
APPLICATION OF TECHNOLOGY ACCEPTANCE MODEL (TAM) IN TELEMEDICINE APPLICATION DURING COVID-19 PANDEMIC

**Noverinda Galuh Puspitarani Sudaryono¹, Mahmud Fadhiil²,
Syarifah³, Evi Rinawati Simanjuntak⁴**

Universitas Bina Nusantara, Jakarta, Indonesia

noverinda.sudaryono@binus.ac.id¹, mahmud.fadhiil@binus.ac.id²,
syarifah@binus.ac.id³, esimanjuntak@binus.edu⁴

ABSTRACT

The COVID-19 pandemic hit the whole world, including Indonesia, forcing people to limit all activities outside their homes, including treatment activities to hospitals. This study aims to examine the application of the technology acceptance model (TAM) to telemedicine applications during the COVID-19 pandemic. The proposed research model is formulated from the extended technology acceptance model theory with empirical testing using data obtained from telemedicine user surveys. This study analyzed two additional external factors: privacy concerns and trust. Data is processed using SmartPLS software. A total of 406 telemedicine users participated in this study with male, n=206; 51%, female, n=200; 49%. Research respondents habitually used telemedicine applications during the COVID-19 pandemic that hit Indonesia. Among these respondents, 94.7% reported using telemedicine services during the COVID-19 pandemic. The most widely used telemedicine application, with a total of 59.7% of respondents, chose Halodoc. The external variable privacy concern does not affect the perceived usefulness of telemedicine used. However, trust and perceived usefulness are associated with a positive significance in telemedicine used during the COVID-19 pandemic in Indonesia. Privacy concerns have a limited impact on the perception of expediency but influence the ease of use of telemedicine apps. On the other hand, trust plays a vital role in shaping telemedicine's perceived usefulness and ease of use during the COVID-19 pandemic, as telemedicine has become indispensable for accessing healthcare services.

Keywords: telemedicine, privacy concerns, trust, tam, covid-19.

Corresponding Author: Noverinda Galuh Puspitarani Sudaryono

E-mail: noverinda.sudaryono@binus.ac.id



INTRODUCTION

Patients generally come directly to health facilities in person to get health services. However, this conventional thing must also be considered regarding its limitations. Therefore, communication technology continues to be developed to provide long-distance medical services, widely known as telehealth or telemedicine (Li, 2020). Telemedicine has been applied to previous events due to a lack of access to healthcare (Sirintrapun & Lopez, 2018). However, recent research has shown that telemedicine has evolved according to the existing infrastructure to continue being used during and after the COVID-19 pandemic (Thomas et al., 2022). Each telemedicine has its advantages, such as teleconferencing for registering new services and devices in the biometric setting of patient health (Cheng et al., 2021). Telemedicine can be used for health systems with superior capabilities in preventing exposure to the coronavirus. There are several concerns in telemedicine, such as medical practice, training for health practitioners, and patient problems in applying telemedicine (Bokolo, 2021).

In some parts of the world, the term telemedicine may differ depending on a group of people or individuals in the country. One of the studies in China mentioned mobile medical treatment (MMT) and E-Consultation, research in Iran and mobile health, mHealth in Arab countries, China and Spain, and mobile health care in Italian research. Of the many existing terms, all refer to applications that provide services for patients in consultation with healthcare providers. With considerations related to the advantages and problems that exist with the adoption of telemedicine, the Technology Acceptance Model (TAM) is used for previous research patterns related to web-based learning and the distribution of masks (Baber, 2021); (Tsai et al., 2021). TAM describes the application of the latest technology with ease that is directly felt by the individual related to the attitudes and behavioral intentions of the application of technology (Anderson et al., 2022).

TAM also explores the perception of use and perceived ease of use in telemedicine applications, proving the potential to control network communication (Anderson et al., 2022). Since the beginning of the pandemic on social media, research has been carried out on the pattern of adoption of telemedicine for speech pathology based on several previous studies (Weidner et al., 2021). The research technique used in this study is a benefit of telemedicine applications that are relatively recently used by users, especially in Indonesia since the COVID-19 pandemic, where telemedicine applications can provide information and health solutions online from doctors directly to users or prospective patients. This research uses TAM to limit telemedicine-related issues by differentiating this study from previous studies, so we can better describe it, such as how telemedicine use is affected by *trust*, *privacy concern*, *attitude toward using*, *perceived usefulness*, *perceived ease of use*, and *intention to use*.

Theoretical Background and Hypothesis Development

Although the use of TAM has proven the user's acceptance and adoption of the common advantages that telemedicine has, the tendency of users in the transition period of medical consultations from offline to online, then identifying factors that affect user acceptance and the adoption of telemedicine is significant (Li, 2020). Therefore, this study uses the TAM model with the addition of several external factors, such as privacy concerns and trust, as shown below:

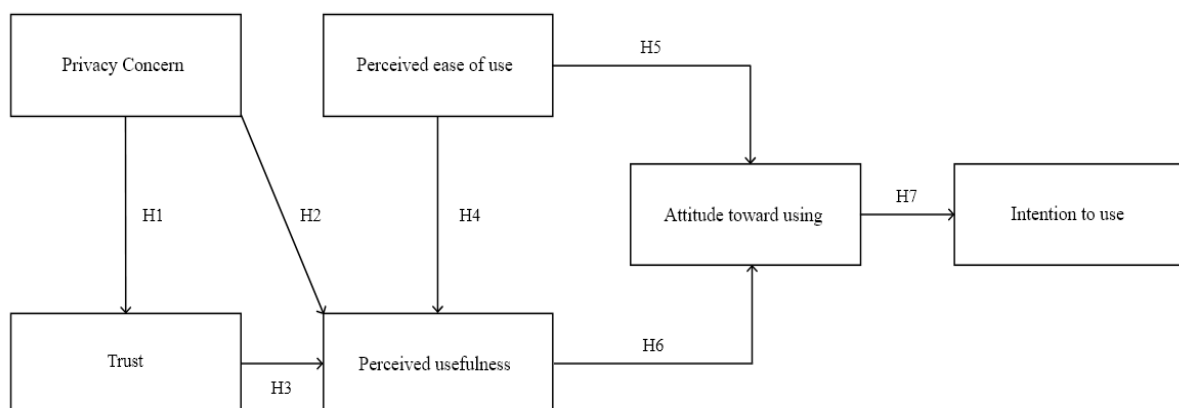


Figure 1. Theoretical Framework

Technology Acceptance Model (TAM)

In 1989, a Technology Acceptance Model (TAM) method was introduced by Fred Davis; TAM determines the causal relationship between system features, perceived benefits, ease of use, attitudes towards use, and actual user behavior. Overall, TAM provides an informative representation of the mechanisms by which design choices affect user acceptance and should therefore assist in the applied context for forecasting and evaluating user acceptance of information technology. TAM places the attitude factor of each user behavior as two variables, namely usefulness and ease of use.

Privacy Concern

Privacy concern can be interpreted as a person's authority to choose freely what and to what extent their personal information will be exposed to others. This is also a driving factor that hinders the use of telemedicine services through mobile platforms and hinders the trust of service providers (Li, 2020). A study says that privacy concerns by patients have a significant negative impact on telemedicine providers. Telemedicine application users may believe that privacy and security are less critical if telemedicine system service providers provide superior healthcare (Archer et al., 2021); (Dhagarra et al., 2020). Based on the definition, here are the hypotheses put forward:

- H1:** Privacy concerns negatively affected telemedicine app service trust during the COVID-19 pandemic.
- H2:** Privacy concerns negatively affect the perceived usefulness of telemedicine application services during the COVID-19 pandemic.

Trust

Trust demonstrates user perceptions of information technology service trust and has been a significant factor influencing the intention to use in receiving and using the service (Guo et al., 2016); (Li, 2020). The existence of risks and uncertainties with the ability to use the application requires trust. A trust can also be defined as a party's willingness to be vulnerable or take risks with the other party's actions based on the expectation that the other party will perform the actions that the user needs, regardless of whether the user can monitor or control the other party (Beldad & Hegner, 2018). The study examined the level of trust that is important in reducing uncertainty when people use telemedicine services (Akter et al., 2013). Trust also pushes Perceived Usefulness to a higher level in telemedicine services. Based on this definition, the target trust of the user is not the application but the application's developer (Beldad & Hegner, 2018). Through the study, the proposed hypothesis:

- H3:** Trust positively affected the Perceived Usefulness of telemedicine app services during the COVID-19 pandemic.

Perceived Ease of Use

Perceived Ease of Use is when a potential user believes that a particular application is valid and that the system is easy to use. The performance benefits of using it outweigh the effort of using the system. An information system can help someone's work if it is easy to use. Perceived ease of use can also be defined as the extent to which people believe in using an information system or application without effort (Qi et al., 2021). The application's ease of use is predicted to increase the user's ability. The study by Jeon & Park, and Cho shows the effect of Perceived Ease of Use on telemedicine applications and Perceived Usefulness (El-Amrawy & Nounou, 2015); (Cho, 2016). Additional studies examine the effect of Perceived Ease of Use on Perceived Usefulness which affects

the decision to use telemedicine applications (Palos-Sanchez et al., 2021); (Palos-Sanchez et al., 2021). Therefore, the proposed hypothesis is as follows:

H4: Perceived Ease of Use positively affects the Perceived Usefulness of telemedicine application services during the COVID-19 pandemic.

H5: Perceived Ease of Used positively affects Attitudes toward using telemedicine application services during the COVID-19 pandemic.

Perceived Ease of Use

Perceived Ease of Use is when a potential user believes that a particular application is practical and that the system is easy to use. The performance benefits of its use outweigh the efforts to use that system. An information system can help a person's work if it is easy to use. Perceived ease of use can also be defined as the extent to which believers use an information system or application without effort (Qi et al., 2021). The ease of using the application is predicted to increase users' ability. The study by Jeon & Park and Cho shows the influence of perceived ease of use on telemedicine applications and their influence on perceived usefulness (Jeon & Park, 2015), (Cho, 2016). Another study by Palos-Sanchez et al. and Li examined the influence of perceived ease of use on perceived usefulness that influences the decision to use telemedicine applications (Palos-Sanchez et al., 2021);. Therefore, the hypotheses proposed are:

H4: Perceived Ease of Use positively affects the Perceived Usefulness of telemedicine application services during the COVID-19 pandemic.

H5: Perceived Ease of Used positively affects attitudes toward telemedicine application services during the COVID-19 pandemic.

Perceived Usefulness

Perceived usefulness plays a significant role in explaining one's habits toward the use of technology (Bettiga et al., 2020). This shows how much people tend to use or not use the app to the extent that they believe it will help them do their job better (Bokolo, 2021). The study researched individual Perceived Usefulness, which positively influences attitudes toward using MMT (Mobile Medical Treatment) services (Bokolo, 2021). This was also revealed who found a positive influence of Perceived Usefulness on the attitude toward using the mHealth application (Palos-Sanchez et al., 2021). Perceived usefulness is defined as far away as the patient knows telemedicine technology information technology that can provide convenience to health monitoring (Qi et al., 2021). Therefore, the hypotheses proposed are:

H6: Perceived usefulness positively affects attitude toward using telemedicine applications during the COVID-19 pandemic.

Attitude Toward Using

According to the Theory of Reasoned Action (TRA) and Technology Acceptance Model or TAM, attitude toward using is the actual behavior of an individual toward a particular action determined by his Behavioral Intention or BI. Refers to a measure of the strength of his willingness to try and exert effort when performing certain behaviors or activities. Attitude toward using refers to the level of profitability or not of the behavior or effort to use a particular information technology (Pan et al., 2019). The study by Davis and Li considers that the intention to use the service reflects the acceptance and adoption of technological applications allegedly influenced by the attitude toward using the relevant service. Based on the study, the hypotheses proposed are:

H7: Attitude toward using positively affects the intention to use telemedicine applications during the COVID-19 pandemic.

Intention to Use

Intention to Use is generally used to measure user intent by using information technology as a function in the future (Bokolo, 2021). Consistent with previous studies, this study also considers that the intention to use a service reflects the acceptance and adoption of telemedicine applications (Li, 2020). Then further data analysis can help in generalizing end-user traits and usage patterns and identifying end-user needs in describing the relationship between intention to use and actual use (Kim et al., 2015).

Purpose of This Study

The purpose of this study is to find out how the user's points of view on using telemedicine services during the COVID-19 pandemic in Indonesia and what factors affect the acceptance of telemedicine service users during the COVID-19 pandemic based on the Technology Acceptance Model (TAM) with privacy concerns and trust for observation of the relationship with factors influencing people's tendency to use telemedicine. The benefits of this research are to enhance understanding of user perspectives on the use of telemedicine services during the COVID-19 pandemic in Indonesia. It is also beneficial for identifying the factors that influence user acceptance of telemedicine services during the COVID-19 pandemic.

METHOD

Previous studies evaluated individuals' experiences using mHealth applications with various external factors (Mahmood et al., 2019). Thus, the study adopts a quantitative approach. Hypothesis testing method using online questionnaires. This research hypothesis was developed based on the technology acceptance model (TAM). An online survey was conducted with a questionnaire filling platform; this survey consisted of 35 questions using a Likert interval scale of 1-5 with a total of 570 respondents.

Instrument Development

Research instruments are tools used to observe each variable under study. These research instruments are adopted from previous studies on telemedicine applications and technologies in the health sector. The questionnaire was made with as many as 35 questions, including the screening questions, respondent profile, and questions related to the use of telemedicine. The questionnaire was translated from English into Indonesian. The questionnaire is divided into three parts, the first is a respondent screening question to determine the suitability of the sample criteria with the research conducted, and the second part contains seven questions related to the respondent's profile and questions related to the use of telemedicine. The third part contains 26 questions consisting of Privacy Concern (n=4), Trust (n=4), Perceived Ease Of Use (n=6), Perceived usefulness (n=6), Attitude Toward Using (n=3), and Intention to Use (n=3). Question items are tailored to the needs and suitability of the research. All question items except profile questions are measured using a 5-point Likert scale with a range of 1 strongly disagree and five strongly agree.

Table 1. Distribution of Construct Items in Question Items

Constructs	Definition	Item	No. Item
Trust	User perceptions of the trust of telemedicine services are the main factors influencing the intention to use in receiving and using health services.	a. The services of this telemedicine provider are reliable	1
		b. Services from this telemedicine provider can provide reliable information	2
		c. Telemedicine service keeps its promise and commitment	3
		d. This telemedicine service can meet my expectations (Li, 2020)	4
Privacy Concern	The authority of a person to freely choose what and to what extent their personal information will be shown to others.	a. Telemedicine will make me lose control of my privacy	5
		b. Using telemedicine services will not cause privacy problems	6
		c. Registering and using telemedicine services will cause a loss of privacy for me because my personal information can be used without my knowledge	7
		d. Other people may take control of my information if I use the telemedicine services	8
Perceived Ease of Use	Users believe that telemedicine is valuable, then at the same time, the application system is easy to use, and the performance benefits of using it outweigh the effort of using the application.	a. Telemedicine apps can make it easier to interact with healthcare providers	9
		b. Telemedicine apps can make it easier to get health services	10
		c. Telemedicine apps can make it easier to remember how to get health services	11
		d. Telemedicine apps can be learned easily	12
		e. Telemedicine apps can minimize the effort of getting health services	13
		f. Telemedicine application is easy to use (Qi et al., 2021)	14
Perceived Usefulness	As far as users know, telemedicine is an information technology that can provide convenience to health monitoring.	a. Using a telemedicine app makes consulting a doctor easier.	15
		b. Using the services of a telemedicine app makes it possible to understand the disease and what treatment is needed more quickly.	16
		c. Using the telemedicine app gives access to complete communication with doctors.	17
		d. Telemedicine apps make it possible to discover how to prevent and treat disease.	18
		e. Using telemedicine apps makes it possible to make better treatment decisions.	19
		f. It is easy to get information regarding telemedicine. (Qi et al., 2021)	20
Attitude Toward Using	The actual behavior of the user toward specific actions, determined by Behavioral Intention, refers to the level of benefits or not the behavior or efforts made in	a. Using a <i>telemedicine</i> service would be a good idea	21
		b. Using telemedicine services is a wise move	22
		c. I like the services that exist in the telemedicine application. (Li, 2020)	23

Constructs	Definition	Item	No. Item
	the use of telemedicine technology.		
Intention to Use	Measurement of users' intention to use telemedicine as a function of the future.	a. I intend to use telemedicine services in the future	24
		b. I believe I will use telemedicine services in the future	25
		c. I plan to use telemedicine services in the future (Li, 2020)	26

Sample and Data Collection

Population refers to the entire group of people, events, or things of interest that the researcher wants to investigate (Sekaran & Bougie, 2016). The population in this study were people who had used telemedicine application services during the COVID-19 pandemic in Indonesia. Data collection will be carried out from May-December 2022. The questionnaire responses received were 570 respondents with 406 valid questionnaires and 164 invalid questionnaires due to the first two things, which are respondents needing experience in using telemedicine applications and needing more understanding related to the intent of the questions.

Data Analysis

Data analysis and hypothesis testing using a structural equation model (SEM) with variants allow statistical testing to measure the relationship of dependence between latent variables (dependents) and variable indicators of the research model by directly measuring the observed variables. SEM is used with partial least squares (PLS). PLS-SEM is used if the research's purpose is exploratory or the development of an existing structural theory (Hair Jr et al., 2021). The application used for data analysis and hypothesis testing is SmartPLS 3.

RESULTS AND DISCUSSION

Participants Profile

All respondents came from 5 provinces on the island of Java, namely DKI Jakarta, Banten, West Java, Central Java, and East Java. The selection of Java Island was carried out because Java is the island with the highest population in Indonesia; economic equality and digital literacy are also evenly distributed and adequate. The sample collected consisted of men at 51% and women at 49%. The age range of respondents was 16-25 years old 41%, 26-35 years old 42%, 36-45 years old 13%, and over 45 years old as much as 4%. Most respondents had the last education Diploma/Bachelor's Degree with a percentage of 63%, followed by Master graduates at 18% and high school at 16%. Most respondents to this study worked as private employees with a percentage of 49%, 22% as students, 12% as ASN, 14% as entrepreneurs, and 3% as housewives. Furthermore, the average monthly expenses of respondents to this study were IDR 5-10 million, with the most significant percentage of 46%, below IDR 5 million by 39%, and above IDR 10 million by 15%. The following is a socio-demographic table of respondents to this study.

Table 2. Socio-Demographic (n=406)

		Frequency	Percentage (%)
Gender	Male	206	51%
	Female	200	49%
Age	16-25	166	41%
	26-35	171	42%
	36-45	52	13%
	>45	17	4%
	Senior High School	66	41%
Education	Diploma/Bachelor Degree	257	42%
	Master Degree	73	13%
	Doctoral Degree	10	4%
	Student	90	22%
Job	Civil Servant	47	12%
	Employee	199	49%
	Entrepreneur	57	14%
	Housewife	13	3%
Monthly Expenses	< 5.000.000	158	39%
	5.000.000 - 10.000.000	188	46%
	> 10.000.000	60	15%

Research respondents habitually used telemedicine applications during the COVID-19 pandemic that hit Indonesia. Among these respondents, 94.7% reported using telemedicine services during the COVID-19 pandemic. The most widely used telemedicine application, with 59.7% of respondents, chose Halodoc, followed by Alodokter at 21.8%, KlikDokter at 12.9%, and other telemedicine services at a percentage below 5%.

Measurement Model

The results of the PLS-SEM are presented in Table 3, where each variable with Cronbach alpha has a value above 0.7 except for the attitude toward using a variable that has a value of 0.616 but still meets the criteria with a value above 0.5 and intention to use with a value of 0.662. Cronbach alpha values range from 0.616 to 0.942. The composite reliability of each variable has a value greater than 0.7, as recommended, and a range from 0.796 to 0.958. In Cronbach alpha and composite reliability, a reliability measurement value ranges from 0 to 1, where values of 0.60 to 0.70 can still be accepted as the lower limit value (Hair et al., 2013). The average variance extracted (AVE) has a smaller value than Cronbach alpha and composite reliability, but values range from 0.526 to 0.851. For AVE, values equivalent to 0.5 or more are a rule of thumb and signify adequate convergence (Hair et al., 2013). Each variable in the AVE has a number above 0.5, as recommended. According to the rule of thumb, a suitable loading factor is the standard estimated loading value of 0.5 or higher and the outstanding value of 0.7 or higher (Hair et al., 2013). The loading factor in Table 3 shows numbers ranging from 0.700 to 0.934, so the results are as recommended.

Table 3. Factor Loading, Cronbach Alpha, Reliability, and Average Variance Extracted

Construct	Item	Factor Loading	Cronbach Alpha	CR	AVE
Trust	TR1	0.748	0.755	0.842	0.571
	TR2	0.7			
	TR3	0.802			
	TR4	0.77			
Privacy Concerns	PC1	0.934	0.942	0.958	0.851
	PC2	0.917			
	PC3	0.929			
	PC4	0.909			
Perceived Ease of Use	PEOU1	0.735	0.821	0.870	0.526
	PEOU2	0.726			
	PEOU3	0.743			
	PEOU4	0.718			
	PEOU5	0.719			
	PEOU6	0.711			
Perceived Usefulness	PU1	0.824	0.882	0.911	0.629
	PU2	0.768			
	PU3	0.813			
	PU4	0.771			
	PU5	0.797			
	PU6	0.785			
Attitude Toward Using	ATU1	0.796	0.616	0.796	0.565
	ATU2	0.711			
	ATU3	0.746			
Intention to Use	ITU1	0.78	0.662	0.816	0.597
	ITU2	0.742			
	ITU3	0.794			

AVE: Average variance extracted

CR: Composite Reliability

Discriminant validity measures the degree to which a construct differs from another. Thus, high discriminant validity provides evidence that a construct captures phenomena other constructs do not have (Hair et al., 2013). Discriminant validity is derived from the square root value of the average variance extracted (AVE) for each construct and the correlation between constructs in the research model (Li, 2020). The overall AVE square root value is more than 0.7; this value is the highest in several relationships between constructs (Hair Jr et al., 2021)—the following table discriminant validity in this study.

Table 4. Discriminant Validity

	ATU	ITU	PC	PEOU	PU	TR
ATU	0.752					
ITU	0.534	0.772				
PC	-0.200	-0.192	0.922			
PEOU	0.515	0.476	-0.178	0.726		
PU	0.423	0.456	-0.141	0.389	0.793	
TR	0.451	0.458	-0.207	0.446	0.355	0.756

Structural Model

It is further developed using structural methods to ensure an explanatory relationship through tests using the PLS-SEM application (Hair Jr et al., 2021). Results from the PLS-SEM analysis in (Figure 2 and Table 5) show that users' Perceived Ease of Use, Privacy Concern, and Trust accounted for 45.8% of their Perceive Use variance in telemedicine service usage ($R^2 = 0.458$); 31.8% Attitude Toward Use variance towards telemedicine service usage described by Perceive Ease of Use and Perceived Usefulness ($R^2 = 0.318$); 26.6% Trust variance to telemedicine service usage is described by Privacy Concern ($R^2 = 0.266$); finally, the Attitude Toward Using of users describes 31.7% of the variance in a user's Intention to Use on telemedicine services ($R^2 = 0.317$).

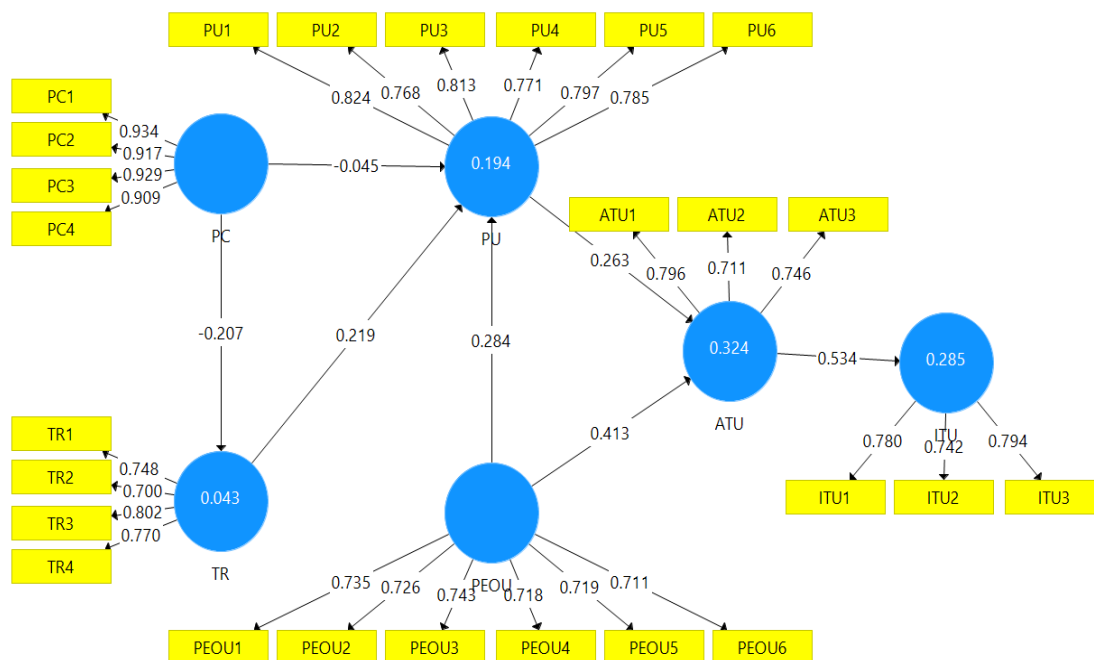


Figure 2. PLS Results and Structural Model

Based on the data processing results using PLS-SEM, it was found that the H1 hypothesis that focuses on the relationship between privacy concerns and trust in telemedicine applications during the COVID-19 pandemic was accepted with a value of $p=0$, $t=4.362$. The data processing results also found that the H2 hypothesis was rejected. This hypothesis focuses on the relationship between privacy concerns and perceived usefulness in telemedicine applications during the COVID-19 pandemic, with a $p\text{-value}=0.173$, $t=1.363$. Another thing happened to H3, where this hypothesis was

accepted with a value of $p=0$, $t=4.387$ relationships between trust and perceived usefulness in telemedicine applications during the COVID-19 pandemic. The reference value for $p\text{-value} < 0.05$ and $t\text{-value} > 1.96$ (Hair et al., 2013).

In addition, the results of the study also found that respondents' perceived ease of use had a significant effect on respondents' perceived usefulness with $p=0$, $t = 4.763$, and respondents' attitude toward using telemedicine applications during the COVID-19 pandemic with $p\text{-value}=0$, $t=7.758$; this supports the H4 and H5 hypotheses. Respondents' perceived usefulness had a significant influence on respondents' attitudes toward using telemedicine applications during the COVID-19 pandemic with $p\text{-value}=0$, $t=5.634$; this supports the H6 hypothesis. The respondent's attitude toward using had a significant influence on respondents' intention to use telemedicine applications during the COVID-19 pandemic with $p\text{-value}=0$, $t=10.595$; this supports the H7 hypothesis. The following is a table of the results of testing the hypothesis of this study.

Table 5. Hypothesis Testing Results

Hypothesis	Path	Path Coefficient	t-Statistic	p-Value	Judgment
H1	PC -> TR	-0.207	4.362	0	Accepted
H2	PC -> PU	-0.045	1.363	0.173	Rejected
H3	TR -> PU	0.219	4.387	0	Accepted
H4	PEOU -> PU	0.284	4.763	0	Accepted
H5	PEOU -> ATU	0.413	7.758	0	Accepted
H6	PU -> ATU	0.263	5.634	0	Accepted
H7	ATU -> ITU	0.34	10.595	0	Accepted

PC : Privacy Concern

TR : Trust

PU : Perceived Usefulness

PEOU : Perceived Ease of Use

ATU : Attitude Toward Using

ITU : Intention to Use

Telemedicine services have become popular, especially in the health sector, because of the convenience offered, especially during the COVID-19 pandemic (Cheng et al., 2021). This certainly makes an idea that arises in everyone's mind related to the adoption of telemedicine use, especially in Indonesia. Telemedicine services certainly make people ask how to get renewable health services. They can change people's behavior to do medical consultations online. With that, this research studies how certain factors, such as privacy concerns and trust, affect the acceptance of telemedicine services. From the data obtained, privacy concerns do not impact adoption and use. However, trust has an impact on the use of telemedicine in Indonesia. In addition, the limitations of this research must also be further studied as a more mature consideration.

CONCLUSION

This assessment proves that there is no relationship between privacy concerns about the adoption of use. However, trust has a relationship with the adoption of telemedicine in Indonesia due to the behavior of people who attach importance to trust in telemedicine brands during the

COVID-19 pandemic. During the pandemic, the public only used telemedicine services because the government required them to get health services such as consultations and drug acceptance through telemedicine services. This is a significant concern related to the use of telemedicine used during the need for health services during the COVID-19 pandemic. Most people use telemedicine services to review anxiety factors related to privacy and trust in a telemedicine brand as a reference in the use of telemedicine in Indonesia. However, telemedicine in the future may have more impact to be used so that young people can get health services from home.

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