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Extending the Theory of Planned Behavior to Predict the Intention of Telecardiology Adoption in Malaysia

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ABSTRACT

Telecardiology had emerged as a promising tool in cardiology to improve the overall services and prevent loss due to cardiovascular diseases. User acceptance is an important determinant for ensuring successful telecardiology implementation. Acceptance of telemedicine is usually indicated by the rate of diffusion throughout the healthcare system as well as the behavioural intention to use among the targeted population. This study examined factors influencing users' intention for telecardiology usage. An extended Theory of Planned Behaviour model was utilised to assess the manner in which an individual's personality traits and beliefs regarding telecardiology influenced their usage intention. This cross-sectional study involved a convenience sample of 423 healthcare receivers and providers of selected hospitals and a cardiac surgery centre in Malaysia. A questionnaire consisting of 46 items was used in data collection. The questionnaire was adapted and developed based on Theory of Planned Behaviour, Technology Acceptance Model and Technology Readiness Index. Structural equation modelling was performed for data analysis. The results underlined attitude, perceived behavioural control and subjective norm as significant determinants of intention. Meanwhile, perceived usefulness and perceived ease of use were the antecedents for the attitude towards telecardiology use. On the other hand, optimism is the only attribute that significantly influenced both perceived usefulness and perceived ease of use towards telecardiology use. The knowledge obtained from this study will allow policymakers and implementers to develop feasible strategies and effective interventions promoting telecardiology usage in Malaysia, combating against its underutilisation that typically leads to loss of time, money and effort.

Keywords: *Telecardiology, telemedicine, technology acceptance, theory of planned behaviour, technology acceptance model.*

INTRODUCTION

Cardiovascular disease (CVD) is ranked as the top cause of mortality in Malaysia by contributing a total of 29,363 or 23.10% of deaths in front of other conditions, such as stroke, influenza, and lung disease. The previous Health Minister Datuk Seri Dr. S. Subramanian has indicated that there are currently 300 cardiologists in the country, with merely 38 of them working in government hospitals. The remaining majority serves in the Ministry of Defence, universities, and private hospitals (Bernama, 2017). A recent study indicated that such a low number of cardiologists may lead to a higher mortality rate and increased rates of major complications for patients diagnosed with congenital heart disease (Diller et al., 2021). Moreover, the cardiologists and cardiac service centre locations are distributed unevenly across different regions in Malaysia, causing those populating in rural areas to face greater challenges in obtaining cardiac services (Wan Ahmad, 2017). Therefore, regions that lack cardiologists and cardiac centres may need to develop new approaches to fulfil their unmet needs for cardiac service and care of CVD patients.

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The importance and value of technology in healthcare service delivery is well-acknowledged by the policy makers. Thus, telemedicine has been adopted in many developed and developing countries alongside the rapid growth of health informatics. It plays an important role in facilitating communication between professionals and in improving the body of knowledge in health science education (Jumreornvong, Yang, Race & Appel, 2020). As technological development in the healthcare industry occurs rapidly, a continuous educational programme for health sciences is required to bridge the teaching and training of medical students and the public alike. Telecardiology is a type of service that falls under the umbrella of telemedicine and is incorporated as a promising tool in cardiology to improve the overall clinical services, prevent loss due to CVD and significantly promote the quality of life among the patients (Mohammadzadeh et al., 2021). The delivery of cardiovascular services is undertaken using information and communication technology (ICT) from a distance. Besides, electrocardiography (ECG) signal and echocardiography images are commonly applied in telecardiology over different modes of telecommunication and delivered from home or clinics to cardiology specialty centres (Yew et al., 2014). Telecardiology offers a variety of cardiovascular services, for instance serving as general information or database system, monitoring and recording patients' cardiac measurements and transmission of electrocardiogram during transportation of patients by using information and communication technology (ICT) from a distance. According to literature, the adoption of telecardiology may potentially reduce the number of unnecessary hospital referrals and admissions, missed diagnoses, and door-to-balloon time (Molinari et al., 2018), as well as improving the access to cardiac services, particularly in rural areas (Khader et al., 2014). The Malaysia Ministry of Health had re-introduced a new telecardiology system in early 2010 after the first telemedicine project was abandoned in 1997 due to implementation and adoption challenges (Yew et al., 2014). Nevertheless, the lack of official reports is apparent regarding the feasibility of the current project and telecardiology acceptance in Malaysia's post-project implementation.

Although some previous studies reported the user's factors that contributed to the success of telemedicine acceptance in Malaysia (Zailani, Gilani, Nikbin, & Iranmanesh, 2014), but there is a lack of empirical study which specifically emphasise on the factors contributed to acceptance of telecardiology. Users' acceptance and their attitudes are the important determinants to promote the embracement of telemedicine (Broens et al., 2007). User acceptance is one of the most significant determinants in technology adoption (Davis, 1989). The reluctance displayed by users in accepting technology will lead to the phenomenon of ICT underutilisation across the health sector. Failure to integrate telemedicine into the health and business landscapes has also resulted in many abandoned systems after their adoption (Yellowlees, 1997) which can result in substantial losses in time, money and effort. Thus, the implementers should initiate necessary steps to modify user's attitudes upon the establishment of their current knowledge and stance. The purpose of this study is to explore the readiness and acceptance of telecardiology among the public population and healthcare practitioners in Malaysia. This will assist in enhancing the capacity for resources utilisation in the near future and predict any issues during the implementation phase, as well as their rectification by using the recommended criteria identified in this study.

HYPOTHESIS DEVELOPMENT

This study evaluated the telecardiology among healthcare providers and receivers through a model which integrates Technology Readiness Index (TRI), Technology Acceptance Model (TAM) and Theory of Planned Behaviour (TPB). TPB generally reports on the behavioral factors that influence the intention to embrace health-related behavior. Some studies have indicated TAM and TRI to be complementary to the TPB model as they are capable of evaluating beliefs about technology in view of telecardiology adoption. For instance, Chau and Hu (2002) had developed an integrated model of TAM and TPB to elucidate physicians' decisions in using telemedicine. Further, Ullah (2020) had combined TPB, TAM and TRI as an integrated model to study technology adoption in the service and manufacturing industry. Yet, application of the similar integrated model in studying telemedicine adoption is still rare. Thus, current research aims to address the knowledge gaps by investigating the predictive factors of the intention to adopt telecardiology through the extended TPB model.

a. Technology Readiness Index

Parasuraman (2000) has proposed the TRI model to measure the readiness of an individual to apply technology via the combination of personal positive and negative beliefs towards the technology. The model has been widely used in different contexts to study technology adoption behaviour, particularly in the domain of e-services (Parasuraman & Colby, 2015). Past studies have conclusively identified various antecedents that can affect the acceptance of technology, but there are a limited number of studies that report on the effects of personal traits in technology acceptance. Although these personal traits typically do not directly impact technology acceptance, they often display a significant indirect relationship with users' perceptions. Therefore, they may potentially and eventually contribute to technology acceptance or usage intentions and behaviours (Koivisto et al., 2016).

TRI, in particular, categorises the readiness-for-use constructs into the drivers and facilitators of technology adoption, underlining the four dimensions of optimism, innovativeness, discomfort, and insecurity. Optimism is one of the drivers that leads to the adoption of new technology, illustrating one's positive belief for technology in enhancing the control, flexibility, and efficiency in their lives. Meanwhile, innovativeness refers to one's motivation to experiment with new technology and champion technology adoption, whereas discomfort and insecurity are two dimensions that address factors inhibiting technology readiness. Discomfort can be defined as the perception of lack of control over the technology and the feeling of being oppressed by it, while the insecurity dimension reflects one's distrust of technology and scepticism of its ability to function properly (Parasuraman and Colby, 2015). Prior studies have integrated TRI with other technology adoption models to explain the roles played by personality traits towards technology acceptance, such as TAM, Unified Theory of Acceptance, Use of Technology (UTAUT), and the Expectation-Confirmation Model (Harst, Lantzsch & Scheibe, 2019).

For example, Lin and his colleagues (2007) have successfully integrated the TRI into TAM which is then known as the Technology Readiness and Acceptance Model (TRAM). The model was utilised to examine the effects of technology readiness constructs on perceived usefulness and perceived ease of use in the adoption of the e-service system. The results have suggested that technology readiness is significantly associated with perceived usefulness and behavioural intention. Their subsequent work also further confirms the mediating effect of perceived usefulness on the relationship between technology readiness and continuance

intention for mobile services (Chen, Liu & Lin, 2013). Rather than examining the aggregated effects of technology readiness, the individual effects of every TRI construct on perceived usefulness and perceived ease of use have proposed that the dimensions of optimism and innovativeness resulted in positive effects on the two variables. In contrast, discomfort and insecurity influence the TAM constructs negatively (Blut & Wang, 2020). Besides, a particular research (Lin & Chang, 2011) has indicated that technology readiness enhances the variables of perceived usefulness and perceived ease of use among customers in self-service technologies. TRI integration into TAM is linked with promoting the explanatory power of perceived usefulness, perceived ease of use and intention of technology adoption (Koivisto et al., 2016). Based on the literature, hypotheses for this work were formulated to examine the relationship between technology readiness constructs with perceived usefulness, perceived ease of use, and usage intention, respectively.

H_1: Optimism has a significant effect on the perceived usefulness of telecardiology.
H_2: Optimism has a significant effect on the perceived ease of use of telecardiology.
H_3: Innovativeness has a significant effect on the perceived usefulness of telecardiology.
H_4: Innovativeness has a significant effect on the perceived ease of use of telecardiology.
H_5: Discomfort has a significant effect on the perceived usefulness of telecardiology.
H_6: Discomfort has a significant effect on the perceived ease of use of telecardiology.
H_7: Insecurity has a significant effect on the perceived usefulness of telecardiology.
H_8: Insecurity has a significant effect on the perceived ease of use of telecardiology.

b. Technology Acceptance Model

The Technology Acceptance Model (TAM) was developed by Davis (1989) to explain computer usage behavior and the general determinants of computer acceptance. Due to the increasing number of studies that test TAM in the scope of healthcare technology acceptance, the model is subsequently portrayed as a suitable theory in explaining users' behaviour in accepting healthcare innovation (Holden & Karsh, 2010).

The TAM models the relationships between users' beliefs about technology use, attitudes toward using technology and intentions to use technology accordingly. It has underlined two beliefs regarding technology use, which are perceived usefulness and perceived ease of use. Davis (1989) defined perceived usefulness as the extent to which a person believes that using technology would enhance their performance and productivity. Meanwhile, perceived ease of use refers to the degree to which a user perceives that using technology will be unburdened by any physical and mental effort. Perceived ease of use significantly influences the user's perceived usefulness, whereas both determinants contribute to users' attitudes towards technology (Davis, 1989). A favourable attitude towards technology usage will most likely result in a positive intention for technology adoption.

In many circumstances, behavioural intention is the only measured outcome as intention is the most contiguous antecedent to technology acceptance, and sometimes the actual use of technology is difficult to be measured (Chau & Hu, 2002). Regardless, the theory indicates attitude as a subjective evaluation of the behaviour, in which users with a more positive attitude are more likely to develop the intention for a behaviour (Ajzen, 1991). Based on the review made by Holden and Karsh (2010) on TAM and other models application in the healthcare industry, the findings have strongly suggested the significant influence of attitude on the intention to use. Kamal, Shafiq and Kakria (2019) have also provided empirical

evidence which indicated that one's intention of telemedicine services can be predicted using perceived usefulness and perceived ease of use.

H_9: Perceived ease of use has a significant effect on the perceived usefulness of telecardiology.
H_{10}: Perceived ease of use has a significant effect on the attitude of telecardiology use.
H_{11}: Perceived usefulness has a significant effect on the attitude of telecardiology use.
H_{12}: Perceived usefulness has a significant effect on the intention of telecardiology use.
H_{13}: Perceived ease of use has a significant effect on the intention of telecardiology use.
H_{14}: Attitude has a significant effect on the intention of telecardiology use.

c. Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is a social psychological model that has been successfully applied to predict a wide range of health-related behaviours and intentions (Ajzen, 1991). Based on the theory, an individual's behaviour can be predicted by the behavioural intention, in which intention refers to the indicator of the extent to which people are willing to try and the amount of effort they are willing to invest to perform an action. It postulates that there are three determinants contributing to the formation of intention, namely attitude towards the behaviour, subjective norm, and perceived behavioural control.

Attitude is the degree to which an individual has a favourable or unfavourable evaluation of the behaviour, while subjective norm refers to the beliefs for certain people that are important for an individual to approve or disapprove of the behaviour. Lastly, perceived behavioural control is defined as an individual's perception of the ability to perform the behaviour. Past studies have investigated the factors that determine people's intention in telehealth system adoption, which showed that all three determinants exerted significant positive effects on behavioural intention (Chang et al., 2015). Furthermore, perceived behavioural control is identified as a significant construct in TPB, which reflects one's belief regarding the degree of ease or difficulty in performing the behaviour; it is assumed to be related to external and internal factors accordingly. Based on limited literature, subjective norm is proposed to influence perceived behavioural control significantly (Dinc & Budic, 2016). In other words, social pressure can pose a significant effect on an individual's belief about their abilities to perform a behaviour. Current study hypothesised that the intention of telecardiology usage is determined by their attitude, subjective norm as well as perceived behavioural control.

H_{15}: Subjective norm has a significant positive effect on the intention of telecardiology use.
H_{16}: Perceived behavioural control has a significant positive effect on the intention of telecardiology use.
H_{17}: Subjective norm has a significant positive effect on the perceived behavioural control in adoption of telecardiology.

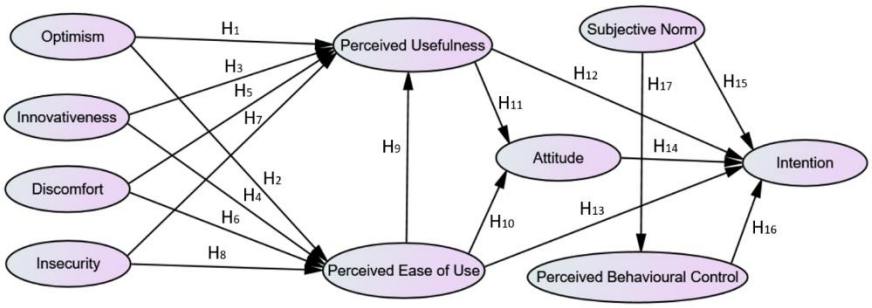

Figure 11: Proposed research model for telecardiology adoption in Malaysia

METHODOLOGY

In understanding the perspectives of healthcare providers and receivers towards the use of telecardiology, the data was collected using the survey method. A cross-sectional study design was employed to examine the determinants that influenced the Malaysian population intention towards telecardiology application. Such design was advantageous as it allowed data collection to be undertaken within a shorter time frame and was appropriate to examine the current attitudes, beliefs, opinions, or practices. It could also be applied in state-wide or national studies for the purpose of gaining a deeper understanding regarding the issue across a larger geographical area (Wang & Cheng, 2020).

a. Ethical Statement

This study is registered under National Medical Research Register (NMRR) as required by the National Institute of Health (NIH) guideline on the conduct of research. The approval (reference number: NMRR-16-1857-32503) to conduct a study focused on the acceptance of telecardiology was granted by the NIH, Ministry of Health (MOH), Malaysia. The data were collected from four public hospitals with heart surgery centres and the National Heart Institute in Malaysia. In obtaining the consent, information regarding the purpose of the study and the desired population was explained carefully to the managerial personnel and the clinical research centres. The ethical approvals were obtained from the directors of the hospitals and clinical research centre before the distribution of the questionnaire was initiated. All relevant ethical safeguards inclusive of ethical consideration and subject protection were appropriately achieved. Prior to their participation, the participants were briefed regarding the purpose of the research and their rights of participation, while also informed about the anonymity of their involvement consent and responses.

b. Research Instrument

Data for this study were collected using a survey, which consisted of a carefully designed questionnaire adopted to assess the healthcare providers' and receivers' intention in telecardiology adoption and the antecedents that contributed to such intention. The questionnaire consisted of four parts: the first part assessed the personality traits that could influence telecardiology acceptance, in which the items were adapted from TRI (Parasuraman, 2000). The second part of the questionnaire was adapted from the TAM (Davis, 1989) and aimed to examine the respondents' beliefs on telecardiology application. Then, the third part consisted of items adapted from the TPB (Ajzen, 1991) that studied the constructs of intention, attitude, subjective norm, and behavioural control. The items in the questionnaire were reviewed and validated by an experienced educational psychologist. The

last part of this questionnaire covered the demographic profile of respondents. The questionnaire used in this study was trilingual; the items were also translated into Mandarin and Bahasa Malaysia as Malaysia is a multi-racial and multi-lingual country.

Prior to the formal distribution of the questionnaire, the items of different constructs were tested to ensure that they were clearly described and could be easily understood by the respondents. Exploratory factor analysis (EFA) and reliability test were subsequently conducted to remove any items having low reliability and non-validity (Yeo, Al-Ashwal, Handayani & Lee, 2019). A Cronbach's alpha score above .75 generally represents a scale of high reliability, while a score of .5 to .75 is considered to be of a moderately reliable scale (Hinton, McMurray & Brownlow, 2014). The internal consistency reliability based on Cronbach's alpha for all constructs in the questionnaire ranged from .644 to .979 and was considered as acceptable to good.

c. Participants

The sample population were recruited through convenience sampling method which consisted of potential users of telecardiology made up of healthcare providers and receivers. The healthcare receivers consisted of the public population and CVD patients who used the technology in their daily lives, whereas the healthcare providers who responded were the cardiologists, general physicians, nurses and support staff in the selected participating locations. The process of sample selection was illustrated in figure 2. Respondents were given options to respond to a paper-based or web-based survey. The data collected from the survey were carefully handled and kept in a secured database which ensures anonymity and confidentiality of the participants.

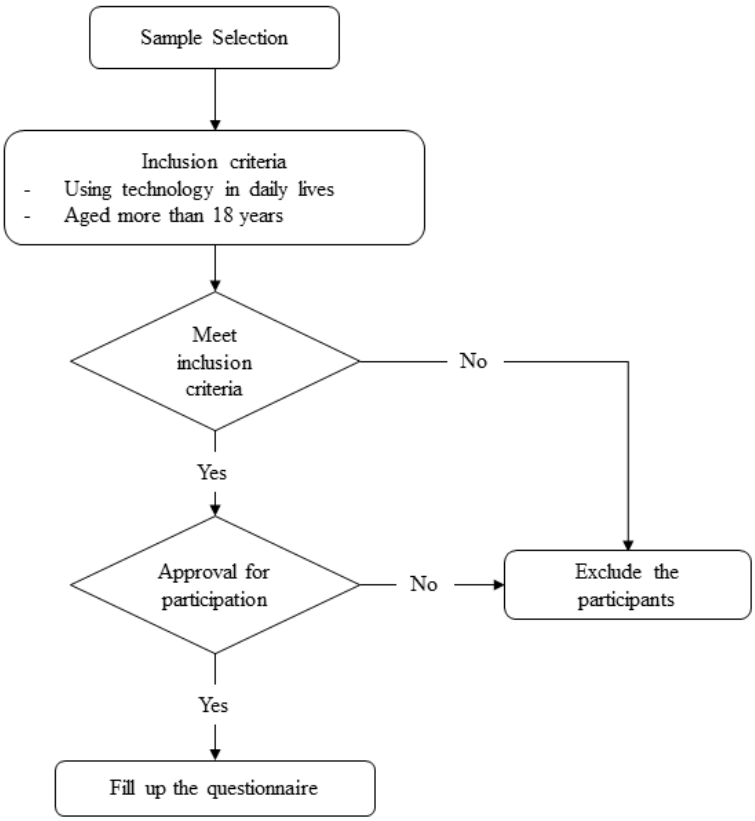

Figure 2: Study flow diagram of participant recruitment procedure

d. Statistical Analysis

The data collected were analysed using the IBM SPSS Statistics and AMOS software, in which the data preparation and preliminary analysis phase were completed by using SPSS. Meanwhile, AMOS was used for a two-step approach for Structural Equation Modelling (SEM), whereby SEM was employed as the analysis method due to multiple reasons. SEM utilisation was justified by: (a) its ability to examine a series of dependent relationships simultaneously, especially the direct and indirect effects among the constructs; (b) its analysis regarding the relationships between the latent and observed variables; (c) its demonstration of random errors in observed variables; and (d) its examination of latent variables using multiple indicators and testing hypotheses at the construct level (Hoyle 2012). During the first step of SEM, a Confirmatory Factor Analysis (CFA) was conducted to develop a measurement model, which provided information regarding the extent to which the measured variables were representative of a smaller number of the constructs (Hair et al., 2010). In the second step of SEM, the proposed structural model was tested to specify the relationships between the exogenous and endogenous latent variables.

RESULTS

A total of 850 questionnaires were distributed, and 423 valid questionnaires were returned, yielding a response rate of 49.8%. Most of the respondents were female (60.76%), whereas the remaining 166 respondents were male (39.24%). More than 70% (N = 308, N = 336) of the participants were less than 35 years old and had graduated from colleges or universities.

Table 1: Demographics profile of the respondents

Variable	Frequency (N)	Percentage (%)
Gender		
Male	166	39.24
Female	257	60.76
Age		
< 18	84	19.86
18 – 25	86	20.33
26 – 35	138	32.62
36 – 45	62	14.66
46 – 55	26	6.15
>55	27	6.38
Education		
Primary school	8	1.89
Secondary school	79	18.68
College / University	336	79.43
Monthly Income (RM)		
< 2000	133	31.44
2001 – 4000	148	34.99
4001 – 6000	88	20.80
6001 – 8000	32	7.57
>8000	22	5.20
Category		
Healthcare receiver	267	63.12
Healthcare provider	156	36.88

Confirmatory Factor Analysis

CFA is a comprehensive method of ensuring the measurement model validity, whereby its methods assess the unidimensionality, validity, and reliability of the latent constructs. Each of the items is allowed to load solely on the main factor of interest, and not on any other factors. Items that do not fit the measurement model due to low factor loading should be removed from the model (Awang, 2015).

Unidimensionality measures mean that a set of measured variables (indicators) can be explained by only one underlying construct (Hair et al., 2010). It is achieved when all measuring items have acceptable factor loadings for the respective latent construct (Awang, 2015). Tabachnick and Fidell (2007) suggested that the loadings above 0.71 to be excellent, 0.63 is very good, 0.55 is good, while 0.45 indicates fair and 0.32 are poor. In this study, all indicators were significantly loaded onto their respective factors, with loadings that ranged between good to excellent and from .520 to .928. Six items yielding loadings below 0.50 were removed.

Validity refers to the ability of the instrument to measure what it is supposed to measure for a latent construct. Construct validity is achieved when the fitness indexes for the measurement model meets the recommended requirement. The fitness indexes indicate how fit the items are in measuring their respective latent construct (Awang, 2015). Based on the result, six items displaying poor loading (below 0.50) were removed to improve the fitness indexes, namely RMSEA, CFI, GFI, IFI, TLI, and Chi-square/df. The fitness indexes for this study are achieved accordingly, with the results displayed in Table 2.

Table 2: Fit indexes for CFA

	Recommended Level of Fit	**Proposed Model**
Absolute fit indices		
Chi-Square	P-value > 0.05, Not applicable for large sample size	Chi-square = 1206.776 df = 693 p = .000
RMSEA	RMSEA < 0.08	.042
GFI	GFI >= .90 shows good fit GFI > .80 shows reasonable fit	.877
Incremental fit indices		
CFI	CFI >.90 shows good fit	.956
TLI	TLI > .90 shows good fit	.951
Parsimonious fit		
Chi-square/df	Chi-Square/df < 3.0 shows good fit	1.741

RMSEA: root mean square error of approximation; GFI: Goodness of fit index; CFI: Comparative fit index; NFI: Normed fit index; TLI: Tucker-Lewis index

Convergent Validity is the extent to which the indicators of a specific construct converge or share a high proportion of variance in common (Hair et al., 2010). To exhibit a satisfactory convergent validity, each construct should have an Average Variance Extracted (AVE) value greater than or equal to 0.5. Reliability is also an indicator of convergent validity that is evaluated using the composite reliability (CR) value. Scores of 0.7 or higher are suggestive of good reliability, while the reliability valued between 0.6 and 0.7 is acceptable (Hair et al., 2010). All items in this study were found to be statistically significant and the values of AVE were higher than 0.5, except for the constructs of innovativeness, discomfort, and insecurity. However, Fornell and Larcker (1981) indicated that the construct's convergent

validity is adequate if the AVE is less than 0.5, while the CR is above 0.6. Therefore, the latent constructs were all retained.

Discriminant validity is the extent to which a construct is truly distinct from the other constructs. CFA assesses discriminant validity by comparing the square root of AVE with the inter-construct correlations (Hair et al., 2010). CFA assesses discriminant validity by comparing the square root of AVE with the inter-construct correlations. From the discriminant validity index table, all the square roots of AVE of the construct are greater than the values of inter-construct correlations which reflected satisfactory discriminant validity, with the exceptions for subjective norm and optimism. Since the model shows adequate fitness, the researcher decided to retain both constructs where the differences for the square root of AVE and inter-construct correlation are considered very small.

Table 3: Reliability, convergent and discriminant validity

	CR	AVE	SN	OPT	INN	DIS	INS	PU	PEOU	ATT	INT	PBC
SN	0.829	0.708	**0.842**									
OPT	0.843	0.519	0.268	**0.720**								
INN	0.816	0.472	0.193	0.614	**0.687**							
DIS	0.655	0.389	0.009	-0.042	0.123	**0.624**						
INS	0.779	0.475	0.178	0.575	0.269	0.108	**0.689**					
PU	0.942	0.763	0.382	0.728	0.460	-0.018	0.602	**0.873**				
PEOU	0.880	0.647	0.443	0.479	0.468	0.101	0.244	0.577	**0.804**			
ATT	0.960	0.827	0.600	0.279	0.239	-0.129	0.122	0.395	0.369	**0.909**		
INT	0.930	0.817	0.808	0.337	0.215	-0.089	0.259	0.437	0.458	0.613	**0.904**	
PBC	0.871	0.694	0.910	0.325	0.232	-0.028	0.236	0.431	0.471	0.639	0.828	**0.833**

The diagonal values are the square roots of AVE and the rest were the inter-construct correlations. CR: Composite reliability, AVE: Average variance extracted, SN: Subjective norm, OPT: Optimism, INN: Innovativeness, DIS: Discomfort, INS: Insecurity, PU: Perceived usefulness, PEOU: Perceived ease of use, ATT: Attitude, INT: Intention, PBC: Perceived behavioural control.

Structural Model Equation

This study examined the direct and indirect relationships among the constructs of the proposed model and tested the fitness between the proposed model and the obtained data. The data was further investigated by employing the SEM. The inter-relationships among the constructs are modelled and the estimated results are reported in Figure 3.

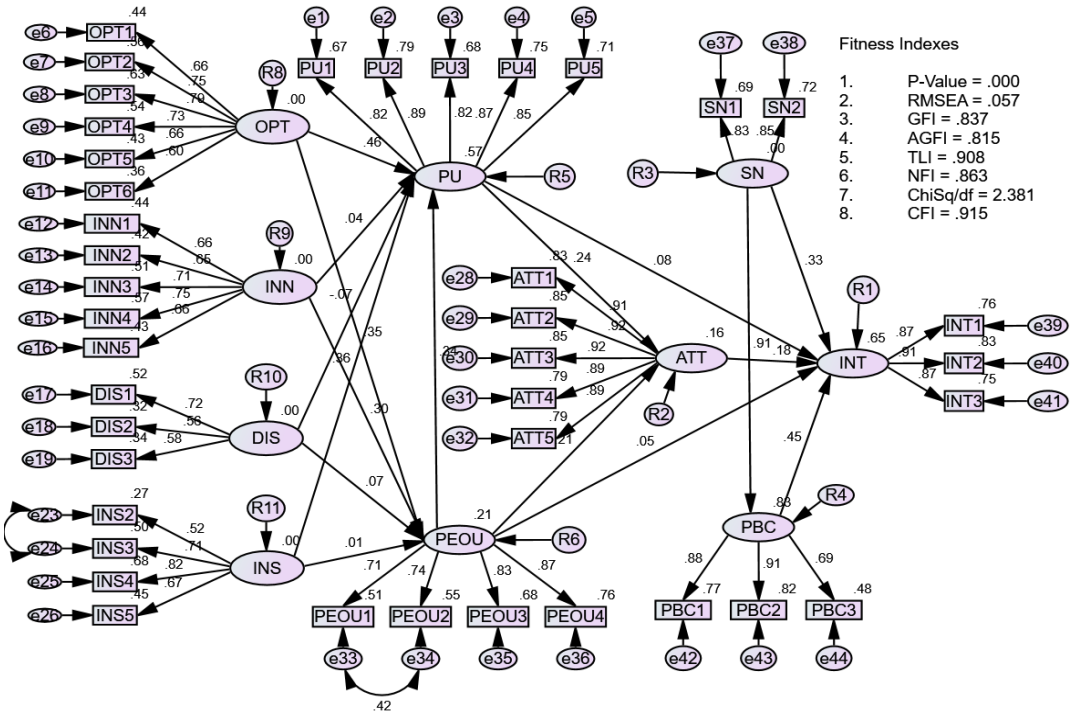

Figure 3: The structural model for telecardiology readiness and acceptance in Malaysia

The structural model indicated a good and acceptable fit based on the results (RMSEA = .058 < 0.08; GFI = .841 > .80; TLI = .909 >.90; CFI = .916 > .90, Chi-square/df = 2.438 < 3). The value of R^2 for the model obtained was 0.65, indicative of its ability to explain 65% of the total variance in the intention of telecardiology usage by including certain exogenous constructs, namely attitude, subjective norm, and perceived behavioural control in the model.

Table 4: Path coefficients for direct effect

Hypothesis		Estimate	S.E.	C.R.	P	Standardized Regression Weight	Support
H_1	OPT → PU	.537	.066	8.176	***	.455	Yes
H_2	OPT → PEOU	.451	.073	6.138	***	.352	Yes
H_3	INN → PU	.038	.044	.848	.396	.037	No
H_4	INN → PEOU	.324	.062	5.244	***	.294	Yes
H_5	DIS → PU	-.052	.040	-1.305	.192	-.059	No
H_6	DIS → PEOU	.059	.056	1.058	.290	.062	No
H_7	INS → PU	.317	.042	7.606	***	.358	Yes
H_8	INS → PEOU	.022	.051	.424	.672	.032	No
H_9	PEOU → PU	.313	.045	6.900	***	.340	Yes
H_{10}	PEOU → ATT	.236	.063	3.732	***	.224	Yes
H_{11}	PU → ATT	.268	.067	4.017	***	.234	Yes
H_{12}	PU → INT	.095	.050	1.906	.057	.083	No
H_{13}	PEOU → INT	.049	.048	1.021	.307	.046	No
H_{14}	ATT → INT	.177	.039	4.574	***	.176	Yes
H_{15}	SN → INT	.332	.143	2.327	*	.330	Yes
H_{16}	PBC → INT	.524	.163	3.208	**	.453	Yes
H_{17}	SN → PBC	.792	.057	13.951	***	.911	Yes

S.E.: Standard error, C.R.: Critical Ratio, OPT: Optimism, INN: Innovativeness, DIS: Discomfort, INS: Insecurity, PU: Perceived usefulness, PEOU: Perceived ease of use, ATT: Attitude, INT: Intention, SN: Subjective norm, PBC: Perceived behavioural control.
*p<0.05, **P<0.01, *** p < .001

The SEM results revealed that three variables (attitude, subjective norm and perceived behavioural control) posed a significant effect on the respondents' intention. The results indicated that optimism (β=.455; β=.352, p<.001) displayed a positive effect on both technology beliefs of perceived usefulness and perceived ease of use. Innovativeness (β=.294, p<.001) were found to influence perceived ease of use significantly whereas insecurity (β=.358, p<.001) influenced perceived usefulness significantly only.

As expected, perceived ease of use (β=.340, p<.001) had significant effect on perceived usefulness. Both perceived ease of use (β=.224, p<.001) and perceived usefulness (β=.234, p<.001) were significant determinants of attitude. Intention was found to be significantly determined by attitude (β=.177, p<.001), subjective norm (β=.332, p<.05) and perceived behavioural control (β=.524, p<.001), which were collectively accounted for 65% of the variance in telecardiology use intention. Moreover, the results also supported that subjective norm (β=.911, p<.001) having a significant effect on subjective norm.

DISCUSSION

This study aimed to assess the factors that influence healthcare receivers' and providers' intention in telecardiology adoption and determine the underlying causal relationships among the factors using the proposed model. The results indicated that attitude towards telecardiology use, subjective norm and perceived behavioural control significantly influence the respondents' intention towards the adoption of telecardiology which are consistent with prior research (Hsieh, 2015; Ramírez-Rivas, Alfaro-Pérez, Ramírez-Correa, & Mariano-Melo, 2020). Individuals with favourable attitudes towards telecardiology are more likely to develop the intention to use the innovation, thus leading to the actual user behaviour. The results suggested that the respondents valued the perceptions of the people deemed as important to them in adopting healthcare innovations.

Perceived behavioural control is underlined as the most influential predictor of telecardiology use intention in this model, which is consistent with the findings from previous studies (Hsieh, 2015). The respondents emphasised the capabilities, such as the financial power and knowledge needed to own or operate the technology. In the context of healthcare, self-efficacy is the judgement of the people regarding their capabilities for utilising telecardiology, whereas the facilitating conditions refer to the resources available to access and operate telecardiology. Thus, it is important for the implementers to concentrate on providing adequate training and campaigns to expose and educate the potential users about the benefits of telecardiology adoption to promote their acceptance and utilisation of telecardiology in the near future. Kim, Eys and Robertson-Wilson (2021) had investigated the role of social norms as the psychosocial factor that influences health behaviours through improving the self-efficacy of an individual. In this study, the results suggested that subjective norm affects the perceived behavioural control towards telecardiology use. In other words, the perceptions of the potential user's peers, co-workers and superiors could significantly affect the users' belief regarding their own capabilities to utilise telecardiology.

Perceived usefulness and perceived ease of use were the significant predictors of the respondents' attitude towards telecardiology use. The users are more likely to develop favourable attitudes towards a technology if they perceive the technology to be beneficial and easy to use. Similar results were also observed in a study which assessed the acceptance of telemedicine in rural population (Holtz et al., 2022). Holtz et al. (2022) reported that the TAM factors successfully explained 91% of the variability in the attitude towards

telemedicine. Additionally, the results showed that perceived ease of use significantly influenced perceived usefulness. This finding aligned with a prior study that indicated that the users perceive the technology is more useful when it is easier to use (Deng, Zhang, & Zhang, 2012). Gefen and Straub highlighted that perceived ease of use captures the intrinsic motivation of using a technology, such as ease of use, ease of learning, flexibility, clarity of the interface and the experiences during the process of using the technology (Gefen & Straub, 2000). This implies perceived ease of use does not contribute directly to the adoption of technology. Instead, it affects technology adoption when the intrinsic characteristics of technology add to the values of the extrinsic aspects of technology which can be examined through perceived usefulness.

As mentioned before, much research had investigated the determinants of technology use based on TAM and TPB. However, the personality traits were usually ignored and not integrated into the model of technology acceptance research. Personality traits are the antecedents of the perceived usefulness and perceived ease of use (Lin & Chang, 2011; Walczuch, Lemmink, & Streukens, 2007). The results of this study indicated that optimism significantly influenced both determinants, which suggested that an optimist seems to confront telecardiology more openly and perceive the technology as more useful and easier to be used, as they focus less on the potential negative outcomes. Consistent with a prior study, innovativeness is a significant predictor of perceived ease of use but not perceived usefulness (Koivisto et al., 2016). The individuals with high innovativeness are often those early adopters, and they have less complex belief sets about new technology (Karahanna, Straub, & Chervany, 1999). Thus, they perceived the technology is easier to be used. Surprisingly, discomfort was found to have positive effect on perceived usefulness. The users with high level of discomfort often consider technology as complicated and tend to have anxiety in using new technology (Kuo, Liu, & Ma, 2013). However, the result of this study implies that although the respondents worry about the complexity of telecardiology adoption, they also desire its benefits. The anxiety towards the technology is due to telecardiology that is still considered as a new technology in Malaysia, one that the public unfamiliar with. By providing more information related to telecardiology, the potential users could develop positive beliefs towards the technology and eventually minimise their anxiety in telecardiology adoption (Underwood, 2002). Consistently, a recent study in Malaysia supported that access to health information and media literacy significantly influence one's health-related behaviours in preventing diseases (Shinta, Salleh & Ali, 2019).

The outbreak of COVID-19 had become a pandemic that affected about 24 million people and more than 82,000 lives had been lost (as of 28th August 2020) due to the COVID-19 (WHO, 2020). The pandemic had brought huge impacts to the world and affects almost every aspect of people's lives. Most of the nations had taken containment measures such as lockdowns, quarantines, and imposed movement restrictions to prevent the spread of COVID-19. The provision of public health services had been negatively affected, hospital visitation without urgency, follow-up and non-urgent hospitalisation were suspended due to the containment measures of the nations. Thus, the use of telemedicine had become an alternative to face-to-face consultation during the pandemic. Statistics showed that the use of telemedicine service had increased massively in the past few months. During the pandemic, telemedicine platforms users in Singapore rose more than doubled and the number of active users of telemedicine platforms in China, Indonesia and Australia also experienced an obvious surge (Kapur & Boulton, 2020). De Simone et al. further indicated that use of telecardiology

minimise the risk of exposure to COVID-19 for both healthcare providers and patients as well as maintain the high procedural standards in providing medical services and consultations which are essential in treatment of cardiovascular diseases (De Simone et al., 2020). The current global health crisis has accelerated the adoption of telemedicine and wider use of telemedicine can subsequently lead to higher user acceptance of telecardiology among both healthcare providers and healthcare receivers.

CONCLUSION

Examination of the potential users' acceptance is necessary in telecardiology adoption, as the implementation of innovation is a complex process which requires a large amount of effort and cost. Implementation failures of healthcare technology could cost millions and become a burden to the nation. This study provided insight into the determinants of telecardiology use intention in Malaysia by testing an integration model of TRI, TAM and TPB using structural equation modelling. The results suggested that attitude, subjective norm, and perceived behavioural control were the significant predictors of the intention of telecardiology use. Despite the fact that this model explained 65% of the variance, the research model has not accounted for over 30% of the variance. There may be other factors that could contribute to the remaining variance, and future study is recommended to explore the constructs to gain a better understanding of the intention of telecardiology use. Besides, the results of this study were obtained using cross-sectional, self-reported data which is susceptible to response bias. Moreover, cross-sectional data makes the determination of causality among the constructs to be difficult and difficult to assess whether changes in prevalence reflect a trend. From the theoretical point of view, this study contributes to the body of literature and fills the gap of telecardiology acceptance in the Malaysian context. The proposed model is an extension of TPB and provides a more comprehensive set of antecedents that better explain the intention to telecardiology application. In addition, this study also provides insight into the determinants that could contribute to the successful implementation of telecardiology which could assist the implementers and policymakers in designing strategies to promote healthcare technology.

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