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Factors of Video Directly Observed Therapy Adoption in Malaysia

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Abstract

Remote patient monitoring using mobile devices can be a cost-effective, time-saving solution limiting patient mobility. Direct observation of therapy (DOT) of tuberculosis patients in Malaysia usually involves traveling to the healthcare facility. Due to the contagious nature of the disease, who comes into contact with patients is at risk of developing it. Additionally, DOT is time–consuming and costly for patients. A smartphone application for remote tuberculosis patient monitoring called video directly observed therapy (VDOT) can be a cost-effective and safer way of patient monitoring. However, before implementing this technology, the user readiness assessment helps policymakers' decision-making. This pre-implementation phase study aims to ascertain users' intent to utilize the VDOT app. The current study examines users' readiness using a modified Unified Theory of Acceptance and Use of Technology (UTAUT). The cross-sectional survey took place in Selangor and the federal territory of Kuala Lumpur, Malaysia. A total of 220 questionnaires were delivered to prospective users, including patients and family members. 68% percent of the questioners were deemed usable and were evaluated using SPSS. The study's findings indicate that users intend to adopt the VDOT app for tuberculosis remote monitoring. Performance expectancy, social influence, facilitating conditions, and trust influence users' behavioral intention to adopt the VDOT app in Malaysia.

Keywords: Malaysia, Mhealth, Public Health, Technology Acceptance, Trust, Tuberculosis, VDOT

Introduction

Despite increased global awareness and diagnostic efforts, tuberculosis continues to be a significant cause of fatality, even though a few kinds of tuberculosis are curable (Baya et al., 2019; Subbaraman *et al*., 2018). Tuberculosis is still a major public health issue because, after the Human Immunodeficiency Virus (HIV), it is the second-highest cause of mortality among adults (Atif *et al*., 2014). Globally, approximately 11 million new cases of tuberculosis occur each year, and over two million people die from active tuberculosis (Baya et al., 2018; Subbaraman *et al*., 2018; Tok *et al.,* 2020). By 2020, it was anticipated that the global

tuberculosis epidemic would exceed a billion people. The goal was to achieve a 35% decrease in active patient numbers (Atif *et al.*, 2014). Before the COVID-19 pandemic, nearly 4000 people perished each day from tuberculosis (McQuaid *et al.*, 2020; WHO, 2019). The impact of this public health emergency on tuberculosis is unknown and consequently remains a matter of apprehension (Wingfield *et al.*, 2020). Besides, this issue has not been thoroughly addressed in any recent study (Glaziou, 2020). It is currently uncertain if the social distance can compensate for tuberculosis care delivery disruptions or the likely impact of these combined COVID-19 disruptions on the tuberculosis burden (McQuaid *et al.*, 2020). The COVID-19 public health emergency is impacting the treatment of other diseases. The pandemic poses a threat to meeting the tuberculosis diminishing target on time. By 2035, the World Health Organization (WHO) hopes to reduce tuberculosis–related mortality by 95% and tuberculosis incidence by 90%. Thus, effective patient management programs should be devised to accomplish this objective, which is necessary to benefit both patients and the community (Uplekar *et al.*, 2015). A novel or improved way of treating tuberculosis must be considered and analyzed to achieve the worldwide target strategy of tuberculosis elimination (The World Bank, 2017).

Tuberculosis is still regarded as one of Malaysia's five most infectious illnesses. As a result, tuberculosis outbreaks continue to pose a severe challenge to the countries' healthcare systems. The success rate of pulmonary tuberculosis treatment is 85 percent (Atif *et al.*, 2014). Due to the contagious nature of the disease, notably pulmonary tuberculosis, treatment, and prevention are challenging for the healthcare system as they are dangerous for public health (Subbaraman *et al.*, 2018). A variety of tuberculosis infections require roughly 180 days of daily therapy (Do *et al.*, 2019; Johnston, Campbell & Menzies, 2017). Tuberculosis patients in Malaysia visit healthcare facilities daily, or a skilled healthcare service provider visits patients' homes to verify medication compliance. This treatment technique is referred to as Direct Observation of Therapy (DOT) (The World Bank, 2017; Story *et al.*, 2016). Although the DOT's direct supervision strategy enhances compliance, it does have significant drawbacks (Lutge *et al.*, 2015). DOT practice is inconvenient for patients and exposes them to risks from others, as the pulmonary tuberculosis virus can spread via the air. It entails aligning the patient's schedule and location with the DOT service provider's routine medication. These barriers prompted the development of mHealth interference dubbed Video Directly Observed Therapy (VDOT) as a means of circumventing such barriers in lieu of DOT adherence (Garfein *et al.*, 2015). The WHO (2015) recommended using communication technology in healthcare settings, and VDOT can treat tuberculosis patients via mobile phone applications. mHealth (mobile health) is successfully aiding in the cessation of smoking (Finkelstein & Cha, 2016; McClure, Hartzler, & Catz, 2016), postoperative care, and diabetic patients' self-management, among other things (Scott *et al.*, 2017; Wu *et al.*, 2017). The VDOT mHealth approach can reduce tuberculosis exposure in the general community without interfering with patients' daily lives. In some high-income countries, the feasibility analysis has revealed favorable research outcomes for VDOT mHealth (Eshet, Reuver & Bouwman, 2017; WHO, 2015).

VDOT is a drug administration monitoring technique that records and transmits digital images of patients' medication ingestion to a specific site for the caregiver's reference. A patient records footage using a smartphone application with a date and time stamp during medicine consumption and then shares it with a healthcare service provider. The clinical supervisor can then monitor and record each dose administered to the patient (WHO, 2015). VDOT enables two distinct strategies. One is real-time, while the other is patient–recorded video sharing. As a result, a simple monitoring strategy for tuberculosis patients provides

flexibility for both parties (Eshet et al., 2017; WHO, 2015). VDOT serves as a daily reminder to take medications. Throughout therapy, patients can contact their clinical supervisor using mobile phone messaging, emailing, and calling capabilities (WHO, 2015). Understanding user's perception is important before implementing any technology in the healthcare industry (Hira et al., 2021). Research has also been conducted on designing features in the VDOT to support distress and loneliness, emotional states that tuberculosis patients always experience during their treatment (Khalid & Ghazali, 2019). However, a modest number of studies have been done to ascertain users' intentions about using VDOT services. This study aims to create an awareness of patients' convenience when using mobile health applications to aid in the design and development of the VDOT app. This research seeks to ascertain the parameters influencing VDOT adoption among the general population in peninsular Malaysia.

Literature Review and Hypothesis

Mobile applications are computer programs optimized for use on portable electronic devices, including smartphones and tablets (Edwards *et al.*, 2016). Medical-related app usage has increased to 500 million (Khechine, Lakhal & Ndjambou, 2016). From the perspective of healthcare app developers, it is critical to understand the factors that drive app uptake and sustained use to create effective apps. The introduction of VDOT could have a substantial impact on public health. It is critical to study how users perceive and forecast their future use of this health app. VDOT acceptance in Malaysia has received scant attention, although some researchers have evaluated the behavioral intention of VDOT adoption in another foreign context using the UTAUT (WHO, 2015; Eshet, de Reuver & Bouwman, 2017). This study intends to empirically validate the conceptual model in the Malaysian context. One of the most widely used technologies adoption theories, UTAUT has four IVs and four moderators, as depicted in Figure 1.

Figure.1 UTAUT model (Venkatesh *et al.* (2003).
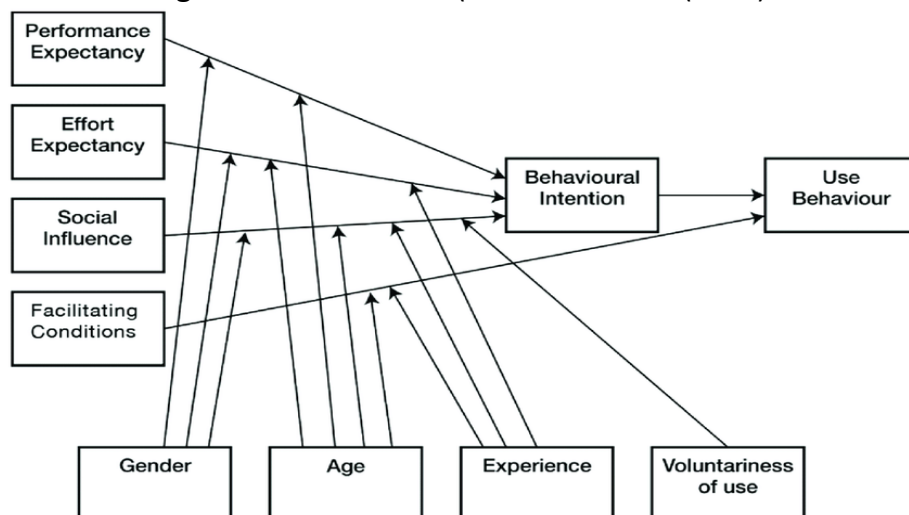
Numerous past studies have employed a modified version of this model; for example, Foon and Fah (2011) incorporated trust as an additional feature and eliminated four moderators, and use behavior from UTAUT. The study found a significant correlation between IVs and DV. Hence, we have added technology trust as an Individual variable (IV) to modify UTAUT, as Fox and Connolly (2018) suggested. This model focuses more on individuals' behavior that suits this study's objectives to examine the associated preadoption factors, as shown in Figure 2. Figure.2 Conceptual model.
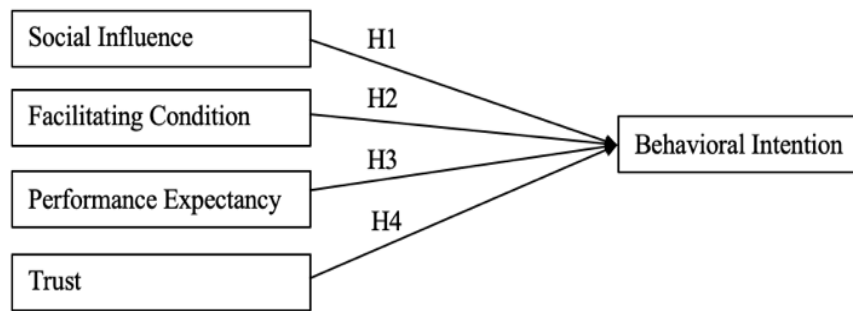
Performance Expectancy

The performance expectancy (PE) of technology is the level to which it can increase the productivity or effectiveness of its clients (Venkatesh & Zhang, 2010). PE was established by integrating the Technology Acceptance Model's (Davis, 1989) perceived usefulness, the Social Cognitive Theory's (Bandura, 1986) outcome expectation, and the Incentive Model's external motivation (Davis, Bagozzi & Warshaw, 1992). PE directly influences the behavioral intention of users towards mHealth (Skoumpopoulou *et al*., 2018; Seethamraju, Diatha & Garg, 2018). Users' understanding of the possible benefits of VDOT will increase the chances of intent to adopt it. VDOT is expected to eliminate the risk of infection, improve cost-efficiency by cutting travel expenses, improve efficient intervention, and smoothen the users' treatment process. PE is the most significant predictor of BI in the UTAUT model. As a result, it is critical to investigate its relationship to the behavioral intention of understanding VDOT users' perception at the early stage of app development. Technologically knowledgeable individuals anticipate fewer complications when utilizing mobile apps to check tuberculosis status and rapidly become acclimated to it (Yuan, Kanthawala & Peng, 2015). The following hypothesis is proposed: If users have a high expectation of performance, they are more likely to create a usage intention to utilize VDOT.

H1: Performance expectancy positively influences behavioral intention to use VDOT.

Social Influence

The term "social influence" (SI) refers to the degree to which users value the beliefs of others (Davis, 1989). It was derived from subjective norms in Ajzen's (1991) Theory of Planned Behavior and the Theory of Reasoned Action by Fishbein and Ajzen (1977). Users' decisions to adopt new apps are influenced by society's acceptability, most notably by user ratings and comments (Yadav, Sharma & Tarhini, 2016). In other words, the opinions of family, friends, peers, and other users influence and affect end-users choices. If an app is desirable and beneficial, users will follow their referees' advice, greatly increasing behavioral Intention to use mHealth through SI (Wang, & Chou, 2016). SI found to have a significant positive influence on users' intentions to adopt mHealth (Arenas Gaitán, Peral Peral, & Ramón Jerónimo, 2015). VDOT offers new services to tuberculosis patients via a relatively new service delivery channel. Therefore, it is expected that users will be interested in others' opinions based on their experiences and views of using VDOT. From peers, friends, and family, patients are likely to develop different perceptions about VDOT. As a result, the VDOT adoption intention is deemed high if SI is favorable.

H2: Social influence positively influences behavioral intention to use VDOT.

Facilitating Condition

Facilitating Conditions (FC) are the motivating factors that demonstrate the comfort or simplicity technology may be used to purchase things and services. It depicts extrinsic restrictions on behavior that limit the availability of resources and technology enabling circumstances (Eshet, de Reuver & Bouwman, 2017; Yuan *et al.*, 2015). The research reveals and demonstrates the importance of support personnel's availability of guidance in assisting users in overcoming technological restrictions. On the other side, enabling conditions emphasize the need for a technologically enabled environment to minimize barriers to technology use, hence facilitating customers' use of mHealth app features. Conducive conditions, for example, improved interface, speed, data processing capabilities, and individual awareness of mobile functions and features, will compel the user to adopt VDOT.

H3: Facilitating condition positively influences behavioral intention to use VDOT.

Trust

Trust is considered a substantial factor in reducing insecurity feelings that assure user intention towards new technology. Technology Trust positively impacts the intention to use technology (Suki & Suki, 2017). Security concerns over mobile apps relating to privacy may stimulate users' trust (Wang & Chou, 2016). Technology trust can be enhanced via an interface with ease of use and the belief in the web interface's safety mechanism. Prospective clients will be motivated to utilize mobile applications if they believe and trust that the app will provide a short wait time, increased convenience, and efficiency. Vulnerability is associated with an initial propensity to take risks despite the possibility of losing critical knowledge.

H4: Trust positively influences behavioral intention to use VDOT.

Behavioural Intention

"Behavioral Intention" refers to an individual's proclivity to perform or abstain from performing a specified future behavior (Venkatesh & Zhang, 2010). Suki and Suki (2017) found that individuals are more likely to engage in a given behavior if their intention toward the behavior is positive. This is a patient-centric study addressing the factors of mobile app-based VDOT adoption. Respondents are asked whether they will adopt the VDOT mobile app once it is available for use.

Method
Population and Sample

Malaysian users 18 years and older with at least one year of experience using mHealth apps were considered respondents. According to the geographical location, this study evaluated two states of Malaysia, namely, Selangor and Federal Territory, for sample collection. Firstly, considering the number population. Secondly, more than 30 percent of mobile phone users reside in these areas (Quoquab et al., 2018). The study implied a convenience method using a floating questionnaire to readily reachable users. Individuals in several public places such as hospitals, university campuses, and university medical centers voluntarily participated as respondents in this study. The respondent from these areas was suitable because of the type of organization. It is believed that the individuals from these premises are supposed to be interested in using mHealth apps than others. Due to ongoing public health emergencies and time constrain, the random sampling method could not be implied. A total of 220

questionnaires were distributed, but 173 questionnaires were received from the identified respondents. One hundred fifty questionnaires (68%) could be retained for further analysis using the statistical package for the social sciences (SPSS) software.

Data Collection and Analysis

The current study used a quantitative method to assess the conceptual model experimentally to ascertain users' intentions to use VDOT apps for tuberculosis treatment. To quantify the study variables from the preceding literature, a Likert scale of 5 (1 = "strongly disagree," 5 i= "strongly agree"). Items for PE, SI, FC, BI have been adopted and adapted from Abrahão, Moriguchi, and Andrade (2016). Items for trust have been adapted from Harris, Brookshire, and Chin (2016) and presented in Table 1.

Table.1. The variables and utilized items

Variable	Code	Items
Performance Expectancy	PE1	If I had tuberculosis, using Mobile Apps for my treatment could be useful in my daily life (Ex: Reducing traveling costs & time)
	PE2	If I had tuberculosis, using Mobile Apps for treatment could help me to accomplish everyday tasks quickly
	PE3	If I had tuberculosis, using Mobile Apps for treatment, I could help improve tuberculosis monitoring
Social Influence	SI1	My doctor would think I should use Mobile Apps for therapy if I had tuberculosis
	SI2	My family would think I should use Mobile Apps for treatment if I had tuberculosis
	SI3	My friends would think I should use Mobile Apps for therapy if I had tuberculosis
Facilitating Condition	FC1	I have the necessary resources (training and knowledge) to use Mobile Apps in the healthcare
	FC2	I have the required assistance if I face any difficulties with Mobile Apps in the healthcare
	FC3	I find Mobile Apps in healthcare compatible with other systems or appliances I use
Trust	TR1	The mobile Apps market in healthcare is trustworthy
	TR2	The mobile Apps market in healthcare has my best interests in mind
	TR3	The mobile Apps market in healthcare has high integrity
Behavioral Intention	BI1	If I had tuberculosis, I intend to use Mobile Apps for treatment when it is available
	BI2	If I had tuberculosis, I would use Mobile Apps for therapy in the next six months
	BI3	If I had tuberculosis, I would plan to use Mobile Apps for treatment in the next six months

A survey questionnaire was used for data collection circulated via both online and offline channels. Due to the impossibility of obtaining all members of the sample population, a non-probability sampling technique was used. According to Kline's rule of thumb, we used a factor of 10 to calculate a minimum number of response requirements as 15 items are present in

the survey questionnaire (Kline, 2011). The sample size found was 150- (10x15). The respondent's age is 18 years and above. The data analysis results are presented in this section. Table 2 presents relevant results. The Cronbach alpha is within an acceptable range between 0.656 to 8.37. Table 3 shows the Pearson correlation coefficient analysis outcome. The relationship between variables is at a significant level.

Table.2. Variable statistics, factor loading, Cronbach alpha, KMO & Barlett's test.

Variable	Mean	Standard deviation	Item to total	Factor loading	Cronbach alpha	KMO & Barlett's test
Performance Expectancy	12.340	1.562			0.656	0.650
PE1	4.050	0.6344	0.509	1.778		
PE2	4.082	0.7113	0.553	0.668		
PE3	4.208	0.6850	0.608	0.554		
Social Influence	11.390	2.2973			0.835	0.719
SI1	3.704	0.9109	0.579	1.256		
SI2	3.843	0.9382	0.617	0.420		
SI3	3.843	0.7998	0.665	0.324		
Facilitating Conditions	11.673	2.0822			0.711	0.665
FC1	3.849	0.9291	0.648	1.902		
FC2	3.874	0.8400	0.553	0.616		
FC3	3.950	0.8479	0.652	0.482		
Trust	11.365	2.0045			0.712	0.671
TR1	3.818	0.8704	0.800	1.904		
TR2	3.843	0.7918	0.743	0.601		
TR3	3.704	0.8535	0.759	0.495		
Behavioral Intention	12.434	2.0578			0.837	0.665
BI1	4.119	0.7985	0.872	2.297		
BI2	4.107	0.7762	0.756	0.518		
BI3	4.208	0.7962	0.676	0.215		

Table.3. Correlation's outcome.

Variable	PE	SI	FC	Tr	BI
Performance expectancy	1				
Social Influence	.502**	1			
Facilitating Condition	.564**	.552**	1		
Trust	.460**	.493**	.583**	1	
Behavioral Intention	.639**	.540**	.652**	.562**	1

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

Result and Discussion

The data validated the assumptions that the independent factors, performance expectancy, social influence, enabling conditions, and trust positively and substantially

influence behavioral intention. The findings reaffirm that the modified UTAUT is capable of explaining the linkages adequately. Additionally, this research corroborates previous research that indicated public readiness for technology adoption in the healthcare sector. The p-value is less than 0.05, meaning that the dependent and independent variables have a significant association between PE, SI, FC, TR, and behavioral intention.

Table.4. β value and p-value.

Hypotheses	β value	P-value	t – value	Result
Performance Expectancy → Behavioral Intention	0.328	0.000	4.878	Supported
Social Influence →Behavioral Intention	0.294	0.000	3.974	Supported
Facilitating Condition →Behavioral Intention	0.178	0.000	2.621	Supported
Trust →Behavioral Intention	0.125	0.125	1.853	Supported

a. Dependent Variable: Behavioural Intention

Conclusion

While VDOT can be utilized anywhere, any time to assist with tuberculosis patient monitoring, the technologies' lack of adoption poses a barrier to their widespread implementation. This work aimed to propose and validate a theoretical VDOT acceptance model. We inferred a modified UTAUT to account for user acceptance of VDOT. The results indicated that all four of the predicted hypotheses were supported. Users' perceptions on performance expectancy, social influence, facilitating condition, trust can positively influence behavioral intention to adopt VDOT. Trust influences behavioral intention at the pre-implementation phase. Performance expectancy, social influence, facilitating condition influences behavioral intention the most. VDOT intervention may be implemented in Malaysia for TB patients.

Nowadays, the mobile phone is utilized daily throughout the world. The cost of interventions using mobile apps is lower, and they are easily available, convenient to use. Smartphone and mobile networking technologies are advancing, creating opportunities for realistic technological intervention (Wingfield *et al*., 2020). This study's limitation includes that respondents were chosen voluntarily and were chosen based on their desire to use mobile technology for healthcare interventions. The study's findings may be skewed, as the respondents have been regarded as tech-savvy. Therefore did not include effort expectancy as a variable. Second, data quality can be a concern. Due to time constraints, the sample size for the analysis was somewhat small. Thirdly, participants were not provided with a prototype of the VDOT mobile application, which does not yet exist in Malaysia. As a result, participants' responses are contingent on their perception of the VDOT mHealth app. Further study could consider including a large sample size and retaining effort expectancy following the original UTAUT. Generation could influence the degree of intention to adopt technology, thus, recommended to be considered a variable. Furthermore, multiple stakeholders' perspectives (i.e., patient, caregiver) can be assessed in the future. The framework of this study could be further tested or expanded with other relevant contextual variables.

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