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EXAMINING INTENTION TO USE OF MOBILE TELEMEDICINE SERVICES AMONG INDONESIANS THROUGH MODIFIED TECHNOLOGY ACCEPTANCE MODEL: SURVEY STUDY

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Abstract. *In developing countries, such as Indonesia, telemedicine services are becoming a more common means of providing basic healthcare. In this research, we applied the modified Technology Acceptance Model (TAM) to measuring factors affecting the adoption of mobile telemedicine in the Indonesian context. We collected data from 256 mobile telemedicine users and processed the data using Partial Least Square (PLS) technique. Some of our hypotheses contribute to describing the behavior intention to use mobile telemedicine, and it shows some agreement with previous research on perceived usefulness and user satisfaction on its impact on behavior intention to use. Perceived ease of use and privacy risk also show a similar result. The result shows that the most sought function on mobile telemedicine applications is searching and education (62.5%), so it is also important to highlight that health-educational and informative content is a significant aspect in increasing awareness and continuance intention to use telemedicine services among mobile telemedicine users. Technology anxiety affects the intention to use mobile telemedicine. However, the effect is not in accordance with the initial hypothesis. A better strategy is needed to increase the adoption rate of mobile telemedicine among elder users.*
Keywords: Continuance intention, Mobile telemedicine, Indonesia, Technology acceptance model

1. **Introduction.** Information technology has led to considerable changes to the traditional healthcare service environment, gradually becoming the most prominent ICT service with extraordinary effects on traditional healthcare mechanisms [1]. In healthcare, one of the most significant developments is telemedicine. Thanks to modern technology,

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multiple services may now be found in various forms, including on-site consultation, online diagnosis, and follow-up rehabilitation and recovery services. Indonesia ranks as the fourth most populated country in the world in 2020.

Telemedicine makes it easier for patients to access healthcare, monitor their health conditions, and make full use of knowledge, especially for people living in rural and remote areas where medical facilities are not always available or necessary [2]. In addition, telemedicine has become more available to the general public with widely applied mobile technology. Quality and efficiency in terms of clinical costs are some of the advantages of telemedicine, nursing care without regional borders, telemedicine can minimize the number of visits and the number of days of hospitalization, can enhance chronic medical services and expand the use of technology, and can be used as field-based nursing education. Moreover, telemedicine has a service value that cannot be replaced by traditional healthcare, and there is an economic value that needs to be promoted for ICT government revenue to grow.

Massive studies have been carried out to examine the acceptance and purpose of using telemedicine services. In general, telemedicine refers to the use of connectivity and information technology for healthcare delivery. Telemedicine, however, is not simply a straightforward blend of healthcare and technology [3].

With the potential use of telemedicine and its current trend that people switched from face-to-face consultation to online consultation due to the late pandemic, we need to understand specific dimensions that considerably influence the behavioral intention in using the mobile telemedicine in Indonesia that, according to Khalil et al. [4], has multiple dimensions. Although health applications are on the market and continue to expand, over 30% mHealth applications have been torn down in a month. The uninstalled app could lead to a loss of over $30,000 a month, and users will not reach their ultimate purpose without using it, which is to improve the quality of life [4]. One of the main challenges to deployment is user acceptance, as we understand that the factors that influence patient acceptability of telemedicine services helps to identify which concerns need to be addressed to enhance acceptance and, as a result, uptake of telemedicine services in mainstream healthcare in the long term.

Behavioral Intention to Use (BI) is defined as the degree of use of computer technology on an application user that can be predicted through the attitude of his attention to technology, such as the desire to add supporting peripherals, motivation to keep using, and the desire to motivate other users [5]. The goal of intentional use in telemedicine refers to a user's efforts to continue using the application once approved for a long time or after a sustained duration. When implementing the telemedicine framework, user involvement is critical because it is the key to attaining the primary goal of improving quality of life [6]. BI has been widely used in earlier research for similar problems and has played an important role in IT. The previous study has looked into what factors influence a health app's adoption, but only a few studies [7], especially from Indonesia, suggest BI for mobile health apps and telemedicine.

Not many researches have been identified in Indonesia related to the Behavioral Intention to Use (BI) of mobile telemedicine. Despite telemedicine's relative maturity and sophistication, this topic's research focuses more on technology and evaluating its services [8-11]. Mobile telemedicine services are in high demand right now. It is possible but does not promise that this service will be accepted long-term following the crisis.

Numerous research studies have shown that telemedicine's overall impact can be affected by various social factors. One of the key factors is the emotional state of the user. For example, people who are in a positive emotional state may be more likely to adopt telemedicine, as they may perceive it as a convenient and efficient way to access healthcare. On the other hand, people who are feeling anxious or stressed may be less likely to adopt telemedicine, as they may prefer to receive care in person. Another important factor is the risk perception of the user. People concerned about the privacy and security of their medical information may be less likely to use telemedicine, while those who believe telemedicine is a safe and secure way to access healthcare may be more likely to use it. Moreover, the user's trust on the technology and the healthcare providers is also a key factor. If the user does not trust the technology, or healthcare providers, they would be less likely to adopt telemedicine. This research uses the Technology Acceptance Model (TAM) to evaluate consumer behavior and assess whether people will continue to use mobile telemedicine in the event after a pandemic. Therefore, we intend to modify the current model using the cumulative effect of multiple social elements such as user emotional state and risks.

2. **Research Model and Hypotheses.** Researchers have developed numerous models to analyze the characteristics of technology acceptability among users throughout the previous few decades and these models have been tested several times to determine their efficacy in various IT-related applications. Davis' Technology Acceptance Model (TAM) is the most well-established and robust framework for technology adoption to date [12]. The research model as shown in Figure 1 is designed to study the critical factors supporting and impeding telemedicine services in a developing country by conducting a questionnaire survey. The research study used Partial Least Squares (PLS) to analyze the research findings and collect data. Then, empirical validation of the proposed research model was performed.

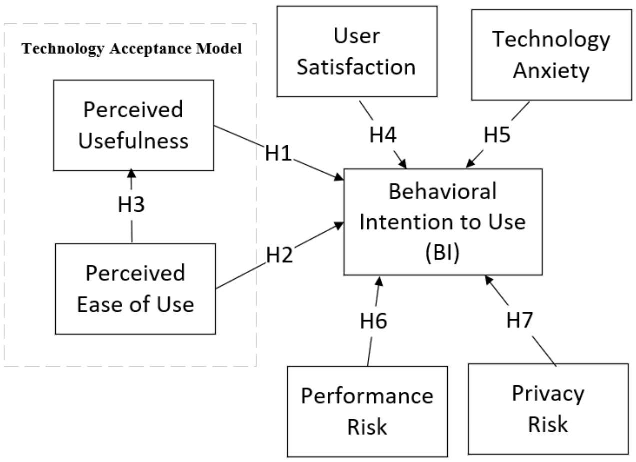

Figure 1. Research model

Telemedicine services give an enhanced alternative to healthcare in developing countries, and hence focusing on the inclusion and impact on the user's perception of extra social variables in the TAM model is crucial. To understand supportive variables in the adoption of telemedicine services, it is required to investigate user behavior within a technology acceptance paradigm. TAM is known as a reliable and efficient methodology for predicting user acceptance of technology [13]. According to TAM, Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and attitude all have a causal relationship with intention and usage behavior. After reviewing the empirical outcomes of TAM in health research, we have decided to make the most common TAM constructions available for health studies operational.

2.1. **Perceived usefulness and perceived ease of use.** The most common and important determinants of technological adoption in initial TAM research are perceived usefulness and perceived ease of use [14-16]. Perceived usefulness is usually described as a person's belief that the use of a system will aid in improving their performance. The users' perceived usefulness expected to positively influence the intention in a mobile telemedicine application to continue to use the application because they consider using these services to achieve better results, as shown in the previous research result [17]. Perceived Ease of Use (PEOU) is defined as the degree to which a person believes that a minimum effort is made using technology [18]. If the technology is simple to use, the obstacles have been overcome, and it will also affect the perceived usefulness of the user. Therefore, we hypothesize that perceived usefulness and perceived ease of use affect behavioral intention to use mobile telemedicine platforms.

H1: Perceived usefulness has a positive impact on behavioral intention to use mobile telemedicine.

H2: Perceived ease of use has a positive impact on behavioral intention to use mobile telemedicine.

H3: Perceived ease of use has a positive impact on perceived usefulness to use mobile telemedicine.

2.2. **User satisfaction.** User satisfaction in this study is defined as the degree of satisfaction of the user with the decision to employ the application and the extent to which it meets his expectations [19,20]. Studies have also shown that user satisfaction with technology increases users' intention to use new technologies [21,22]. Satisfied users tend to have higher use of their services, strong contact, and often want to advise their families about the product or service. Thus, the basis of the hypothesis on user satisfaction is stated as

H4: User satisfaction has a positive impact on behavioral intention to use mobile telemedicine.

2.3. **Technology anxiety.** The fundamental TAM model has been enhanced in this research to include certain extra factors, such as technology anxiety, user satisfaction, and risks, such as performance and privacy risk. The Technology Anxiety (TA) itself is defined as a concern or people's apprehension while considering or beginning to utilize computing technologies that they had not used previously [23]. Technological anxiety is a negative emotional response, and between the use of a new system and TA a negative association occurs. Likewise, consumers could be anxious to use similar services in the setting of telemedicine. Therefore, it is vital to study the effect this element can have on the intention of use [24]. Therefore, we hypothesize that

H5: Technology anxiety has a negative impact on behavioral intention to use mobile telemedicine.

2.4. **Performance risk and privacy risk.** There is no denying the importance of risk as an important prediction for human behavior. In health and information technology topics, the consequences of risk and uncertainty cannot be reduced, but risk variation or uncertainty about the use of IT varies considerably across patients and physicians [25]. Research shows seven additional elements of risk, including time, performance, financial, social, physiological, privacy and overall risks, in the context of uncertainty and task-related concerns with online services [24]. Performance Risk (PeR) is the possibility for a product, service, program, or project to not provide as much value as necessary [26], while the term of privacy risk refers to the possibility of losing control over one's personal information [27]. Risks have been demonstrated to have a negative effect on continuation intention in previous research [28], particularly in online and mobile services. Suppose users of mobile telemedicine believe that service performed by the application is below expectations that were resulting in a loss in functional, economic or even social and their privacy is at risk by supplying personal information. In that case, they may experience decreased pleasure and be hesitant to continue using the mobile telemedicine services. Therefore, the following hypothesis has been determined:

H6: Performance risk has a negative impact on behavioral intention to use mobile telemedicine.

H7: Privacy risk has a negative impact on behavioral intention to use mobile telemedicine.

3. **Result and Discussion.** The study was carried out in the Greater Area of Jakarta, Indonesia, from May through August 2020. We excluded 150 replies from participants who never had access to mobile telemedicine services from an initial survey of 406 interviewees. This resulted in 256 answers available for a total response rating of 63%, and this sample was sufficient for the minimal SEM requirements utilizing the MLE process for the 100 to 150 samples [29]. The questionnaire was divided into two parts. The first part detailed the participants' basic demographic characteristics, including gender, age, education, income, and the mobile telemedicine application used. The other part includes questions about the numerous variables included in the research model. This study uses PLS-SEM approaches to analyze the data. PLS-SEM is the acknowledged solution to smaller samples and sample data that are not usually distributed [30]. Smart PLS version 3.3.3 was employed in this study. We analyzed data using the PLS-SEM in two steps: first, we validated the model's measurement, and then we validated the structural model [31]. After analyzing the structural model, the PLS algorithm verifies hypotheses using t-tests and path values.

The data gathering process got 256 legitimate respondents who were already using mobile telemedicine, with 109 men and 147 females participating. Table 1 summarizes the demographic data collected from respondents in this study. It reveals that most responders (37.1 percent) were between the ages of 20 and 29, indicating a productive age. Respondents' educational attainment was primarily at the college level: diploma-undergraduate, followed by graduate-doctoral degrees. The majority of respondents used Halodoc, with approximately 86 percent mainly for search and education purposes.

3.1. **Measurement model evaluation.** Before examining and calculating the proposed conceptual model, the survey instrument was tested. We conducted many tests, including

Table 1. Demography of respondent

Demography	Total	%	Demography	Total	%
Sex			Chronic illness		
Male	109	42.6%	Yes	8	3.1%
Female	147	57.4%	No	248	96.9%
Age			Telemedicine platform used (more than one)		
< 20	15	5.8%			
20-29	95	37.1%	Halodoc	221	86.3%
30-39	78	30.5%	Alodokter	94	36.7%
40-49	57	22.3%	Klikdokter	16	6.3%
> 50	11	4.3%	SehatQ	6	2.3%
Education			GoodDoctor	8	3.1%
High-School	42	16.4%	Others	7	2.7%
Diploma-Undergraduate	121	47.3%	Telemedicine services (more than one)		
Graduate-Doctoral	93	36.3%			
Monthly Income (IDR)			Search and education	160	62.5%
<= 3 million	70	27.3%	Online consultation	125	48.8%
3.1-7 million	77	30.1%	Drug purchases	117	45.7%
7.1-11 million	41	16%	Others	10	3.9%
11.1-15 million	20	7.8%			
> 15 million	48	18.8%			

Table 2. Summary of measurement of the model evaluation

Variable	Indicator	Loading factor	VIF	CA	CR	AVE
Behavioral intention to use	BI1	0.898	1.659	0.773	0.898	0.815
	BI2	0.907	1.659			
Perceived ease of use	PEOU1	0.896	2.277	0.835	0.901	0.753
	PEOU2	0.848	1.748			
	PEOU3	0.858	2.026			
Perceived usefulness	PU1	0.795	1.327	0.747	0.855	0.663
	PU2	0.848	1.812			
	PU3	0.798	1.640			
Performance risk	PeR1	0.827	1.542	0.745	0.880	0.787
	PeR2	0.943	1.542			
Privacy risk	PrR1	0.808	2.989	0.899	0.904	0.826
	PrR2	1.000	2.989			
Technology anxiety	TA1	0.981	3.266	0.918	0.934	0.826
	TA2	0.904	3.947			
	TA3	0.836	3.002			
User satisfaction	US1	0.930	3.365	0.925	0.952	0.869
	US2	0.935	3.876			
	US3	0.932	3.446			

validating the proposed measurement model for all structures to accomplish this. The reliability and validity checks are summarized in Table 2. For all constructions, Cronbach's Alpha values ranged from 0.745 to 0.925, and the composite reliability value was between 0.855 to 0.952. As a result, these demonstrate an acceptable level of reliability.

Convergent validity was estimated using factor loading, Composite Reliability (CR), and Average Variance Extracted (AVE). Each object has a loading factor greater than 0.7, whereas the CR range between 0.855-0.952 and AVE between 0.663-0.869, respectively, as shown in Table 2, and this shows that all calculated indices exceeded the acceptable threshold. The results in Table 3 verify the data's discriminant validity. The entries in the correlation matrix's corresponding columns and rows must be fewer than the diagonal element [32].

Table 3. Discriminant validity (Heterotrait-Monotrait ratio)

	BI	PEOU	PU	PeR	PrR	TA	US
Behavioral intention to use	1						
Perceived ease of use	0.614	1					
Perceived usefulness	0.772	0.804	1				
Performance risk	0.179	0.093	0.108	1			
Privacy risk	0.107	0.054	0.071	0.696	1		
Technology anxiety	0.114	0.231	0.185	0.237	0.245	1	
User satisfaction	0.776	0.741	0.804	0.251	0.086	0.095	1

3.2. **Structural model evaluation.** In order to verify the validity of our hypothesized model, we conduct hypothesis testing by examining path coefficients (β) and the related significance level between the dependent and independent variables. The theoretical model was validated using the bootstrapping method utilizing a standardized path coefficient and p-values [33]. Table 4 summarizes the structural model constructed to ascertain the relationship between the model's main variables.

Table 4. Analysis of the model

Hypothesis	Path coefficient	P-values	Conclusions
H1 – PU $\rightarrow$ BI	0.254	0.001	Accepted
H2 – PEOU $\rightarrow$ BI	0.079	0.256	Rejected
H3 – PEOU $\rightarrow$ PU	0.636	0.000	Accepted
H4 – US $\rightarrow$ BI	0.419	0.000	Accepted
H5 – TA $\rightarrow$ BI	0.159	0.013	Accepted
H6 – PeR $\rightarrow$ BI	-0.132	0.015	Accepted
H7 – PrR $\rightarrow$ BI	0.131	0.072	Rejected

Additionally, we investigate the dependent variable using Moore's R^2 value [34]. A number between 0.5 and 0.7 is considered moderate, and an R^2 value of $0.3 < R < 0.5$ is regarded a weak or small effect size. The coefficient of determination of behavioral intention to use is 0.521 and 0.405 for perceived usefulness. As can be observed, perceived usefulness ($\beta = 0.254$, $p < 0.005$) and user satisfaction ($\beta = 0.419$, $p < 0.001$) are important factors in determining the acceptability of mobile telemedicine services in Indonesia. Thus, both support H1 and H4. Further, perceived usefulness was found to be highly affected by perceived ease of use ($\beta = 0.636$, $p < 0.001$), supporting H3. However, perceived ease of use ($\beta = 0.079$, $p = 0.256$) and privacy risk ($\beta = 0.131$, $p = 0.072$) did not have a significant impact on behavioral intention to use. Therefore, the H2 and H7 are rejected.

Performance risk displays a barrier on behavioral intention to use telemedicine service ($\beta = -0.132$, $p < 0.05$), supporting H6. On the other hand, technology anxiety ($\beta = 0.159$, $p < 0.05$) proves to be related to the behavioral intention to use that supports the H5, but it is not proven to have an effect and correlation as in the hypothesis.

Consistent with earlier research on the effect of user satisfaction on intention to use e-health services, we find that user satisfaction is a strong predictor of loyalty to mobile telemedicine. If users perceive mobile telemedicine services as satisfactory, they are likely to feel highly satisfied and motivated to continue using the application; thus, it will support the main telemedicine purpose to provide more accessible healthcare for people living in rural and remote areas or people that are currently unavailable to get face to face consultation.

Perceived usefulness also plays an important role in affecting the behavioral intention to use mobile telemedicine. Perceived usefulness represents consumers' expectations about the advantages associated with the use of an IT product/service. In this research, we found that the most sought function on mobile telemedicine applications is searched and education, around 62.5% of our respondents use mobile telemedicine to look for information. We assume this is triggered by the need to obtain more reliable information about their health condition. Other services with high usage are online consultation (48.8%) and drug purchases (45.7%).

From this research, we also find that perceived ease of use highly affects the perceived usefulness. We recognize that before the COVID-19 pandemic that boosts mobile telemedicine use, the adoption of mobile telemedicine in Indonesia is very low. So, at this very moment, many mobile telemedicine users are early adopters, as shown in Figure 2. Thus, users may experience greater satisfaction when they perceived mobile telemedicine applications to be easy to use during initial interactions.

An interesting result is shown on the technology anxiety influence on behavioral intention to use. In this research, we find that technology anxiety somehow affects the intention to use mobile telemedicine. However, the effect is not in accordance with the initial hypothesis. This result is not in accordance with previous research by Kamal et al. [24] that mentions that technology anxiety negatively affects the behavioral intention

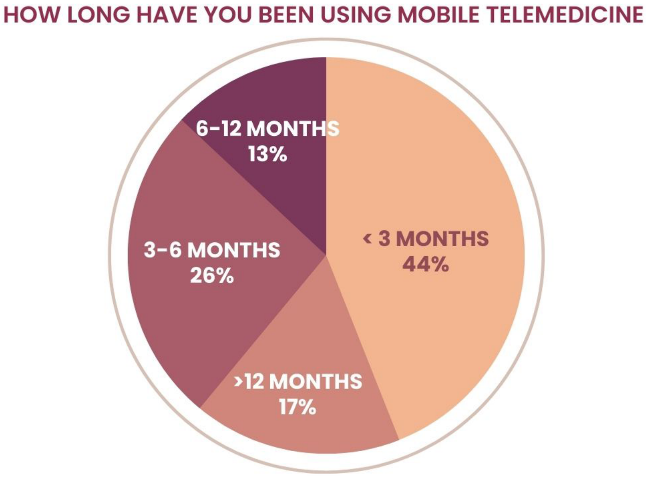

Figure 2. Respondent's mobile telemedicine usage period

to use. Our explanation for this result is that when we distributed the questionnaires and the momentum of the high COVID-19 cases in Indonesia, users ignore their anxiety for more important things, such as accessible healthcare.

However, this ignorance does not apply to the performance risk. Indonesian users still agree that more risk on the performance side will dissuade them from using the mobile telemedicine application. As we mentioned before, many mobile telemedicine users are early adopters with higher concerns about healthcare access. So if they discover a threat in their initial interactions, it is easier to switch not to use the application. However, our results show that this performance risk effect has a low value. Hence, we can agree that people focus more on other factors in deciding whether they will continue using mobile telemedicine.

Another study's findings are that perceived ease of use and privacy risk do not directly influence behavioral intention to use. On the first factor, we argue that it is related to our respondent background age that is still in productive ages. Younger people use mobile devices for a greater range of purposes than their elders (many of which simplify daily routines and improve performance) (e.g., calling or sending a message). As a result, user impressions may differ for perceived ease of use and privacy risk. This result also shows that mobile telemedicine providers should have a better strategy to increase the adoption rate of mobile telemedicine among elder users.

4. **Conclusions.** Telemedicine offers much potential in Indonesia as a developing country to help the country's healthcare system. Telemedicine services can be an important component of the existing traditional healthcare system. This study evaluates factors influencing the adoption of telemedicine services based on a TAM as a theoretical model. This study's findings add to the current research literature about the design and development of telemedicine services. The study's findings also emphasize how this entire process may be made more successful for the adoption of telemedicine services among people in developing countries who have specific characteristics such as cultural ethics, education background, age, and access to physical healthcare.

It is also important to highlight that health-educational and informative content is a significant aspect in increasing awareness and continuance intention to use telemedicine services among mobile telemedicine users. It also transforms user behavior regarding searching for and getting valid health news.

According to coefficient of determination value, many factors that can influence behavioral intention to use telemedicine are not yet explored in this study. Further research may examine other variables such as information quality and system quality. It is also important to focus on factors to increase the adoption rate of mobile telemedicine among elder users.

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