ACCEPTANCE OF SUSTAINED UTILIZATION BEHAVIOR OF TELEMEDICINE IN THE POST-COVID-19 ERA

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Abstract. The coronavirus disease 2019 (COVID-19) is spreading around the world, and Taiwan is no exception. Faced with the outbreak of the epidemic, the Taiwan government immediately ordered a policy of banning indoor dining. The main purpose of the present research is to extend a Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM) theoretical framework to explore acceptance of sustained utilization behavior of telemedicine in the post-COVID-19 era. An online survey was administered in Taiwan during the COVID-19 pandemic from February 22 to April 6, 2022, and a total of 359 responses were collected by convenience sampling method, and partial least square (PLS) analysis was deployed to examine the hypothesized relationships. The results showed that the sustained utilization behavior of telemedicine had independent significant associations with behavioral intentions; the behavioral intention had independent significant associations with subjective norms, attitudes, perceived behavioral control, perceived usefulness, and perceived ease of use. Moreover, perceived usefulness had independent significant associations with perceived ease of use. This study provides theoretical and practical insights into the psychological and behavioral processes of public use of telemedicine during the post-COVID-19 pandemic, thereby helping policymakers better understand the important developmental implications of telemedicine.
Keywords: *COVID-19, Theory of Planned Behavior, Technology Acceptance Model, sustained utilization behavior of telemedicine*

Background

The global pandemic caused by the coronavirus disease 2019 (COVID-19) has so far had a significant impact on human life and health. Due to the rapid spread of the epidemic, the governments around the world are trying to limit the community spread of the disease, as well as the economic impact, and Taiwan is no exception. While simple measures such as social distancing, wearing masks and increasing access to testing have been implemented to seek a return to normal daily activities, there is a clear need for innovative tools to intercept the spread of COVID-19, improve efficiency and quality of care, and reduce pressure on healthcare systems worldwide. Following the outbreak of COVID-19 in Taiwan in May 2021, the government asked hospitals to set aside enough capacity to treat COVID-19 patients. Fewer patients actually go to hospitals because most people are afraid to go out for fear of infection. However, the demand for disease remains, and Taiwanese used to see doctors 14 to 15 times a year on average, two to three times as

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many as people in European countries (Wu et al., 2010). This has prompted governments and hospitals to start promoting telemedicine. Taiwan's medical law limits telemedicine to mountainous areas, outlying islands and remote areas. However, as COVID-19 is highly contagious, the government has relaxed restrictions, so individuals who are quarantined at home can use telemedicine, and their family members can pay and receive medicine at the hospital after the visit, which can not only effectively reduce the psychological pressure of patients seeking medical treatment during the epidemic, but also reduce the risk of exposure. The health authorities provide the list of telemedicine institutions and registration information of all counties and cities immediately, so that people in need can further understand the medical procedures and the latest news of telemedicine (Huang et al., 2021). In addition, the new law provides that national Health Insurance can be used to support telemedicine services. Telemedicine involves the use of technology to deliver clinical care remotely. During the delivery of telemedicine care, the physician and the patient are physically separated. Telemedicine, as defined in this study, refers to the practice of medical treatment at a distance in which patient data, documents and other information are transmitted through an information communication system to provide intervention, diagnosis, medical decisions and subsequent treatment recommendations (Kamal et al., 2020). The main purpose of the present research is to extend a Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM) theoretical framework to explore acceptance of sustained utilization behavior of telemedicine in the post-COVID-19 era.

As individual and technical factors are generally considered to be the two most critical factors, some classical theories or theoretical models are proposed to examine the utilization and implementation of technology from a certain Angle. Examples are Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM) (Lee, 2009; Xie et al., 2017; Beglaryan et al., 2017). In TPB, some factors at the individual level have been proved to be potential factors affecting the final behavior. This shows that a person's final behavior is driven by behavioral intention, which is a function of attitude, subjective norms and perceived behavioral control (Ajzen, 1991). Attitude refers to a person’s positive or negative feelings about a particular behavior. Subjective norm is a kind of social factor that refers to whether social pressure influences individuals to carry out a specific behavior. Perceived behavior control refers to the possible interference or obstacle perceived by the individual according to their past experience when carrying out a specific behavior (Armitage and Conner, 2001). TAM model is also one of the most cited typical theoretical models in the field of technology adoption, mainly including technological level factors (Mathieson, 1991; Beglaryan et al., 2017). Perceived usefulness and perceived ease of use are two critical aspects, according to TAM, referring to the attributes of technology that influence technology adoption or implementation. Perceived usefulness refers to the degree to which a technology is perceived to improve performance, while perceived ease of use reflects the degree to which the technology is easy to use (Venkatesh and Davis, 2000).

On the basis of TPB or TAM, several studies have shown their explanatory power in explaining specific behaviors of health professionals and are often applied in the medical field (Wills et al., 2008; Holden and Karsh, 2010; Hsieh, 2015). The correlation between final technology utilization behavior and individual (or technological) factors is verified, and the importance of potential influencing factors in these two levels is highlighted (Yousafzai, 2012). In the face of this new virus, technology has changed the way we seek care, leading to an innovative approach that is worth exploring. Therefore, the continued

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use of telemedicine in the post-pandemic era is an important factor, which also involves major policy developments in the country. Whether telemedicine can enable patients to truly express the chief complaint and meet the same needs as the actual presence. As we all know, smart healthcare treatment is the trend of the whole world. Telemedicine has adapted traditional medical practices to enable patients to access medical services through telecommunications. Telemedicine thus creates a new relationship between small and large hospitals and between patients and hospitals. This is particularly beneficial for patients living in rural areas where health systems are less developed than in cities. However, telemedicine needs to balance the interests of all parties in order to promote the sustainable development of telemedicine in the future. Therefore, it is appropriate to improve the promotion of telemedicine through the analysis of this study. Whether telemedicine is worth developing in this field is worth further understanding in the present era. Consequently, a multivariate data assessment and process is established to achieve the study objectives.

Theoretical model and hypotheses

To fully investigate the extent of sustained utilization behavior of telemedicine in the post-COVID-19 era, the theoretical model of this study was inspired by the integration of TPB and TAM and takes into account seven factors, namely attitude, subjective norm, perceived behavioral control, perceived usefulness, perceived ease of use, behavioral intention, and final utilization behavior. The proposed theoretical model is shown in *Figure 1*.

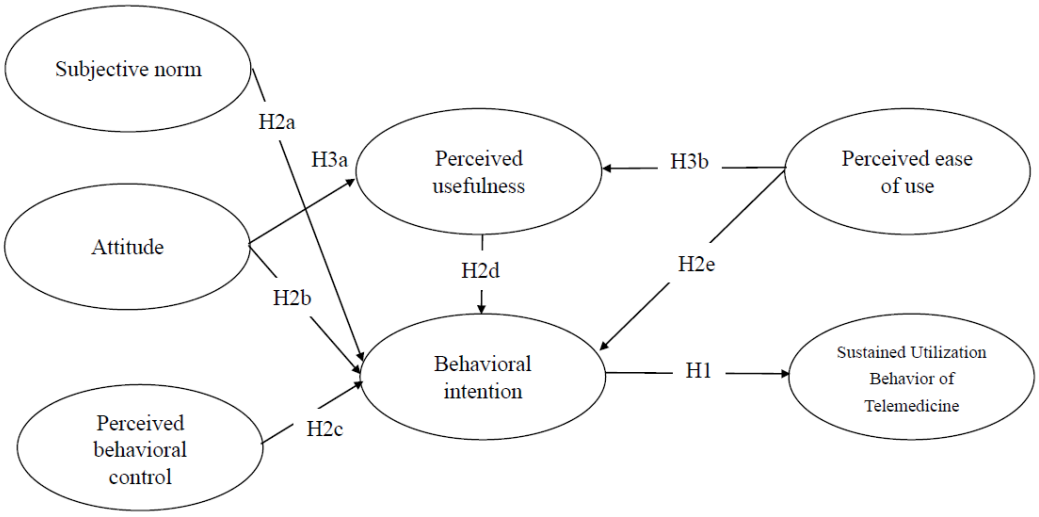

Figure 1. *Research framework*

According to the literature reviewed previously, the corresponding hypothesis is as follows:

H1: There is a positive relationship between behavioral intention and sustained utilization behavior of telemedicine.

H2a: There is a positive relationship between subjective norm and behavioral intention.

H2b: There is a positive relationship between attitude and behavioral intention.

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H2c: There is a positive relationship between perceived behavioral control and behavioral intention.

H2d: There is a positive relationship between perceived usefulness and behavioral intention.

H2e: There is a positive relationship between perceived ease of use and behavioral intention.

H3a: There is a positive relationship between attitude and perceived usefulness.

H3b: There is a positive relationship between perceived ease of use and perceived usefulness.

Methodology

Sampling and data collection

The hypothesis model was tested by quantitative investigation design. In the context of the current COVID-19 pandemic, it was appropriate to use online questionnaires and surveys to solicit responses in order to limit face-to-face contact and comply with prevailing social distance requirements. This prompted us to collect online data using SurveyCake, a trustworthy and world-class cloud-based survey service to create professional online customer surveys. This study focuses on the use of telemedicine to consult physicians in order to reduce contact with the public in the context of the COVID-19 pandemic. The online survey of our study was open to the public in Taiwan from February 22 to April 6, 2022. A total of 359 responses were collected by convenience sampling method. Participants would be given a brief statement (on a page before the survey begins) about the purpose of the study, the method of data collection, and information about the legal requirements for data protection. On the last page, the researchers attached a short statement stating that "clicking the final 'Submit' button signifies that the respondent agrees to participate in the study." The data analysis for this study was limited to participants over 20 years of age who had telemedicine experience and whose care-seeking behavior had been affected by COVID-19. Online surveys were typically completed in less than 10 minutes. Due to the observational nature of the study, the present study did not require Institutional Review Board approval of the local Ethics Committee. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964, as revised in 2013. Nonetheless, the participation was fully informed about the study on a voluntary basis and the survey responses were anonymous.

Measures

The survey instrument comprised three sections and was based on items drawn from the literature. The first section included a description of the research. The second section of the questionnaire collected demographics such as gender, age, marriage, education, and occupation. The third consisted of five constructs related to the hypotheses. The attitude, subjective norm and perceived behavioral control concept contained in TPB theory were adapted from prior research (Taylor and Todd, 1995). In particular, four items for the attitude, three items for the subjective norm, and three items for the perceived behavioral control were used. The perceived usefulness, perceived ease of use and behavioral intention concept contained in TAM theory were adapted from prior research

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(Davis et al., 1989; Moon and Kim, 2001). In particular, four items for the perceived usefulness, three items for the perceived ease of use, and three items for the behavioral intention were used. Respondents were asked to identify the underlying psychological factors and levels of acceptance that they believed would enable continued use of telemedicine during the post-COVID-19 pandemic in order to predict and understand public behaviour. Three items used to measure sustained utilization behavior of telemedicine were adapted from a study by Hoque and Sorwar (2017). Respondents were asked to indicate their practical behaviour towards the continued use of telemedicine. All items were assessed on a seven-point Likert-type scale (from 1 = strongly disagree to 7 = strongly agree). The survey questionnaire containing these measures was pretested with experts and academics. We used four guidelines in the process: preparation, pretesting, revision, and documentation. The pre-test of this questionnaire was designed to identify concepts or structures specific to a language or culture and sent to different online groups and platforms for healthcare professionals. Based on the results of the pre-test, the questionnaire was revised to avoid conceptual bias and to achieve constructive equivalence representing the same underlying concept in different languages.

Analysis

The collected data were analyzed by SPSS 25 statistical software, and we used partial least square (PLS) technique, supported by SmartPLS 2.0 M3 software (Ringle et al., 2005), to validate the proposed model in two stages: measurement model and structural model (Hair et al., 2013).

Results

As shown in *Table 1*, most respondents in the sample were male (54.6%, n = 196), between the ages of 30–39 (39.3%, n = 141), and were married (68.5%, n = 246). Most respondents had a college education (54.0%, n = 194) and were employed in the private enterprise (43.2%, n = 155).

Measurement model evaluation

As suggested by Hair et al. (2013), this study utilized individual questions factor loading, composite reliability (CR), average variance extraction (AVE), and Cronbach's α to assess reliability. We compiled the results in *Table 2*. First, according to Hair et al. (2013), the factor loading must be higher than the standard 0.75. The results of the analysis showed that the factor loading of each question for attitude, subjective norm, perceived behavioral control, perceived usefulness, behavioral intention, perceived ease of use, and sustained utilization behavior of telemedicine were higher than the standard 0.75. In addition, the CR and Cronbach's α should be higher than the standard 0.7 and the AVE should be higher than the standard 0.5 (Hair et al., 2013). The results showed that the CR and Cronbach's α were higher than 0.9 and the AVE was higher than 0.7, all of which were above the standard, indicating that the constructs and measurement variables of this study had sufficient reliability.

Furthermore, the validity was assessed by convergent validity and discriminant validity, and the results were shown in *Table 2*. The AVE was used to interpret and measure the extent of potential variables, as suggested by Fornell and Larcker (1981). The analysis of this study showed that the AVE was higher than 0.7 for all components.

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The criterion higher than 0.5 indicates adequate convergent validity. The discriminant validity was attained if the square root of AVE for each construct is higher than the correlations between the construct and the other constructs (Fornell and Larcker, 1981). As shown in *Table 3*, the square root of AVE for each construct was between 0.85 - 0.95, which was higher than the correlation coefficient between the constructs. Then it could be inferred that the theoretical model had sufficient discriminant validity. After the above, the study had sufficient reliability and validity to proceed to the next step of structural model analysis.

Table 1. *Demographic information of respondents*

Demographic information	Categories	Cases	Percentage
Gender	Female	163	45.4%
	Male	196	54.6%
Age	20~29	74	20.6%
	30~39	141	39.3%
	40~49	82	22.8%
	50~59	43	12.0%
	≧60	22	5.3%
Marriage	Married	246	68.5%
	Unmarried	99	27.6%
	Other (including divorced, widowed, separated, etc.)	14	3.9%
Education	Master or above	52	14.5%
	College	194	54.0%
	Junior college	63	17.5%
	High School	39	10.9%
	Junior high school or below	11	3.1%
Occupation	Public Sector	62	17.3%
	Private Enterprise	155	43.2%
	Freelance	36	10.0%
	Self-employment	47	13.1%
	Home Management	20	5.8%
	Student	39	10.6%

Structural model evaluation

The structural model evaluated the path coefficients between constructs based on directionality and significant correlation. A bootstrapping procedure was used to test the statistical significance of each path coefficient. The results of the Smart-PLS part coefficients and significance values are shown in *Figure 2*. *Table 4* shows the summary of our hypotheses testing. As hypothesized, all of the proposed hypotheses were supported. Sustained utilization behavior of telemedicine was significantly influenced by behavioral intention (β=0.652, $p < 0.001$), providing support for H1. Behavioral intention was significantly influenced by subjective norm (β=0.439, $p < 0.01$), attitude (β=0.541, $p < 0.05$), perceived behavioral control (β=0.339, $p < 0.001$), perceived usefulness (β=0.371, $p < 0.01$), and perceived ease of use (β=0.720, $p < 0.01$), providing support for H2a, H2b, H2c, H2d and H2e. The relationship between attitude and perceived usefulness in H3a is not valid. Perceived usefulness was significantly influenced by perceived ease of use (β=0.451, $p < 0.01$), providing support for H3b. Overall, the model explained about 72.6%, 63.1%, and 55.3% of the determined variance in the sustained utilization behavior of telemedicine, perceived usefulness and behavioral intention, respectively.

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Table 2. *Reliability and validity analysis*

Constructs/Items	Factor Loading	AVE	CR	Cronbach α
Attitude		0.931	0.933	0.907
The continued use of telemedicine would be reassuring.	0.826			
The continued use of telemedicine would be safe.	0.769			
The continued use of telemedicine would be pleasant.	0.903			
The continued use of telemedicine would be worthwhile.	0.791			
Subjective norm		0.759	0.940	0.913
My friends think I should keep using telemedicine.	0.772			
My families think I should keep using telemedicine.	0.841			
People who are important to me think that I should keep using telemedicine.	0.889			
Perceived behavioral control		0.903	0.916	0.935
Keep using telemedicine is entirely within my control.	0.962			
I have the knowledge and ability to keep using telemedicine.	0.973			
I am able to skillfully use telemedicine on an ongoing basis.	0.910			
Perceived usefulness		0.924	0.937	0.924
Telemedicine is useful to me.	0.788			
Telemedicine allows me to conveniently communicate with others.	0.821			
Telemedicine improves my efficiency of communication with others.	0.897			
Telemedicine allows me to more easily communicate with others.	0.923			
Behavioral intention		0.892	0.923	0.906
I will frequently use telemedicine.	0.951			
I will recommend telemedicine to others.	0.852			
I will continue using telemedicine in the future.	0.896			
Perceived ease of use		0.774	0.919	0.937
Overall, telemedicine is easy to use.	0.943			
Learning to operate telemedicine is easy for me.	0.912			
It is easy for me to become skillful at using telemedicine.	0.884			
Sustained Utilization Behavior of Telemedicine		0.932	0.954	0.941
Keep using telemedicine services is a pleasant experience.	0.972			
I have recently continued to use telemedicine in practice.	0.903			
I spend a lot of time using telemedicine on an ongoing basis.	0.875			

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Table 3. *Discriminant validity analysis*

Variables	1	2	3	4	5	6	7
1. Attitude	0.917						
2. Subjective norm	0.824	0.862					
3. Perceived behavioral control	0.796	0.805	0.913				
4. Perceived usefulness	0.801	0.789	0.843	0.881			
5. Behavioral intention	0.725	0.693	0.716	0.831	0.934		
6. Perceived ease of use	0.692	0.714	0.684	0.749	0.817	0.896	
7. Sustained Utilization Behavior of Telemedicine	0.744	0.769	0.790	0.763	0.652	0.805	0.908

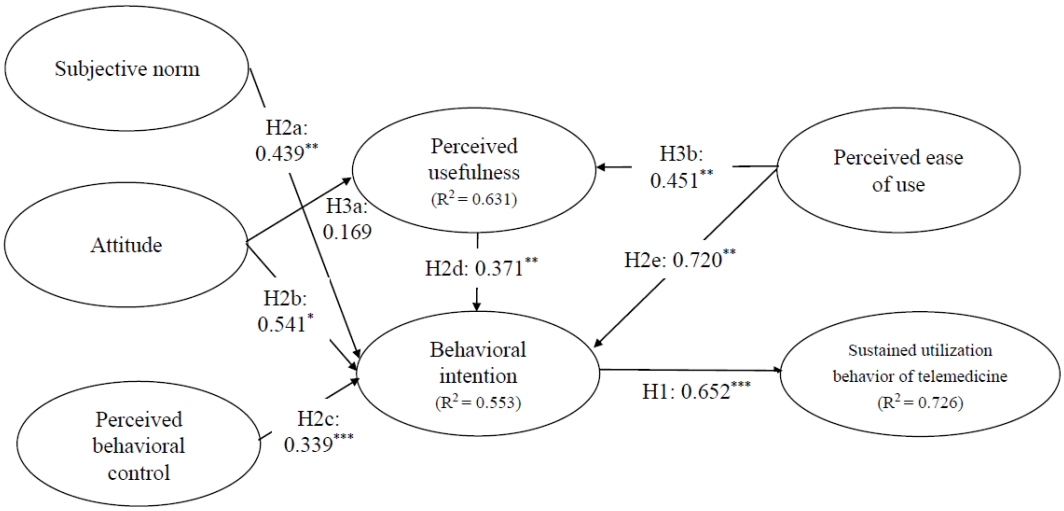

Figure 2. *Path Coefficient Analysis *p < 0.05, **p < 0.01, ***p < 0.001*

Table 4. *Research hypothesis validation*

Hypothesis	Path coefficient	t-value	Results
H1 Behavioral intention →Sustained utilization behavior of telemedicine	0.652***	6.24	Supported
H2a Subjective norm → Behavioral intention	0.439**	9.31	Supported
H2b Attitude → Behavioral intention	0.541*	7.21	Supported
H2c Perceived behavioral control → Behavioral intention	0.339***	5.96	Supported
H2d Perceived usefulness → Behavioral intention	0.371**	4.28	Supported
H2e Perceived ease of use → Behavioral intention	0.720**	5.67	Supported
H3a Attitude → Perceived usefulness	0.169	0.84	Not supported
H3b Perceived ease of use → Perceived usefulness	0.451**	3.46	Supported

*p < 0.05, **p < 0.01, ***p < 0.001

Discussion

In the global COVID-19 outbreak, after more than two years of prevention, Taiwan is also threatened by the epidemic, which has a significant impact on people's medical

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seeking behavior, and highlights the importance of telemedicine. As the virus is brought under control, the sustained utilization behavior of telemedicine has become an important issue. Therefore, our theoretical framework, based on TPB and TAM, focuses on the continuous applicability of telemedicine. It is worth noting that this study was conducted in a post-epidemic era in Taiwan, where the government and local residents learned lessons from the 2002 SARS outbreak and responded more quickly and effectively. Therefore, this study gathered the opinions of Taiwanese people in special situations and produced meaningful findings. According to the results of this empirical study, the sustained utilization behavior of telemedicine was positively correlated with behavioral intentions, suggesting that telemedicine plays an important role in times of epidemics and that its deployment can improve access to the entire health system and the quality of care delivered to remote, underserved, and poor communities. During the recent new COVID-19 pandemic in the US, telemedicine visits for urgent care increased by 683% between March and April 2020 (Mann et al., 2020). Given the increased patient burden on healthcare systems in the face of the COVID-19 pandemic, there is growing interest in shifting provider-patient contact from clinics to patients' homes in order to minimize unnecessary face-to-face contact and reduce the transmission of novel coronavirus (Rockwell and Gilroy, 2020). Represents the fact that this has been extended by social acceptance as an actual predictor of behavioral intentions for the use of telemedicine, and that intention constructs are direct and robust predictors of technology acceptance and use (Venkatesh and Bala, 2008).

This study also found that TPB theory and TAM theory are of great significance to behavioral intention. The results showed that the behavioral intention was positively correlated with subjective norms, attitudes, perceived behavioral control, perceived usefulness, perceived ease of use. In previous patient-based studies, factors of TPB theory have a significant impact on behavioral intention (Kamal et al., 2020; Tao et al., 2020). This also suggests that if the overall policy direction is towards technological solutions, it may encourage people to participate more in telemedicine, which means that having relevant knowledge, familiarity with technology, supportive facilities and enhanced self-capacity may enhance the behavioral intention to participate in telemedicine. Telemedicine are being widely adopted to treat COVID-19 patients because they provide treatment to patients without them having to explicitly visit a hospital. Most COVID-19 patients must self-isolate, so with the help of telemedicine, appropriate medical assistance can be provided. In other words, COVID-19 is creating a great deal of knowledge about the effectiveness of telemedicine in times of crisis, and according to the results of this study, attitudes to telemedicine, subjective norms, and perceived behavioral control are the most relevant variables to explain patients' intentions to use these services. A practical implication of this research is that communication strategies should focus on demonstrating the benefits of these technologies, initially through surrogate experiences, and then stimulating engagement with these services. The promotion of such participation is relevant to patients as well as family members or caregivers and health care providers. Absolutely, perceived ease of use is an important determinant of usefulness. Our study showed that increasing the perceived ease of use of telemedicine will increase its usefulness and thus its intent and continued use. All the more reason for governments to face up to the barriers to the use of telemedicine, which, despite its promise, still faces challenges. For example, barriers to the implementation of telemedicine, including resource-limited Settings, and differences in healthcare and health literacy among different populations, can lead to differences in perceptions and ease of use of

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telemedicine. Around the world, 43% of households do not have Internet access at home, and even within developed countries, there are some differences in Internet access and availability (Nouri et al., 2020). Also, many elderly patients and families may not have smartphones or computers. They may not have enough knowledge to successfully participate in telemedicine video access using these devices, and with regard to the knowledge gap with this technology, it is estimated that 32% of older adults will not be able to participate in telemedicine (Lopez et al., 2021; Brody et al., 2022).

This study has some limitations and provides opportunities for future research. First, we used an online questionnaire to collect data, so those who may have limited Internet access are not included in this sample. Second, our study did not extensively explore other factors associated with COVID-19 behavior, such as other factors that might influence the use of telemedicine. It is suggested that future research can expand the framework of this study to realize effective two-way interaction between public and government on new technology intervention. In addition, since this study occurred during a sudden and unstable pandemic, it may lack the depth of a longitudinal study. Third, this study believes that the use of telemedicine requires certain skills, so the study subjects are over 20 years old. Therefore, the distribution of children under 20 years of age or younger was not involved in this study, and it is recommended that future studies examine the use of telemedicine in more detail by age group to expand the applicability and accessibility of telemedicine. Furthermore, this study emphasizes the role of telemedicine through Internet access, but telemedicine can also be carried out by telephone, and worldwide telephone access is much better than the Internet. It is suggested that future research can also explore different modes of telemedicine. Finally, the possible relationship between perceived risks and actual risks over time should be taken into account, particularly the extent to which the epidemic has been contained over time. While telemedicine has been deployed since the onset of the COVID-19 pandemic to facilitate early diagnosis, while minimizing the risk of transmission and monitoring symptoms of healthcare providers, more investigations are needed to further optimize its potential benefits in fighting the COVID-19 pandemic.

Conclusions

During health crises and emergencies, the public needs to be ready to take precautions, as the novelty and unpredictability of outbreaks can largely overwhelm the capacity of health systems. The main purpose of the present study is to explore the acceptance of sustained utilization behavior of telemedicine in the post-COVID-19 era. Telemedicine has undoubtedly made a positive contribution to access to healthcare amid the challenges of healthcare delivery during the COVID-19 pandemic. However, the increasing popularity and continued use of telemedicine has led to discussion of its clinical value. Telemedicine is a powerful tool that can shorten the distance between patients and clinics and facilitate communication, and should be implemented continuously in the future to help patients who truly need it to provide informed medical care. This study hopes that future scholars will be able to extend the basic logic of this study to quantify the effectiveness of using remote therapy to treat diseases. The results of this study can provide information for governments on how to encourage participation and continued use of telemedicine and integrate telemedicine into future government health policy development, using health care organizations to promote the concept. This has helped raise awareness of the advantages of telemedicine and the public's willingness to embrace it.

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