

Telemedicine Adoption: An Empirical Review of Theoretical Model Usage

ABSTRACT

Telemedicine dramatically increased during the pandemic, primarily due to lockdowns. But most patients now have the option to visit doctor's offices again and their continued utilization of telemedicine is unknown. Therefore, it is important to determine the factors that impact a patient's decision to adopt telemedicine. The purpose of this paper is to review previous research that investigated the patient's adoption of telemedicine through a theoretical lens. Knowing what theoretical models were utilized in the past can help guide future research. Fifty-five studies were found that investigate the adoption of telemedicine from the patient's perspective. TAM and UTAUT were the most abundant theoretical models utilized. Both theoretical model's constructs were consistently significant across the studies identified, with only a few exceptions.

Keywords

Telemedicine adoption, telehealth, mhealth, e-Health

INTRODUCTION

The National Institute on Aging (NIA), one of the 27 institutes and centers which comprise the National Institute of Health (NIH) defines telehealth as a "service that uses video calling and other technologies to help you see your doctor or other health care provider from home instead of at a medical facility" in addition to providing health-education services and training (NIA, n.d.). The NIA describes telemedicine as a subset of telehealth, which provides for online health-professional visits outside of the medical facility (NIA, n.d.). We found many other similar terms with varying definitions and overlap that are used by various institutions, leading to a lot of confusion. Such terms include e-Health, mobile health (mHealth), teleconsultation, telecare, mobile health services, and more. The World Health Organization (WHO, 2022) defines e-Health as "the cost-effective and secure use of information and communication technologies (ICT) in support of health and health-related fields". The Global Observatory for eHealth (GOe), which is part of the WHO, defines mobile health (mHealth), as a component of eHealth focused on "medical and public health practice supported by mobile devices" (WHO, 2011). The Food and Drug Administration (FDA, 2020) utilizes the term Digital Health. It is a comprehensive description of remote medical services which includes "mobile health (mHealth), health information technology (IT), wearable devices, telehealth and telemedicine, and personalized medicine". For this paper, the term telemedicine as described by the NIA best fits our investigation.

The use of telemedicine has been on a steady rise in the last five years, but most significantly since the beginning of the 2020 Covid-19 Pandemic. Before the pandemic, from 2017 to 2018, telemedicine use grew 12 percent (FAIR, 2020a), but overall use was still relatively low. In April 2019, overall telemedicine claims represented just .15% of medical insurance claims (FAIR, 2020b). But soon after the beginning of the pandemic in early 2020, telemedicine medical claims rose over 8000% to 13% of medical claims (FAIR, 2020b). In a joint survey by the CDC and the U.S. Census Bureau, 24.2% of adult participants used telemedicine either via phone or video with a medical professional in June 2020, several months after the pandemic began (CDC, 2022). That number rose to 25.7% in April 2021 and has leveled off at 21.8%

in February 2022. Overall, the pandemic dramatically increased the use of telemedicine and we believe it will continue to be a major part of healthcare delivery.

Because we believe telemedicine will remain a primary delivery mechanism for healthcare, we want to investigate the factors that influence its adoption. The purpose of this paper is to review previous research that investigated the patient’s adoption of telemedicine through a theoretical lens. We will identify the theories used and common results of the identified prominent empirical theoretical research.

The remainder of this paper is organized as follows. The next section outlines the methodology used for identifying theoretical papers investigating the adoption of telemedicine. The next section summarizes the theories used and reports the common findings. The conclusion section follows and discusses the highlighted findings, contributions, limitations, and the potential for future research.

METHODOLOGY

We searched for theoretical research that investigated the adoption of telemedicine in popular database and conferences through March 2022. Over 300 databases were searched, including ProQuest, EBSCO, ACM Digital Library, AIS Library, ScienceDirect, Web of Science, and Google Scholar. We started with the search terms “adoption of telemedicine” and “adoption of telehealth.” As we discovered different terms, such as “e-health,” we performed additional searches. Papers were selected where the adoption of telemedicine, as described in the introduction section, was investigated from the perspective of the patient/user and not the perspective the doctor/institution. We also limited our research to studies that used theoretical models as the basis of their research. Once we found acceptable studies to include in our research, we scanned the references sections of those studies to identify further studies.

We did not include studies that investigated the adoption of mobile health services that did not include services that involved consultation with a medical professional. Some studies investigated the adoption of services, such as weight management and medical information apps. We also did not include studies that investigated wearable devices, such as Fitbit watches, because we wanted to make sure the study investigated a technology that was being used for medical care between a patient and a medical professional. Such wearable devices may be used in a non-medical professional context and therefore were not included in this paper.

FINDINGS

Overall, 55 theoretical papers were identified that investigated the adoption of telemedicine from the perspective of the patient/user. A total of 19 different theoretical models have been utilized. The specific papers are listed by author, title, and theoretical models utilized in appendix 1. Table 1 below summarizes the theoretical models utilized. The total count is more than 55 because some researchers combined/used multiple models in their research.

<i>Abbreviation</i>	<i>Theoretical Model Name</i>	<i>Count</i>	<i>Percentage of Studies</i>
TAM	Technology Acceptance Model	23	41.82%
UTAUT	Unified Theory of Acceptance and Use of Technology Model	16	29.09%

UTAUT2	Unified Theory of Acceptance and Use of Technology Model 2	7	12.73%
PMT	Protection Motivation Theory	4	7.27%
TRA	Theory of Reasoned Action	4	7.27%
DOI	Diffusion of Innovation Theory	3	5.45%
TPB	Theory of Planned Behavior	3	5.45%
SCT	Social Cognitive Theory	2	3.64%
BHSU	Behavioral Model of Health Service Utilization	1	1.82%
DFM	Dual Factor Model	1	1.82%
FITT	Fit between Individuals, Tasks and Technology Framework	1	1.82%
HBM	Health Belief Model	1	1.82%
SCapT	Social Capital Theory	1	1.82%
TAM2	Technology Acceptance Model 2	1	1.82%
TRI	Technology Readiness Index	1	1.82%
TRI2	Technology Readiness Index 2.0	1	1.82%
Trust	Trust Based Model	1	1.82%
TTF	Task Technology Fit	1	1.82%
VAB	Value-Attitude-Behavior Model	1	1.82%

Table 1: Adoption of Telemedicine Theoretical Model Usage

The Technology Acceptance Model (TAM) was utilized in 41.82% of all included theoretical studies that investigated the adoption of telemedicine. The Unified Theory of Acceptance and Use of Technology Model (UTAUT) was utilized in 29.09% of studies and UTAUT2 was utilized in 12.73% of studies. Combined, the UTAUT models were utilized 41.82% of the time, the same as TAM. Beyond TAM and the UTAUT models, only five other theoretical models were utilized more than once. Those are Protection Motivation Theory (7.27%), Theory of Reasoned Action (7.27%), Diffusion of Innovation Theory (5.45%), Theory of Planned Behavior (5.45%), and Social Cognitive Theory (3.64%). The remaining 11 theoretical models were only utilized once.

Since most of the studies utilized TAM and UTAUT/UTAUT2, we analyzed the results of these studies for trends. Almost all studies that utilized TAM found all TAM constructs to have significant relationships with the intent to adopt telemedicine. However, Huang (2013) found that perceived usefulness was not a significant predictor of intent to adopt telemedicine.

Like the TAM studies, most UTAUT and UTAUT2 studies found all constructs significant. However, there were three constructs that were found insignificant across several studies. For example, Alam (2020) and Hsu et al. (2021) found that effort expectancy had an insignificant relationship with behavioral intention. Price value was also found to have an insignificant relationship with behavioral intention (Alam et al., 2021, Alam, 2020). In addition, social influence was also found in several studies to have insignificant relationships with behavioral intention (Cimperman, 2016; Boontarig, 2012).

CONCLUSION

The global Covid-19 pandemic significantly increased the use of telemedicine in the United States, bringing usage from less than 1% to nearly 25% of patient's doctor's visits. Many patients that may have never used the technology might have tried it for the first time due to the dangers of the pandemic and

limited doctor's office openings. Even after the pandemic's peak, at the time of this writing, and the reopening of doctor's offices, there is still a 22% usage rate (CDC, 2022). Though the pandemic may have promoted or even forced increased use of telemedicine, patients are now in an environment where they again get to choose if they want to use the technology, assuming it is available to them.

The purpose of this study was to investigate the theoretical models used to determine the factors that impacted patient's adoption of telemedicine. By determining which theoretical models were utilized and the results yielded, areas of further research can be determined. This study found 55 studies that utilized theoretical models. Like other research that investigated the adoption of various technologies, most theoretical studies that investigated the adoption of telemedicine utilized the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology Model (UTAUT/UTAUT2) (Harris, 2019). The results of these studies demonstrated that TAM's constructs are significant across studies. UTAUT and UTAUT2 studies also demonstrated that most constructs were significant across studies, with a few exceptions. Most of the other theoretical models were only utilized once. Therefore, there is further research that can be done utilizing these one-time studies as well as using new theoretical models yet introduced to this topic.

The contribution of this research has theoretical implications for future research in that theoretical models utilized have been identified so that researchers can utilize different or modified theoretical models. The primary limitation of this research is that studies in a non-English language were not included. Another limitation is that not all studies identified here are of the same quality, so the results of some studies may be more reliable than others.

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APPENDIX A: Identified Theoretical Studies

Author	Article Title	Year	Theoretical Model
Alaiad et al.	The Determinants Of M-Health Adoption in Developing Countries: An Empirical Investigation	2019	UTAUT, DFM, and HBM

<i>Alam et al.</i>	Adoption Intention and Usage Behavior of MHealth Services in Bangladesh and China: A Cross Country Analysis	2020	UTAUT
<i>Alam et al.</i>	Factors Influencing MHealth Adoption and Its Impact on Mental Well-Being During COVID-19 Pandemic: A SEM-ANN Approach	2021	UTAUT2
<i>Alam, M.</i>	Factors Influencing the Adoption Of mHealth Services in A Developing Country: A Patient-Centric Study	2020	UTAUT2
<i>AlBar & Hoque</i>	Patient Acceptance of E-Health Services in Saudi Arabia: An Integrative Perspective.	2019	TAM and TRA
<i>Baudier et al.</i>	Patients' Perceptions of Teleconsultation During COVID-19: A Cross-National Study	2021	UTAUT2
<i>Baudier et al.</i>	The Future of Telemedicine Cabin? The Case of The French Students' Acceptability	2020	UTAUT2
<i>Boontarig et al.</i>	Factors Influencing the Thai Elderly Intention to Use Smartphone For E-Health Services	2012	UTAUT
<i>Cimperman et al.</i>	Analyzing Older Users' Home Telehealth Services Acceptance Behavior—Applying an Extended UTAUT Model	2016	UTAUT
<i>Deng et al.</i>	Applying Technology Acceptance Model to Explore the Determinants of Mobile Health Service: From the Perspective of Public User	2012	TAM
<i>Deng et al.</i>	What Predicts Patients' Adoption Intention Toward MHealth services In China: Empirical Study	2018	TAM
<i>Deng et al.</i>	Comparison Of the Middle-Aged and Older Users' Adoption of Mobile Health Services in China	2014	TPB and VAB
<i>Deng, Z.</i>	Understanding Public Users' Adoption of Mobile Health Service	2013	MHB and TAM
<i>De Veer et al.</i>	Determinants Of the Intention to Use E-Health by Community Dwelling Older People	2015	UTAUT
<i>Duarte & Pinho</i>	A Mixed Methods UTAUT2-Based Approach to Assess Mobile Health Adoption	2019	UTAUT2
<i>Dwivedi et al.</i>	A Generalized Adoption Model for Services: A Cross-Country Comparison of Mobile Health (m-health)	2016	UTAUT and UTAUT2
<i>Faqih & Jaradat</i>	Mobile Healthcare Adoption Among Patients in a Developing Country Environment: Exploring the Influence of Age and Gender Differences	2015	TAM
<i>Fox & Connolly</i>	Mobile Health Technology Adoption Across Generations: Narrowing the Digital Divide	2018	Mix of SCT and PMT
<i>Guo et al.</i>	Investigating M-Health Acceptance from A Protection Motivation Theory Perspective: Gender and Age Differences	2015	PMT
<i>Guo et al.</i>	The Dark Side of Elderly Acceptance of Preventive Mobile Health Services in China	2013	TAM
<i>Guo et al.</i>	The Privacy–Personalization Paradox in mHealth Services Acceptance of Different Age Groups	2016	Trust

<i>Guo et al.</i>	Understanding The Acceptance of Mobile Health Services: A Service Participants Analysis	2012	TAM
<i>Guzman</i>	Examining The Role of Filipino Elderly Attitudes Toward Computer and Internet on Their Behavioral Intention for Telehealth Participation	2020	DOI
<i>Hoque</i>	An Empirical Study of MHealth Adoption in a Developing Country: The Moderating Effect of Gender Concern	2016	TAM
<i>Hoque & Sorwar</i>	Understanding Factors Influencing the Adoption of MHealth By the Elderly: An Extension of The UTAUT Model	2017	UTAUT
<i>Hoque et al.</i>	Investigating Factors Influencing the Adoption Of E-Health in Developing Countries: A Patient's Perspective	2017	TAM
<i>Hsiao et al.</i>	Investigating The Success Factors for The Acceptance of Mobile Healthcare Technology	2013	TAM and TRA
<i>Hsu et al.</i>	Predictors Of Future Use of Telehomecare Health Services by Middle-Aged People in Taiwan	2011	UTAUT
<i>Huang, J.</i>	Innovative Health Care Delivery System – a Questionnaire Survey to Evaluate the Influence of Behavioral Factors on Individuals' Acceptance of Telecare	2013	TAM
<i>Hwabamungu & Williams</i>	m-Health Adoption and Sustainability Prognosis from A Care Givers' and Patients' Perspective	2010	TTF, FITT, and UTAUT
<i>Jen & Hung</i>	An Empirical Study of Adopting Mobile Healthcare Service: The Family's Perspective on The Healthcare Needs of Their Elderly Members	2010	TPB
<i>Kohnke et al.</i>	Incorporating UTAUT Predictors for Understanding Home Care Patients' and Clinician's Acceptance of Healthcare Telemedicine Equipment	2014	UTAUT
<i>Lee & Han</i>	Determinants Of Adoption of Mobile Health Services	2015	BHSU
<i>Lee & Rao</i>	Perception Of Influencing Factors on Acceptance of Mobile Health Monitoring Service: A Comparison Between Users and Non-Users	2013	UTAUT
<i>Lv et al.</i>	Explaining The Mobile Health Services Acceptance from Different Age Groups: a Protection Motivation Theory Perspective	2012	PMT
<i>Macedo, I.</i>	Predicting The Acceptance and Use of Information and Communication Technology by Older Adults: An Empirical Examination of The Revised UTAUT2	2017	UTAUT2
<i>Mohamed et al.</i>	A Technology Acceptance Model for Mobile Health Applications	2011	TAM
<i>Peeters at al.</i>	Factors Influencing the Adoption of Home Telecare by Elderly or chronically Ill People: A National Survey	2012	DOI
<i>Peixoto et al.</i>	Drivers For Teleconsultation Acceptance in Brazil: Patients' Perspective During The COVID-19 Pandemic	2022	TAM

<i>Quaosar et al.</i>	Investigating Factors Affecting Elderly's Intention to Use M-Health Services: An Empirical Study	2018	UTAUT
<i>Rajak & Shaw</i>	An Extension of Technology Acceptance Model for MHealth User Adoption	2021	TAM
<i>Rego et al.</i>	Perceptions Of Patients and Physicians on Teleconsultation at home For Diabetes Mellitus: Survey Study	2021	TAM and UTAUT
<i>Rho, et al.</i>	Factors Influencing the Acceptance of Telemedicine for Diabetes Management	2014	UTAUT
<i>Shareef et al.</i>	Effect Of Mobile Phone SMS On M-Health: An Analysis of Consumer Perceptions	2015	UTAUT
<i>Shareef et al.</i>	Predicting Mobile Health Adoption Behavior: A Demand Side Perspective	2014	TAM
<i>Spaulding et al.</i>	Diffusion Theory and Telemedicine Adoption by Kansas Health-Care Providers: Critical Factors in Telemedicine Adoption for Improved Patient Access	2005	DOI
<i>Su et al.</i>	Factors Affecting Patients' Acceptance of And Satisfaction with Cloud-Based Telehealth for Chronic Disease Management: A Case Study in The Workplace	2020	TAM2
<i>Sun et al.</i>	Understanding The Acceptance of Mobile Health Services: A Comparison and Integration of Alternative Models	2013	Mix of TAM, PMT, UTAUT
<i>Tsai, C.</i>	Integrating Social Capital Theory, Social Cognitive Theory, And the Technology Acceptance Model to Explore a Behavioral Model of Telehealth	2014	Mix of TAM, SCT, SCapT
<i>Yeo, et al.</i>	Healthcare Receivers' Acceptance of Telecardiology in Malaysia	2019	Mix of TAM, TRI, and TPB
<i>Yosser et al.</i>	Technology Readiness Index 2.0 As Predictors Of e-Health Readiness Among Potential Users: A Case of Conflict Regions in Libya	2020	TRI 2.0
<i>Zhang et al.</i>	User Acceptance of Mobile Health Services from Users' perspectives: The Role of Self-Efficacy and Response-Efficacy in Technology Acceptance	2017	TAM
<i>Zhang et al.</i>	Understanding Gender Differences In M-Health Adoption: A Modified Theory of Reasoned Action Model	2014	TRA
<i>Zhang et al.</i>	Nonlinearities In Personalization-Privacy Paradox in mHealth Adoption: The Mediating Role of Perceived Usefulness and Attitude	2014	TAM
<i>Zola it et al.</i>	Can Bahraini Patients Accept E-Health Systems?	2019	TAM and TRA