's surroundings on his or her conduct. It adds to showing the applicability of the Theory of Rational Action (Ajzen, 1991). with β = 0.196 and Cronbach's Alpha = 0.871, and shares the same viewpoint as Mardiyati & Rosalina (2017) that the opinions of others around users impact them.

Personal Innovativeness in IT (PIIT)

Personal IT innovation had the least influence on the habit of using health care apps on mobile phones, with a Standardized Coefficients β = 0.132 and a Cronbach's Alpha = 0.783. This demonstrates that people in Vietnam are eager to learn about and utilize mobile health care applications. The findings are totally compatible with Weisheng Chiu's (2020) claim that this element plays an essential role in the diffusion and application of products and services, and that it favorably influences an individual's intention and behavioral attitude toward technology.

Trust (TR)

With a high level of confidence at Cronbach's Alpha = 0.865 and β = 0.412, trust has the largest positive impact, contributing to a strong positive influence on the Behavior of using healthcare application on smartphone. When researching the elements influencing the adoption of adopting electronic health care apps in developing nations, Rakibul Hoque (2016) came to the same result. This is because the likelihood that they will continue to use it is very high if the first time the user finds the information reliable.

6. Conclusions, limitations and directions for further research

6.1. Conclusions and findings

This research shows that there are 4 independent variables affecting the decision to use health care applications on smartphones in Viet Nam. They are Trust (TR), Attitude and perceived control (APBC), Subjective Norm (SN), and Personal Innovativeness in IT (PIIT), in decreasing order of influence, respectively.

New findings from this research include first of all 2 new independent variables named Trust (TR) and Personal Innovativeness in IT (PIIT). Next, this research combines 2 variables Attitude (ATT) and Perceived Behavioral Control (PBC) into a new one named Attitude and Perceived

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Behavioral Control (APBC). Meanwhile, the variable Intention (INT) is eliminated from the initial model.

Regarding the first variable combination, the observed variables at ATT and PBC are lumped together into one factor because they are highly correlated with each other. That is, they vary similarly. Meanwhile, the combination of INT and BE was due to the fact that there was no significant difference from intention to behavior to use healthcare applications on smartphones. Once intending to continue using, smartphone users will tend to display behaviors.

6.2. Limitations and future research

The empirical results reported herein should be considered in the light of some limitations.

Firstly, the scope of this study is in Hanoi and Ho Chi Minh city - 2 major cities in Vietnam. Therefore, these conclusions can be partial. These big cities are at the forefront of technology adaptation and application, not to mention that people in this area have higher living standards.

The second limitation lies in the research method, as the authors only conduct quantitative research, not qualitative research. For convincing results as well as high accuracy, it is recommended to combine 2 methods.

The third limitation of this study lies in the process of translating the original scales from English to Vietnamese. In the original scale (English version), the adjectives used have similar meanings, and when translated into Vietnamese, it is difficult to find synonyms but different in nuance, leading to misunderstandings of readers in the expressions of the scale.

Therefore, the authors propose some future research suggestions that address the limitations of this study. Due to the complexities of Vietnam's terrain, researchers of future studies need to expand the size of the survey, including different groups of individuals. Next, they need to carry out qualitative research to deliver the most comprehensive research results.

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Appendix1. General information

1. Which of the following mobile health care applications do you often experience?

□ Group 1: Guide/ Control/ Support exercise applications	1. Monitor basic health indicators (Heart rate, Blood pressure; Cholesterol; Height; Weight;...) 2. Control schedule, personal activities 3. Provide guided exercises or nutrition regimens 4. Combine with other exercise equipment (treadmill; bicycle machine;...)
□ Group 2: Medical care applications	5. Monitor advanced health indicators (Oxygen Saturation,...) 6. Healthcare and medical insurance 7. Online health consultation (linking hospitals, clinics, ...)
□ Both groups above	

2. Gender

□ Male □ Female

3. Age

□ 18 - 25 years □ 26 – 30 years □ 31 – 40 years □ 41 – 50 years □ Over 50 years

4. Literacy

□ Below college □ College □ Under – Graduate □ Post - Graduate

Appendix2. Measurement Items

Perceived Behavioral Control (PBC)

PBC1: It is mostly up to me whether or not to use SHAs.
PBC2: I had the resources, knowledge and ability to use smartphone healthcare applications.
PBC3: Using smartphone healthcare applications is entirely within my control.
PBC4: I would be able to use smartphone healthcare applications well for my job.

Attitude (ATT)

ATT1: Using smartphone healthcare applications would be a good idea.
ATT2: Using smartphone healthcare applications would be a pleasant experience.
ATT3: Using smartphone healthcare applications would be a wise idea.
ATT4: I like the idea of using smartphone healthcare applications.

Subjective Norm (SN)

SN1: People who are important to me (family, friends…) think I should use smartphone healthcare applications.
SN2: People who influence me (KOLs, celebrities, influencers…) think I should use smartphone healthcare applications.

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SN3: Medical professionals/ employees/ consultants think I should use smartphone healthcare applications.
SN4: Medical professionals/ staff/ consultants recommend that I use smartphone healthcare applications.
SN5: Medical professionals/ staff/ consultants introduce smartphone healthcare applications to me.

Personal Innovativeness in IT (PIIT)
PIIT1: I keep up with the latest technological developments in my areas of interest.
PIIT2: I like to experiment with new information technologies.
PIIT3: Among my peers, I am usually the first to try out new information technologies.
PIIT4: I am often turned to by others for advice on new technologies.

Trust (TR)
TR1: Based on my past experience with the smartphone healthcare applications vendor, I know it is honest.
TR2: Based on my past experience with the smartphone healthcare applications vendor, I know it cares about customers.
TR3: Based on my past experience with the smartphone healthcare applications vendor, I know it offers good service.
TR4: Based on my past experience with the smartphone healthcare applications vendor, I know it is reliable.
TR5: Based on my past experience with the smartphone healthcare applications vendor, I know it understands its market.

Intention (INT)
INT1: I intend to continue using smartphone healthcare applications in the future.
INT2: I plan to increase my use of smartphone healthcare applications in the future.
INT3: I plan to continue using smartphone healthcare applications frequently.
INT4: I intend to use smartphone healthcare applications at every opportunity in the future.

Behavior (BE)
BE1: I will tell others about the benefits of this healthcare application due to the large amount of information I received during the use process.
BE2: I have positive comments regarding valuable information provided by smartphone healthcare applications.
BE3: I will introduce smartphone healthcare applications I use to my friends and relatives.
BE4: I will recommend others to use smartphone healthcare applications due to the persuasive information I received during the use process.
BE5: My family and I usually use smartphone healthcare applications.