REVIEW OF COMMON THEORETICAL MODELS PREDICTING PHYSICIANS' TELEMEDICINE ADOPTION

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Abstract

During the recent COVID-19 outbreak, telemedicine proved to be an invaluable resource. Although the significance of this technology has been previously established and recorded, clinical users have been slow to adopt this digital tool. The drivers of telemedicine adoption, the barriers to its acceptance and use, have been studied by many researchers around the world. Although many such studies focus on technical factors that influence adoption, there are some studies that address user behavioral aspects that influence telemedicine acceptance and use. Studies investigating physician behavior concerning telemedicine adoption are moderately less as compared to patient behavior. Many researchers have attempted to explain the phenomenon using theories drawn from research in psychology and information science. Based on a literature review, we present an evaluation of common behavioral model theories used in telemedicine research.

Keywords: Acceptance, adoption, behavior, model, physician, telemedicine, technology, theory.

INTRODUCTION

Telemedicine is an important tool for digital health and can be used to solve critical healthcare problems, as recently evidenced by the COVID-19 pandemic. Telemedicine has not only helped manage crowds and maintain social distancing, but has also helped address issues of access and shortages of healthcare workers. Telemedicine practices have undoubtedly been successful during the pandemic, but it remains to be seen whether they will continue to be used. Telemedicine adoption research draws on a theoretical model of information technology (IT) and information science (IS) to explain the behavioral nuances of technology acceptance. Telemedicine was introduced in India decades ago but has not yet been accepted. The simple implementation of a technology, however useful it is, does not bring its intended benefit until it is accepted and used. Telemedicine has become main stream due to the urgent situational needs of the pandemic, professional awareness, policy changes, and the introduction of clinical practice guidelines. In this paper, we present an analysis of theories commonly used in telemedicine research from the available literature in our attempt to propose a revised adoption model for predicting physician telemedicine adoption in the context of a pandemic[**Error! Reference source not found.**].

METHODOLOGY

A literature search was performed. First, the keywords and their combinations to be used were defined; then, relevant literature containing these terms was identified; then, the shortlisted articles were analysed in detail to extract relevant information about the research area; and finally, we extracted relevant information that met our research criteria. The free and openly available online databases were searched for relevant literature on the adoption of telemedicine in India and globally. We used Google Scholar and PubMed databases to search for peer-reviewed publications and selected keywords relevant to the research area to search for scholarly articles. Keywords and their combinations used for searching are: adoption; barriers; challenges; behavior; behavioural theory; determinants; drivers; factors; conceptual framework; physician; technology; telehealth; telemedicine; and theoretical model. We conducted a comprehensive literature review to uncover different approaches to studying telemedicine adoption in general and theoretical frameworks for researching adoption in particular.

THEORETICAL MODELS USED IN TELEMEDICINE RESEARCH

One approach to describing technology acceptance in informatics research is through the use of theoretical models. Both established and modified models have been used consistently to predict acceptance or rejection of new innovations. A search of the published literature reveals theoretical models used to test telemedicine adoption by physicians. The common models are described below.

Theory of Reasoned Action (TRA): Martin Fishbein and Icek Ajzen came up with TRA in 1967 to study what makes people act the way they do. TRA says that a key factor in behaviour is the intention to act[**Error! Reference source not found.**]. Attitudes and subjective norms for that behaviour affect how someone plans to act. Attitudes are "positive or negative personal feelings about doing the behaviour of interest," while subjective norms are what "most individuals that are important to me think I should or shouldn't do the behaviour in question." The goal of an action is its motivation, which can be used to predict how the action will be carried out.

Theory of Planned Behavior (TPB): TPB is a psychology theory that relates attitudes to behaviour. Attitude, subjective norm and perceived behaviour control are the three key components of this strategy[**Error! Reference source not found.**,**Error! Reference source not found.**]. In 1985, Icek Ajzen increased the predictive value of TPB by including 'perceived behavioural control' It investigates "individuals' perception of the difficulty or ease of accomplishing a desired action."

Technology Acceptance Model (TAM): In 1989, Davis adopted TAM from Reasoned Action Theory (TRA). This is the model most frequently used to explain computer use and adoption of information technology. Numerous studies of telemedicine have utilised a Technology Acceptance Model (TAM)[**Error! Reference source not found.**,**Error! Reference source not found.**,**Error! Reference source not found.**] consisting of Perceived Usefulness (PU)[**Error! Reference source not found.**], Perceived ease of use (PEOU)[**Error!**

Reference source not found.], and Attitude (AT), either alone or in collaboration with other theories to predict usage intention and actual utilisation. PEOU is defined as "the extent to which the use of a certain system requires no physical or mental effort," whereas PU is defined as "the extent to which the use of a particular system improves performance."

Technology Acceptance Model 2 (TAM 2): Venkatesh and Davis updated the TAM concept to Technology Acceptance Model 2 in 2000. The second TAM provides a more thorough explanation of the perceived usefulness construct. The enhanced model incorporates social impact processes (subjective norms and images). The four cognitive processes of occupational relevance, output quality, outcome traceability, and perceived simplicity of use were also strong determinants of perceived utility. Images are perceived enhancements to one's status when using the system. Occupational relevance is the capability of a system to support the work function of an individual. An individual's perception of how well a task is being executed is the output quality. Outcome traceability is the demonstration of actual results, and positive outcomes foster a favourable perception of the system's utility. Perceived usability is the actual usability of a system[**Error! Reference source not found.**].

Technology Acceptance Model 3 (TAM 3): Venkatesh and Bala (2008)[**Error! Reference source not found.**] modified the Technology Acceptance Model from version two to version three, with a focus on expanding the number of determinants that influence Perceived Usefulness and Perceived Ease of Use of a technology, resulting in a positive Behavioral Intention followed by Use Behavior. Subjective Norm, Image, Job Importance, Output Quality, and Result Demonstrability influence Perceived Usefulness. Anchor variables (Computer Self-Efficacy, Perception of External Control, Computer Experience, and Computer Playfulness) and adjustment variables influence Perceived Ease of Use (Perceived Enjoyment and Objective Usability). Experience moderates the correlation among perceived stress and perceived ease of use, between projected ease of use and usefulness, and between perceived usefulness and ease of use and continuance intention[**Error! Reference source not found.**].

Unified Theory of Acceptance and Use of Technology (UTAUT): In 2003, Venkatesh V., Morris, Davis, and Davis merged eight theoretical elements to create the *Unified Theory of Technology Acceptance and Use (UTAUT)* model. *Rational Behavior Theory (TRA)*, *Innovation Diffusion Theory (IDT)*, *Planned Behavior Theory (TPB)*, *Technology Acceptance Model (TAM)*, *Social Cognitive Theory (SCT)*, *Combined TAM-TPB* Model, Core Elements of *Motivation Model (MM),* and *Personal Computer Usage Model (MPCU)* were combined to create a model that predicts and describes the adoption, acceptance, and use of new technologies[**Error! Reference source not found.**]. All of the aforementioned models rely heavily on behaviour, or the application of new technologies. According to UTAUT theory[**Error! Reference source not found.**], the four major components are the crucial antecedents of intended usage and behaviour. *"Performance Expectation (PE), Effort Expectation (EE), Social Influence (SI), and Facilitating Conditions (FC)"* constitute the UTAUT paradigm's main structure. In addition to basic components, the model includes

moderator variables, such as gender, age, experience, and desire to use, which modify the effect of four fundamental components on user intent and behaviour. The definition of performance expectation is *"The extent to which a person believes that utilising a system will help them obtain a benefit."* The anticipation of effort is *"The ease with which a system can be utilized."* Social influence is *"the extent to which other prominent individuals recognise the need to use the system." "Supportive Organisational or Technical Infrastructure"* are enabling conditions[**Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.**].

Unified Theory of Acceptance and Use of Technology 2 (UTAUT 2): UTAUT 2 contains three more constructs in addition to the UTAUT construct. "Hedonistic motivation, Price value, and Habit" The structure of behavioural intentions and technology use is impacted by individual variables such as name, age, gender, and experience. UTAUT 2 enhanced "variance explained by behavioural goals (56%) and technological use (40%)" The definition of hedonic motivation is "enjoyment or pleasure received from utilising technology." The cost-effectiveness of a product or service is significant to consumers (individuals), but less so to employees (in organizations). Cost and pricing can impact consumer technology adoption. Limayem et al. (2007) defined a habit as "the extent to which one tends to perform an action automatically as a function of learning." UTAUT 2 is more descriptive, however it is up to researchers to construct the version that is optimal for their research[**Error! Reference source not found.**].

Social Cognitive Theory (SCT): Social Cognitive Theory (SCT) is also a behavioural prediction theory that explains alterations in behaviour based on individual, behavioural, and environmental characteristics. Self-efficacy, which indicates the inherent self-regulatory capacity to regulate between knowledge and action, is a crucial component of SCT. The definition of self-efficacy is a basic perception in their ability to execute a task. This concept was introduced by the psychologist Albert Bandura and focuses on individual judgement. According to Luszczynska and Schwarzer, self-efficacy drives all of a person's actions, and this conviction influences our capacity to face difficulties and make decisions[**Error! Reference source not found.**].

DISCUSSION

According to Davis (1993)[**Error! Reference source not found.**], "user acceptability is often the determining factor in determining the success or failure of an information system." TAM was inadequate because it did not address individual perspectives, relied on external variables, and did not consider the relationship between usage attitudes and usage intentions. However, some of the TAM variables are useful and still relevant to research on behavioural intentions in healthcare. Zailani et al. (2014)[**Error! Reference source not found.**] found that physicians' attitudes influence behavioural intentions, and positive attitudes towards technology motivate them to use technology. Attitudes that refer to positive or negative feelings about technology use are not included in the UTAUT model. Dwivedi

(2019)[**Error! Reference source not found.**] proposed a modified version of his UTAUT model, showing attitude as one of the components that describe individual acceptance and use of information systems and technologies. Hu et al. (1999)[**Error! Reference source not found.**] argued that physician attitudes toward telemedicine and concerns about the risks of using telemedicine technology were also observed to be important factors influencing acceptance. Several recent studies have cast doubt on the UTAUT model. This is due to the fact that this design does not always compensate for an individual's acceptability of technology, necessitating the addition of additional factors to the original variables, such as identity, trust, habits, gratification, attitudes, perceived risk, safety, etc., depending on the investigated domain and population. Computer self-efficacy is described as a person's view of his or her own computer proficiency. When it comes to telemedicine, it is the user's belief in the technology's ability to be controlled that matters. Rho et al. (2014)[**Error! Reference source not found.**] found that self-efficacy positively impacted the usability and usefulness of telemedicine when examining factors affecting receptivity and behavior. According to Hah et al. (2019)[**Error! Reference source not found.**], self-efficacy influences users' beliefs about the usability of technology. A systematic analysis of theories that predict end-user acceptability of telemedicine systems was conducted. Hurst L. et al. (2019)[**Error! Reference source not found.**] propose that technological adoption models and theories are applicable to the study of telemedicine uptake. As both technology characteristics and human attributes influence end-user acceptance, the social environment should also be considered when planning a telemedicine implementation. From the literature, we find that the UTAUT model was used more frequently than the TAM to describe patient acceptance rather than physician acceptance. as social influence applies more to patients and the TAM construct of perceived usefulness is more relevant to physicians. Even then, the research using TAM most often used additional predictors from TIB, TPB, and TRA, including acceptability factors informing both technology and individual attributes, thus indicating that the modified TAMs were more predictive than the original models. Many studies included predictors of UTAUT, such as social influence and facilitating conditions, in their TAM. Social influence is the concept of making assumptions about what others might think of oneself also applies to telemedicine technology. The most significant predictor is perceived usefulness, which is connected to the reality that professionals want to give the best possible treatment for their patients. It has been proven that perceived ease of use is a significant predictor of adoption, highlighting the need of building user-friendly applications. Thus, the PU and PEOU components of TAM have proven to be strong predictors of acceptance among physicians. So we find that telemedicine acceptance was most commonly predicted by combining constructs from TAM and UTAUT such as perceived usefulness, social influence, and attitude.

CONCLUSION

Telemedicine adoption has been studied from both an individual and an organisational perspective. Of the many different behavioural theories used to explain the adoption of telemedicine by physicians, a review of the published literature suggests that

the TAM and UTAUT theories are more commonly used to explain the adoption of telemedicine technology. UTAUT has been used to illustrate adoption from a patient perspective, whereas the use of TAM has been favoured in physician adoption studies. The use of other technology adoption theories such as TPB (Planned Behavior Theory), TRA (Rational Behavior Theory), TTF (Task Technology Fit), and IDT (Innovation Diffusion Theory) is less common in telemedicine adoption research and provides scope for future research. The various technology acceptance theories investigated provide an overview of the factors influencing behaviour towards telemedicine adoption.

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