Aalto University
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THE ACCEPTANCE OF TELEMEDICINE TECHNOLOGY AMONG MEDICAL DOCTORS IN FINLAND

Master's Thesis
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Abstract

Historically, healthcare has been seen as a slow adopter of new technology. Telemedicine services and its related technologies currently face significant changes and rapid expansion, partly due to the Covid-19 pandemic. It is generally accepted that the success of any new technology relies to a great extent on users' satisfaction and satisfied medical doctors are therefore one of the key objectives of telemedicine service success.

This quantitative study aims to determine which factors predict the adoption of telemedicine technology among medical doctors in Finland. It applies the telemedicine service acceptance model (TSA) which is based on the technology acceptance model (TAM) and has been previously validated in South Korea. In addition, this study evaluates the effects of Covid-19 pandemic on the medical doctors' attitude towards telemedicine services.

To test the hypotheses of the TSA model, an online survey was distributed to medical doctors in Finland. Non-probabilistic "snowballing" sampling technique was used and resulted in 185 responses. Structural equation modeling was applied to evaluate the causal relationships within the model.

The results confirm the original TAM constructs: perceived ease of use & perceived usefulness are strong predictors of medical doctors' behavioral intention to adopt telemedicine technology, and perceived ease of use is a predictor of perceived usefulness. Of the new predictive constructs in the TSA model, self-efficacy and accessibility of medical records were predictors of perceived ease of use, whereas accessibility of patients was a predictor of perceived usefulness. Perceived incentives were not found to be important concerning the intention to use telemedicine technology. Also, having had experience with telemedicine either before or during the Covid-19 pandemic and if the attitude towards telemedicine services had improved during the Covid-19 pandemic, they both predicted a higher behavioral intention to use telemedicine services in the future.

This study contributes to the theoretical knowledge of technology acceptance by identifying important factors increasing the medical doctors' acceptance of telemedicine technology. The results also indicate that the adoption of telemedicine services is likely to further accelerate due to the Covid-19 pandemic.

Keywords technology acceptance model, healthcare technology, telemedicine services, behavioral intention to use technology, Covid-19 pandemic

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Tiivistelmä

Historiallisesti terveydenhuoltoalaa on pidetty hitaana uuden teknologian omaksujana. Etälääketieteen palvelut ja siihen liittyvä teknologia kokevat tällä hetkellä paljon muutoksia ja nopeaa kasvua, osittain Covid-19-pandemiasta johtuen. On yleisesti tunnustettu, että minkä tahansa uuden teknologian menestys riippuu paljolti käyttäjien tyytyväisyydestä ja tyytyväiset lääkärit ovatkin etälääketieteen palveluiden onnistumisen kannalta avainasemassa.

Tässä kvantitatiivisessa tutkimuksessa määritetään, mitkä tekijät ennakoivat etälääketieteen teknologian omaksumista lääkäreiden keskuudessa Suomessa. Tutkimuksessa käytetään etälääketieteen palveluiden omaksumismallia (TSA; telemedicine service acceptance), joka perustuu teknologian omaksumismalliin (TAM; technology acceptance model) ja on aikaisemmin validoitu Etelä-Koreassa. Lisäki tässä tutkimuksessa tarkastellaa Covid-19-pandemian vaikutuksia lääkäreiden asenteisiin etälääketieteen palveluita kohtaan.

Etälääketieteen palveuiden omaksumismallin hypoteesien testaamista varten verkkopohjaista kyselyä jaettiin lääkäreille Suomessa. Ei todennäköisyysotantaan perustuvaa ”lumipallotekniikkaa” käytettiin vastausten keräämisessä, jonka seurauksena kyselyyn kertyi 185 vastausta. Rakenneyhtälömallia käytettiin tarkasteltaessa syy-yhetyksiä.

Tulokset vahvistavat alkuperäisen teknologian omaksumismallin käsitteitä: koettu käyttöhelppous & koettu hyödyllisyys ennakoivat vahvasti lääkäreiden käyttöaikeita omaksua etälääketieteen teknologiaa sekä koettu käyttöhelppous ennakoi koettua hyödyllisyyttä. Etälääketieteen palveluiden omaksumismallin uusista ennakoivista käsitteistä minäpystyvyys ja pääsy potilasasiakirjoihin ennakoivat koettua käyttöhelppoutta, kun taas potilaiden saavutettavuus ennakoi koettua hyödyllisyyttä. Koettujen kannusteiden ei todeta olevan tärkeä tekijä ennakoimassa etälääketieteen teknologian käyttöä. Lisäksi aikaisempi kokemus etälääketieteestä joko ennen Covid-19-pandemiaa tai sen aikana sekä jos asenne etälääketiedettä kohtaan Covid-19-pandemian aikana oli parantunut ennakoivat molemmat korkeampaa etälääketieteen teknologian käyttöaikeita tulevaisuudessa.

Tämä tutkimus edesauttaa teknologian käyttöönoton teoreettista ymmärryspohjaa tunnistamalla niitä tärkeitä tekijöitä, jotka lisäävät etälääketieteen teknologian omaksumista lääkäreiden keskuudessa. Tulokset osoittavat myös, että etälääketieteen palveluiden omaksuminen todennäköisesti kiihtyy entisestään Covid-19-pandemian johdosta.

Avainsanat teknologian käyttöönotto, terveysteknologia, etälääketieteen palvelut, teknologian käyttöaikeet, Covid-19-pandemia

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Health information technology (HIT) is an umbrella term referring to technology-driven information systems that are being used to store, share, and analyze health information (Kruse and Beane, 2018). Health information technologies are complementary and synergistic tools for telemedicine which is described as “the use of electronic communications and information technologies to provide clinical services when participants are at different locations” (The American Telemedicine Association, 2006).

More broadly, World Health Organization (2010) defines telemedicine as follows:

“The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities”.

Telemedicine is not a separate medical specialty, but it offers a means for healthcare providers to extend the traditional practice “outside the walls” (The American Telemedicine Association, 2006). By means of telemedicine and telecommunications technology, the same health services as those which would be provided in face-to-face between patients and health care professionals can be delivered. At the same time, advancements in telemedicine have made healthcare affordable and accessible to many, and the market is expected to grow as technology advances and acceptance increases. Specialized companies are emerging in this field, but also established health insurers and large healthcare institutions have started to offer medical care through telemedicine services (Thielst, 2010). Especially two phenomena are expected to embrace telemedicine and its usage in the future. First, a significant number of younger patients are entering or have entered the population with chronic disease conditions such as diabetes, obesity, and mental health disorders. Second, a rapid increase of consumer electronics and personal communication tools, even among older patients, has caused people to look for newer and more modern solutions to care delivery (Ghosh and Ahadome, 2012).

Telemedicine market can be divided into five segments: type, application, modality, end user and geography (Fortune Business Insights, 2019). Table 1 illustrates the telemedicine market segments. The type-segment consists of products and services, of which the services segment accounts for the maximum share and is expected to dominate the market throughout the following years. This is due to the health reimbursement for teleconsultation, adoption of real-time communication devices, and entry of new service providers in the market. Also, the demand for telemedicine products is expected to grow and they help in evaluation and diagnosis of patients.

The application segment includes teleradiology, telepathology, teledermatology, telepsychiatry, telecardiology, and others. Especially teleradiology holds a substantial share of the market due to the adoption of Picture Archiving and Communication System (PACS). Radiology images are then easily transmitted and integrated with Electronic Health Records (EHR). As teleradiology is an efficient diagnostic tool, the demand is expected to increase. Other mentioned application segments are also expected to have a growth rate during the following years.

As regards to modality, the telemedicine market is divided into store-and-forward and real-time segments. Store-and-forward is an asynchronous method that enables healthcare professionals to share patient information such as images and lab reports, and the medical information can be reviewed at a different time and location. In real-time or synchronous telemedicine, video conference or phone consultation is used to discuss any health issue.

Characterized by end-user, the market segment includes healthcare facilities and homecare. The demand for telemedicine is estimated to grow across homecare and healthcare facilities. Especially homecare telemedicine is likely to gain recognition due to the population ageing.

Regional analysis divides the market into North America, Europe, Asia Pacific, Latin America, and Middle East & Africa. As of 2018, North America dominated the telemedicine market with a value of 14.6 billion USD and is expected to dominate the market also during the following years. Market growth is anticipated across all continents due to the changes in socio-economic factors such as ageing population, increasing usage of the internet and high unmet patient population. The market is steadily becoming more competitive around the world with the launch of several telemedicine programs and the entry of new market players with big funding. The global telemedicine market was worth 34.2 billion USD in 2018 and is expected to be valued at more than 185.6 billion USD by 2026. (Fortune Business Insights, 2019)

TYPE	APPLICATION	MODALITY	END USER	GEOGRAPHY
Products	Teleradiology	Store-and-forward	Healthcare facilities	North America
Services	Telepathology	Real-time	Homecare	Europe
	Teledermatology			Asia Pacific
	Telepsychiatry			Latin America
	Telecardiology			Middle East & Africa
	Others			

Table 1. Telemedicine market segments (Fortune Business Insights, 2019).

The ongoing coronavirus pandemic (Covid-19) caused by a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which was declared as a pandemic in March 2020, has accelerated the adoption of telemedicine. During lockdown and social distancing, there has been a higher preference for virtual consultation. In the United States between March 2nd and April 14th, 2020, telemedicine visits increased from 102.4 daily to 801.6 daily, which implies a 683% increase (Mann et al. 2020). Telemedicine is not just a temporary trend during Covid-19 but is anticipated to largely transform and dictate the future of healthcare. Accessibility, affordability, and reimbursement policies are also expected to drive the adoption of telemedicine in the future (Wosik et al. 2020).

1.1 Research objective

Despite the numerous promising benefits of telemedicine, there remains many hindrances to its full adoption. Historically, healthcare has been reluctant to change and seen as a slow adopter of new technology. Telemedicine services rely on technology and satisfied healthcare personnel are a crucial part of telemedicine implementation success – an unused telemedicine service cannot be successful. There are still many challenges to telemedicine technology acceptance among medical doctors (Menachemi et al. 2004). Rho, Choi and Lee (2014) developed the telemedicine service acceptance model (TSA) as an extension the technology acceptance model (TAM; see Chapter 2.2.2) and included three predictive constructs from the previously published telemedicine literature: 1) accessibility of medical records and accessibility of patients as clinical factors, 2) self-efficacy as an individual factor and 3) perceived intentions as regulatory factors. The TSA model is further explained in the Chapter 3. The purpose of this research is to explain the predictive factors influencing medical doctors' willingness to use telemedicine services in Finland by applying the TSA model. To meet this objective, the following research question needs answering:

1. What are the major drivers influencing the intention of medical doctors to accept and use telemedicine services in Finland?

As a secondary research question, I examine the impact of Covid-19 pandemic on telemedicine service acceptance by comparing the usage of telemedicine services before and during the pandemic. Therefore, my secondary research question is as follows:

2. What is the impact of Covid-19 pandemic on telemedicine service usage among medical doctors in Finland?

1.2 Structure of the thesis

The Chapter 2 explains the theory behind technology acceptance in general and how different technology acceptance models have evolved. Later in the chapter, specific characteristics of technology acceptance in healthcare context are described. Last in the chapter, the current telemedicine situation in Finland is introduced and opportunities and barriers of telemedicine services are elaborated.

The Chapter 3 introduces the research model and hypotheses, and the Chapter 4 explains the data collection and quantitative analysis methods used in the study. The Chapter 5 presents the results of the study and finally, in the Chapter 6, the results are concluded and further discussed.

2 LITERATURE REVIEW

2.1 Technology implementation and acceptance

Bringing new technology into a complex organization disrupts existing behaviors and routines, requiring learning from the new users. Technology implementation brings several challenges, and the process can unfold in many ways - not solely determined by the technological features but also by the interaction between the technology and personnel in the organization. The same technology can be interpreted differently and create different responses within the same organization, even though they may appear similar from the outside (Levitt and March, 1988). Research on technology implementation shows that the implementation is especially difficult when a new technology challenges existing forms of interdependence among individuals or groups. In those cases, implementation can become an organizational learning challenge where perceived organizational risks and benefits become important to the implementation success (Orlikowski, 1993). The way how technologies are implemented needs careful design to realize the benefits. It has even been argued that the design of technology implementation may separately determine to some extent if users accept and use new technologies – regardless of the technological usability considerations. It has therefore become evident that managers and decision-makers need not only technological knowledge, but also must gain understanding about how technologies relate to the users' values (Karsh, 2004).

Already several decades ago, Rogers (1962) popularized the diffusion of innovation theory (DOI). The theory aims to explain how, why and at what rate technological innovations spread and are adopted. In his book *Diffusion of Innovations,* which is now in its fifth edition, Rogers (2003) defines diffusion as "the process in which an innovation is communicated through certain channels over time among the members of a social system". This definition concludes the four key elements of the diffusion of innovation theory: innovation, communication channels, time, and social system. Innovation is described as an idea, practice, or project that is perceived as new by an individual or organization – in other words, only the perception matters even if the innovation was invented a long time ago. Diffusion is a specific kind of communication that occurs through channels, that is how a message gets between sources (from doctor to patient, for example). During communication, participants create and share information together so that a mutual understanding is reached. A time dimension reflects the overall process of diffusion, adopter groups and the rate of adoption. Lastly, since social system is where diffusion of innovations happens, it is affected by the social structure of the social system. Social system is defined by Rogers as "a set of interrelated units engaged in joint problem solving to accomplish a common goal". The nature of the social system is claimed to influence individuals' innovativeness, which is one of the main criteria to classify adopter groups (Rogers, 2003). However, particularly within the healthcare domain, applying the DOI model has not been straightforward in predicting the behavior. Different factors have influence on distinct units of healthcare workers (Ward, 2013). As an example, there is a difference in the attitude towards the adoption of technology whether you are a young male doctor (more task focused) or an older female nurse (more influenced by social factors). In these cases, a unified approach towards the adoption of technology innovation in healthcare is likely to be unsuccessful. An organizational culture that highlights the importance of teamwork is therefore essential (Yarborough & Smith, 2007).

Rogers (2003) categorized five different adopter groups based on innovativeness defining it as "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system". This classification consists of innovators, early adopters, early majority, late majority, and laggards. Innovators are the very first ones who are willing to experience new ideas and bring the innovation to the organization. Generally, innovators have a lot of technical knowledge. After the innovators, come the early adopters. They often hold leadership roles and are considered as role models by other members of the organization – therefore, their attitudes towards innovations are more important than innovators'. This leads to early majority's innovation decision which takes some more time, but they are neither the first nor the last to adopt the innovation. Their networks and interaction with other members are important for the diffusion process, which eventually leads to late majority adopters. They wait until most of the members of the social system adopt the innovation. First, they feel uncertain about the innovation, but economic situation and peer pressure can make them feel safe to adopt the innovation. The last adopter group, laggards, decides to adopt the innovation only after making sure that it works and is successfully adopted by other members. They have the most skeptical and traditional view, which is one of the reasons for a longer time to decide and adopt new technologies. After all, the diffusion of innovations is very much dependent on human capital referring to the users' knowledge, experience, and skills. (Rogers, 2003)

The stage models of technology implementation point out important activities and user reactions during pre-implementation and post-implementation stages. The pre-implementation phase entails initiation, organizational adoption, and adaptation, while the postimplementation phase includes user acceptance, routinization, and infusion. *Initiation* identifies an organizational problem or opportunity which requires a technological solution, *adoption* decides to adopt the given technology, *adaptation* tailors the technology towards organizational procedures and needs, *acceptance* induces organizational members to commit to the technology usage, *routinization* encourages the usage of technology to become as a normal activity and *infusion* embeds the technology more deeply within the organizational work (Cooper and Zmud, 1990; Saga and Zmud, 1994). The main difference between pre-implementation and post-implementation stages is that during the pre-implementation stage the primary adoption occurs by the organization and during the post-implementation stage the secondary adoption occurs by individual users. Post-implementation interventions play a role in organizational, managerial, and support activities that occur after the deployment of a system to enhance the level of user acceptance of the system - these interventions can be critical to help users to go through the initial resistance, or any changes associated with the new system (Venkatesh and Bala, 2008). Users' post-implementation usage behavior is mostly voluntary, and the user decides the extent of the usage and the effort devoted to learning (Carlson and Zmud, 1999). Therefore, the user acceptance and confidence are critical for further development of any new technology. According to a cross-sectional questionnaire-based study to evaluate the opinion of physicians regarding e-health, medical doctors believe in the usefulness in e-health (Ruiz Morilla et al. 2017). Having previous experience with healthcare technology increases their openness to its implementation and makes them consider that the benefits of technology outweigh the possible shortcomings (Ruiz Morilla et al. 2017). The aim of post-implementation interventions is to make users feel that the new technology increases their job performance and that they have abilities to use the new system free from effort (Venkatesh and Bala, 2008).

All things considered, technology acceptance is defined as "an interdisciplinary domain, which employs psychology and information systems fields of study to investigate users' attitudes towards new technologies" (Sezgin and Yıldırım, 2016).

2.2 Technology acceptance theories

2.2.1 Theory of reasoned action (TRA) and theory of planned behavior (TPB)

The theory of reasoned action (TRA) and the theory of planned behavior (TPB) are theoretical constructs that focus on individual motivational factors that determine the probability of performing certain behaviors (Fishbein and Ajzen, 1975; Ajzen, 1985). The theory of reasoned action seeks to explain the causes of resulting behaviors by suggesting that a person's behavior is determined by their behavioral intention. On the other hand, behavioral intention is then predicted by a person's attitude towards the behavior and subjective norms regarding the behavior. The TRA describes attitude as "an individual's positive or negative feelings about performing the target behavior" and subjective norm as "the person's perception that most people who are important to him or her think he or she should or should not perform the behavior in question". Variables external to the attitude and subjective norms are assumed to influence behavioral intention only to the extent that they affect those two. (Fishbein and Ajzen, 1975)

The theory of planned behavior (TPB) is seen as an extension to the TRA. Both TRA and TPB share an underlying assumption that the best predictor of a behavior is intention. However, the TPB maintains what TRA contains, while also incorporates and adds modifications that enable better accuracy in understanding attitudes and predicting the *actual* behavior (Ajzen, 1985). It includes an additional moderating construct called perceived control over performance of the behavior. It is an external variable that has both an indirect effect on behavior through behavioral intentions and a direct effect on behavior. The indirect effect is assumed to reflect the motivational influence for behavioral intention. When people believe that they have little control over performing the behavior due to a lack of required resources, then their intention to perform the behavior can be low even if they have positive attitudes and subjective norms towards the behavior. On the other hand, the more resources an individual think he or she possesses, then the stronger should be their perceived behavioral control and therefore it is more likely that the behavioral intention will be carried out (Ajzen, 1985). Empirical studies have suggested that people's behavior is strongly affected by the confidence they have in their ability to perform the behavior (Bandura et al., 1980). Moreover, the meta-analysis of 56 health behavior researchers using TPB found that the theory's performance differs across different health applications, which implies that external factors are needed to reflect the specifics of the adoption according to the type of health behavior being studied (Godin & Kok, 1996). Figure 1 below shows the models for TRA and TPB.

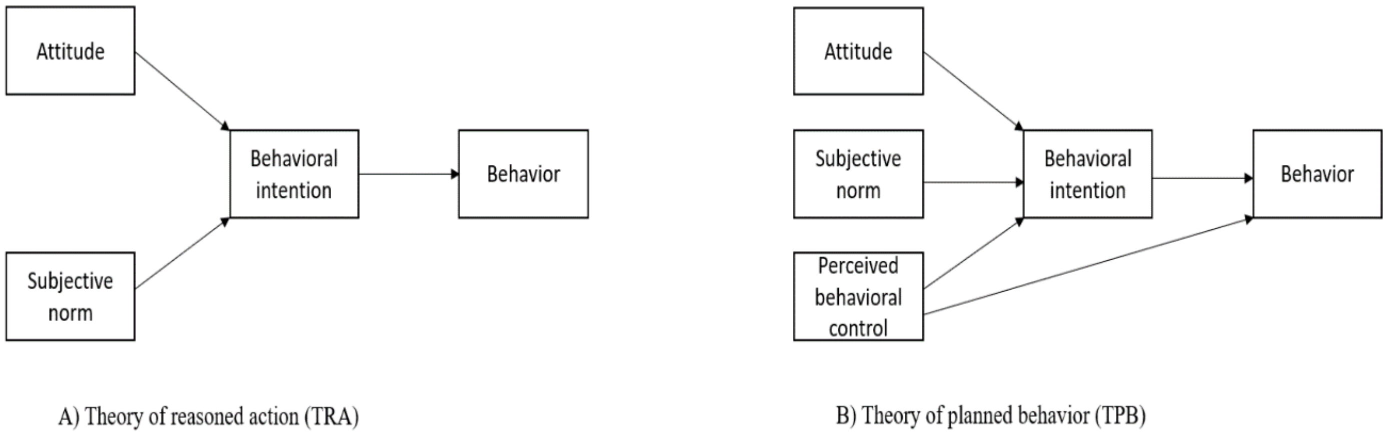

Figure 4. Models for the TRA and TPB. (Fishbein and Ajzen, 1975; Ajzen, 1985)

2.2.2 Technology acceptance models: TAM, TAM 2, UTAUT and TAM 3

The original technology acceptance model (TAM) was first introduced by Davis (1986) and is one of the most influential theories in the literature modeling how users accept and use new technologies. It is based on human behavioral and psychological sciences. The roots of TAM come from the theory of reasoned action and the theory of planned behavior (see Chapter 2.2.1). Those two theories and TAM have behavioral elements that are mainly based on a person's intention to act. However, the main difference in TAM is that the measures are replaced with the two technology acceptance measures: perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness refers to the degree to which a person believes that using a particular system would enhance his or her job performance, while perceived ease of use refers to the degree to which a person believes that using a particular system would be free from effort (Davis 1989). Additionally, TAM considers external variables such as social influence when determining the attitude. Davis et al. (1989) generated the first version of TAM to describe computer usage behavior as shown in Figure 2 below. It aims to explain the general determinants of computer acceptance that lead to explaining users' behaviors across a wide range of end-user technologies and user populations.

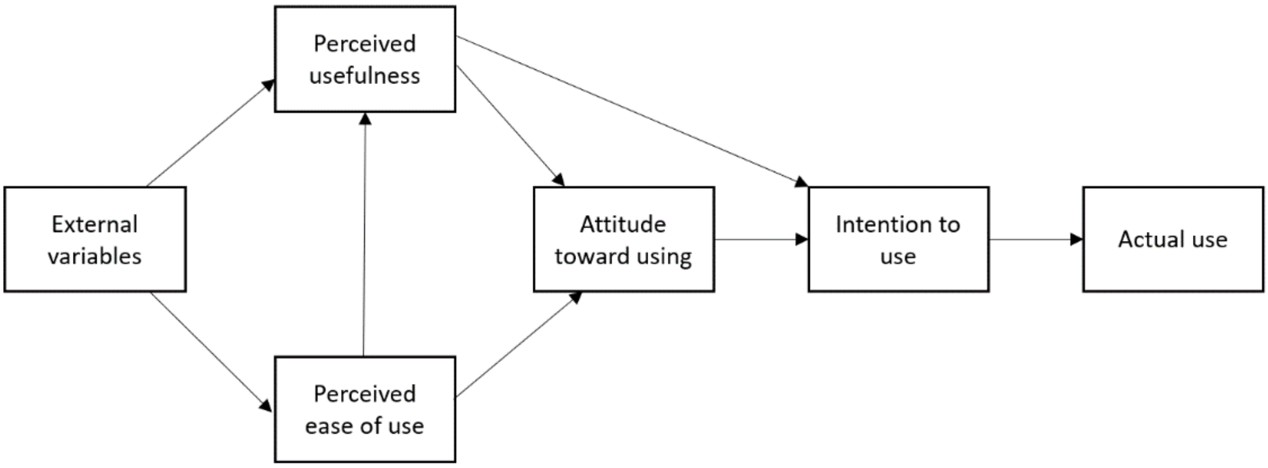

Figure 5. Technology Acceptance Model, version 1 (TAM). (Davis et al. 1989)

Later, the TAM model has been further expanded and the two major upgrades are the technology acceptance model 2 (TAM 2) (Venkatesh and Davis, 2000; Venkatesh, 2000) and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al. 2003). TAM 2 provides a more detailed explanation to the construct of perceived usefulness. The extended model includes social influence processes, which are subjective norm and image, together with four cognitive instrumental processes, which are job relevance, output quality, result demonstrability, and perceived ease of use, as other important predictors influencing perceived usefulness. Subjective norm is described as "the person's perception that most people who are important to him or her think he or she should or should not perform the behavior in question", as in TRA. Image is the extent how much an individual's status is perceived to enhance when using the system. Job relevance is the system's ability to support an individual's job tasks. Output quality is an individual's perception of how well the system performs a task. Result demonstrability points out that if the differences between usage and positive results are noticeable, individuals will have a more positive attitude about the system's usefulness. Perceived ease of use describes how effortless a system is to use. These key forces explain up to 60% of the variance in perceived usefulness. The two moderators to perceived usefulness are experience and voluntariness. Based on four longitudinal field studies, TAM 2 was supported at three points of technology acceptance measurement: pre-implementation, one-month post-implementation and three months post-implementation. (Venkatesh et al. 2000)

The UTAUT theory, the unified theory of acceptance and use of technology, is a further extension of TAM 2. Perceived usefulness, perceived ease of use and subjective norm are respectively renamed as performance expectancy, effort expectancy and social influence. As an additional predictor of user behavior, it includes a fourth construct: facilitating conditions. They are beliefs about the presence of personal or organizational support encouraging technology acceptance. In a longitudinal study, UTAUT was found to account for 70% of the variance in intention to use and around 50% in actual use. (Venkatesh et al. 2003)

An integrated model of technology acceptance, known as TAM 3 (Venkatesh and Bala, 2008), was then developed by combining TAM 2 (Venkatesh and Davis, 2000) and the model of the determinants of perceived ease of use (Venkatesh, 2000). The determinants of perceived ease of use are computer self-efficacy, perception of external control, computer anxiety, computer playfulness, perceived enjoyment, and objective usability. The first four of them are anchoring determinants meaning that they influence initial judgments. The last two, perceived enjoyment and objective usability, are adjusting determinants meaning that after gaining experience with the new system, they start to play more role in determining perceived ease of use. The TAM 3 model describes a complete network of the determinants of individuals' information technology adoption and use. It suggests three new relationships that are moderated by experience: the relationships between 1) perceived usefulness and perceived ease of use, 2) computer anxiety and perceived ease of use, and 3) behavioral intention and perceived ease of use. The model suggests that with increasing hands-on experience with a certain technology or system, the influence of perceived ease of use on perceived usefulness will be stronger. Perceived ease of use is especially important in the early period of system use since perceptions about usefulness are still being formed. Second, the model suggests that with increasing experience, the effect of computer anxiety on perceived ease of use will decline. Experience is expected to help users have more accurate perceptions of the efforts required to complete certain tasks and find enjoyment. Lastly, the model suggests that experience will moderate the effect of perceived ease of use on behavioral intention so that the effect will be weaker over time. In other words, with increasing experience, users have more procedural information about the system and therefore less importance is placed on perceived ease of use when forming behavioral intentions (Venkatesh and Bala, 2008). TAM 3 is illustrated in Figure 3.

In the context of healthcare, certain TAM model relationships have consistently found to be significant. For instance, there is strong evidence that the perceived usefulness and perceived ease of use have an impact on affecting the healthcare technology acceptance. Even though TAM models predict a substantial portion of the user acceptance of healthcare technology, the theory may benefit from additions and modifications to adapt it specifically to healthcare. (Holden & Karsh, 2010)

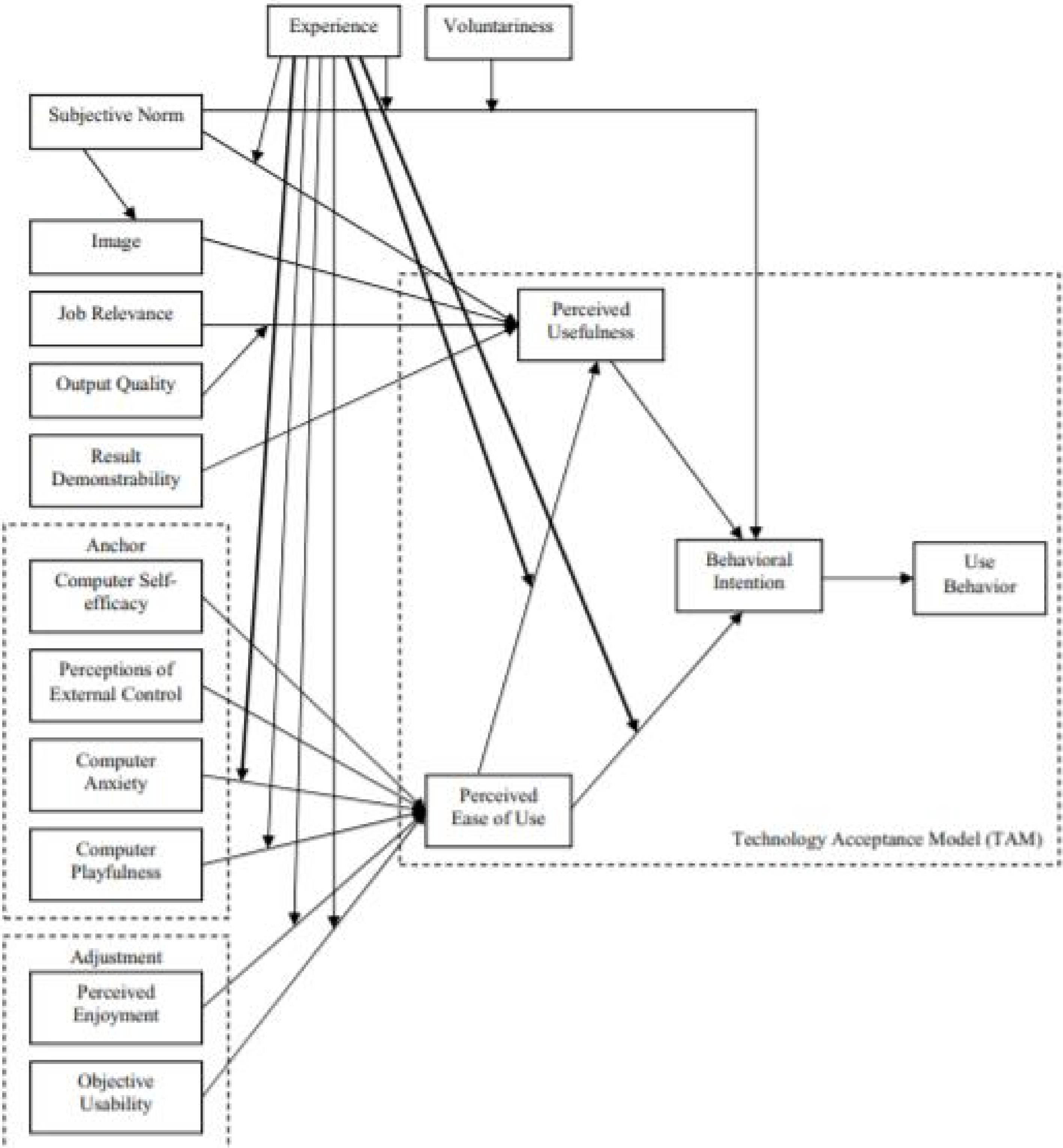

Figure 8. Technology Acceptance Model 3. (Venkatesh and Bala, 2008)

2.3 Technology acceptance in health care

In general, the theory of reasoned action (TRA) that has led to the theory of planned behavior (TPB) and technology acceptance model (TAM), in addition to diffusion of innovation theory (DOI) and unified theory of acceptance and use of technology (UTAUT) are the most distinguished concepts and constructs to understand attitudes that lead towards the acceptance of technological innovations (Gucin and Berk, 2015). Physicians' professional setting exhibits the essential characteristics of user, technology, and context that may differ significantly from those in ordinary business settings (Chau and Hu, 2002). There are many benefits of technology acceptance and usage for both patients and health care professionals. From the patients' point of view, the mobile technologies assure accessibility for health care, getting treatment, being under observation, self-evaluation, and checking up on the health status (Kane, 2014). From the health care professionals' point of view, the technology usage has been shown to shorten the treatment period and assure precise transfer of medical records – hence leading to less mistakes in treatment process (Khan and Woosley, 2011). Additionally, the health care technology usage has been shown to provide financial savings for patient, doctor, and government (Fontenot, 2014).

Predictors whether health care workers accept and intend to use new technologies can be divided into organizational, technological, job and individual factors (Karsh, 2004). One of the most important organizational factors is how well the new technology will be implemented together with existing technologies, workflow, the environment, and other social systems. In other words, resistance to the new technology is likely if it does not work well with other existing technologies, is not practical in the existing environment or does not positively influence the workflow (Karsh, 2004). Another important predictor of technology acceptance is management commitment. The commitment must be shown through explicit actions and the reasons for the new technology must be clarified to foster positive attitudes (Smith and Carayon, 1995). Well-designed training programs have been proven to support end user acceptance of technology. Training can also lead to other important variables for the acceptance of technology, including self-efficacy and intrinsic motivation (Agarwal et al., 2000; Venkatesh, 1999). Moreover, a well-designed end user participation during the implementation of new technology can also increase the probability of acceptance (Karsh, 1997). Organizational justice is another essential factor for new technology implementation; meaning that if individuals are being treated fairly, they are more likely to develop attitudes and behaviors that are necessary for successful implementation, even under challenging conditions of adversity and loss (Cobb et al., 1995).

The technological factors contributing to technology acceptance are response time, flexibility, breakdowns or crashes, usability, and usefulness (Karsh, 2004). The last two are central and most often studied due to the theory of technology acceptance model (TAM). The other technological factors have direct and indirect effects on technology acceptance. The direct effect proposes that well-designed technologies are more likely to be accepted than those seen as poorly designed. The indirect effect suggests that new technology changes the nature of work, and end users react to those changes. New technologies may change the job structure and consequently, perceptions of the technology are influenced. There is empirical evidence that if new technology implementation leads to more significant job changes, it is more likely that the users will develop perceptions of negative impacts. For instance, it is worth noting that most patient safety technologies often lead to critical job changes as well. (Karsh, 2004)

Additionally, individual factors predict technology acceptance too. Computer self-efficacy and feeling confident with one's own abilities is shown to have an impact on intentions to use computers and other technologies (Agarwal et al., 2000). The education level and experience with technology has also been found to affect perceived ease of use (Agarwal and Prasad, 1999). Age matters too since younger users put more emphasis on attitudinal factors such as effect on performance, whereas older users find ease of use and perceptions of others being more important. Gender plays a role as a moderator as well: women find ease of use and subjective norms important, while men find usefulness to be critical (Venkatesh and Morris, 2000). Furthermore, based on the diffusion of innovations theory, early adopter professionals' attitude and behavior are different to late adopters. For instance, early adopters tend to perceive innovations as easier to use and more advantageous, whereas the late adopters have more negative beliefs about technological innovations, so considering personal characteristics is recommended while constructing programs to enhance technology usage (Escobar-Rodríguez and Romero-Alonso, 2014). Additionally, a research conducted in ten different developing countries reveals that technology usage while studying medicine, as well as promotion by government, are predictors of innovation acceptance by affecting behavioral intention (Nuq and Aubert, 2013). However, there is still a lack of intervention programs in healthcare for technology usage, even though the number of studies on this topic is increasing (Gucin and Berk, 2015).

2.4 Telemedicine services in Finland

Finnish healthcare system relies mainly on public health care providers, like in other Nordic countries. Most of the health care is financed through taxes and other support from the government. Additionally, there are private health care services that are based on insurances and service fees (Hämäläinen and Reponen, 2015). Finland is going through a major reform of social and health services. The risen cost of public services in health care combined with an aging population and migration to urban areas has led to an unequal distribution of services - the smaller municipalities are too small to organize enough health care services. The goal of the reform is to achieve better services that are customer-oriented, effective, cost-efficient, and well-coordinated (Kouri et al., 2018).

The first Finnish national strategy for applying health care information technologies was launched in 1996 (Ministry of Social Affairs and Health, 2015). Since then, Finland has recognized the need for information society police development and built a national strategy on how to develop information and communication technology (ICT) in the health care sector. Nowadays, the documentation of patient data is carried out by electronic means at all levels of care. The latest Information Strategy for Social and Health Care 2020 was published at the end of 2014. Its objective is to contribute to the renewal of the social welfare and health care sector as well as improve information management and increase the provision of online services to support the role of citizens in maintaining their own well-being. Making active use of health care-related information and refining it into knowledge is therefore crucial for supporting both the health care service system and individual citizens. (Ministry of Social Affairs and Health, 2015).

The Finnish Society for Telemedicine and e-Health (FSTeH) was founded in 1995, and the aims of the society are: 1) to promote population health through telecommunications and 2) to disperse expert knowledge within health care. The society is multi-professional having members from different backgrounds, such as medical doctors, nurses, engineers, businesspeople, researchers, educational staff, and health administrators (Reponen, 2005). Moreover, Finland is one of the first countries in Europe to establish a professional special competence program for healthcare information technology since 2012 to medical doctors and since 2015 to dentists. It requires two years of full-time service in healthcare information technology-related positions and other theoretical studies. The new competence gives them an ability to utilize their knowledge about health care processes for the benefit of the new information and communication technologies in health care (Reponen, 2017).

Both public and private sector considers digitalization as one of the possible solutions to tackle the problem of uneven distribution of services (Kouri et al. 2018). Digitalization of public services is stated as one of the strategic priorities by the Finnish government. Teleradiology was first used in Finland in 1969 when x-ray images between Oulu and Helsinki were sent, 600 kilometers in between. Even though the quality of the images was considered adequate, the costs were still too high for routine clinical use. Around the same time, first electrocardiograms (ECG) were tested and sent over a telephone line in remote health care centers in Lapland, and telephone consultations had already been common. Later, in the beginning of 1990s the modern digital telemedicine networks started to emerge. Also, the usage of teleradiology started to spread connecting various hospitals and health care centers. Applications of telemedicine were developed in other specialties as well, such as telepsychiatry video consultations and teleorthopedic consultation services. As a result, comprehensive telemedicine consultation networks were starting to form. By 2010, all public and private care providers had all the medical records, images, and laboratory data in digital format – this served as an essential digital backbone for further developments in telemedicine (Kouri et al., 2018). All health care services, both public and private, obey the same treatment guidelines and patient documentation policies, which enables the opportunities offered by telemedicine (Hämäläinen and Reponen, 2015).

By deregulation, some bureaucratic barriers have been removed from preventing the implementation of new services – for example, The National Supervisory Authority for Welfare and Health (Valvira in Finnish) approved providing online health services by means of a video call or smartphone in late 2015 (Kouri et al., 2018; Ministry of Social Affairs and Health, 2015). Consequently, Terveystalo, the largest healthcare service company in Finland, launched a new service to chat with a doctor online. It became evident that there is a customer need and treating certain medical conditions was made possible without compromising high standards of quality, ethics, and patient safety. Therefore, five months from the launch the availability was extended to 24/7 service. The physicians are private practitioners and pick patients from a virtual queue. Queueing time is short, response time being around a few seconds. The service is accessible from anywhere in Finland, so it helps in rural areas with low availability of physician resources. About 80% of the chat appointments last less than 12 minutes and it is possible to prescribe medicine and do referrals. Other healthcare service companies in Finland have also implemented online doctor services. This new manner for physicians to create their working days has also given them flexibility to working life. (Kouri et al., 2018)

Finland has applied telemedicine in a few ways recently. For example, The Virtual Hospital 2.0 is a citizen centered digital healthcare service as a result of a joint effort of all five Finnish University Hospitals in Helsinki, Turku, Tampere, Oulu and Kuopio. Its central outcome is the website Terveyskylä.fi ("Health Village") digital health service, which provides information and support for citizens, care for patients and tools for professionals. It makes digital healthcare services equally available to all Finnish people regardless of their place of residence or income level. The provided services complement the traditional treatment pathways by monitoring the quality of life, symptoms, and lifestyle. It is therefore well-suited to monitor living with long-term illness before and during treatment. (Kouri et al. 2018)

Another current project for developing digital health care services is ODA – Digital self-care services, which is run by primary healthcare units of major cities in Finland. It aims to build a personal healthcare clinic at home to implement digital service package which includes electronic well-being check-up and training, smart diagnosis and estimates the need for services. The ODA project combines data from different sources to provide fluent, automated self-care service chains. (Kouri et al., 2018)

2.4.1 Opportunities and barriers of telemedicine

Telemedicine can improve the effectiveness, accessibility, continuity, and quality of care. The offered telemedicine service should be as competent and have equal effect as a traditional visit to physician. Telemedicine services can be utilized to collect patient information before the visit to save time during the face-to-face visit, which improves effectiveness. While an in-person visit may be required at first, telemedicine services can also be conducted to follow-up – especially in the case of patients with chronic conditions. The frequency and duration of hospital visits can therefore be reduced compared to traditional health care practice. Moreover, the use of telemedicine by means of electronic communication rather than telephone messaging allows both the physician and the patient respond at their convenience; this also works especially with long-term illnesses. (Hickson et al., 2015)

Telemedicine brings healthcare services for the people in the areas where there are no physical offices or geographical accessibility is otherwise challenging. As a result, there are no travel costs, need for infrastructure or fuel, and less time invested in general; no need to take that much time from work for the patient. It is especially valuable for people in remote or rural areas, vulnerable groups, and ageing populations. Initially, telemedicine was advocated as a solution to ease the accessibility of health services by rural patients who face geographic barriers (LeRouge et al. 2010). In addition to geographical location, distance can also be defined in terms of socioeconomic status and time constraints (Haluza and Jungwirth, 2014). Therefore, as telemedicine technology evolves, it is recommended to explore it as part of holistic care for both urban and rural patients (Muzammil, 2020).

Telemedicine also provides an opportunity to gain important medical insights by analyzing constant health data for a patient collected through remote monitoring that is then combined with other data sources such as laboratory results and electronic medical records (Ghosh and Ahadome, 2012). Additionally, it is a tool that can be used to transform health care by encouraging higher patient involvement in decision-making and providing new methods to maintaining a healthy lifestyle (The American Telemedicine Association, 2006).

The growing number of e-visits, expansion of telemedicine in areas of radiology, cardiology, and others have resulted in the development of new business and healthcare models around telemedicine (Fortune Business Insights, 2019). The Covid-19 pandemic has rapidly expanded the use of telemedicine for urgent and nonurgent visits. In the United States, it was reported that in the first half of 2020, telemedicine visits were 8 to 10 times higher than in 2019 (Custer, 2020). The pandemic has suddenly accelerated the adoption of telemedicine services and serves as an opportunity to change the structure of health plan networks (Custer, 2020; Wosik et al. 2020).

There are several challenges affecting the implementation of telemedicine services: reimbursement & malpractice, clinical & economic benefits, acceptability to providers & patients, and technological requirements (Ghosh and Ahadome, 2012). One of the biggest challenges is the lack of a defined reimbursement model, which may result in that the medical community is not willing to take on this “additional” work. Furthermore, physicians have raised a concern of a possibly higher chance for malpractice if critical patient information gets lost in the amount of data. This may cause them to be targets for malpractice lawsuits, especially in the private sector. (Ghosh and Ahadome, 2012)

In terms of clinical and economic benefits, there remains a lack of clear evidence base. One study analyzed the effectiveness of telemedicine in terms of clinical outcomes and cost-effectiveness by conducting a systematic review of reviews (Ekeland et al. 2010). According to the reviews, the clinical effectiveness varies depending on the type of intervention: for example, home telehealth for diabetes and telehealth approaches to secondary prevention of coronary heart disease were found to be therapeutically effective, whereas evidence is limited regarding the use of virtual reality in stroke therapy and telemonitoring for heart failure. However, it has been underlined that lack of evidence does not necessarily mean lack of experience and in some cases, interventions are only unproved (Barlow et al. 2007). Telemedicine is not an appropriate model of care for all medical conditions, such as when a hands-on physical examination is needed (Miller and Derse, 2002). Moreover, cost is always a vital consideration when making decisions to implement new services of delivery, even if they have been shown to improve patient outcomes (Ekeland et al. 2010). There remains lack of enough knowledge and understanding of the costs of telemedicine. Several studies suggest telemedicine to be economical, however, definite conclusions have not been drawn and the cost-effectiveness also depends on the type of intervention (Rojas and Gagnon, 2008). Another economic aspect is not only the costs to health services, but also costs to the users and their social networks (Griffiths et al., 2006).

Health care industry is historically a late adopter of technology and the late adoption acts as a barrier to many initiatives that are based on the use of technology. Facilitating the adoption of all forms of technology in health care is critical to improved outcomes, expanded access and better efficiency. Telemedicine projects have faced the problems of organizational change when introducing new systems. Also, training the health care personnel when introducing new systems has raised another challenge. As a possible solution to overcome the resistance, new alliances between leaders from health technology, clinical medicine and public health should be made. (The American Telemedicine Association, 2006)

The medical community shares different views of telemedicine; some are more certain about the necessity of wider adoption of telemedicine, while others are not convinced that it could improve the quality of care. Additionally, telemedicine can only be successful if also patients are engaged and compliant to the clinical regimen, which may require a higher level of self-management from the patient (Ghosh and Ahadome, 2012). A high level of doubtfulness towards technology in healthcare has been observed across EU countries (European Commission, 2018).

It is worth noting that there are some disadvantages of using technology in health care, of which one of the major issues is ensuring patients' personal privacy (Ghosh and Ahadome, 2012). Moreover, the provided services are directly affected by the quality of the technology used, for example: the speed of Internet, 3G versus 4G or fiber optic versus dial-up broadband. Studies suggest that poorer broadband infrastructure in rural areas prevents telemedicine in the United States (Drake et al. 2019; Wilcock et al. 2019). The challenge of reliable Internet connection is even more apparent in developing countries (Muzammil, 2020). In more developed countries the emerging 5G technologies are expected to enhance the quality of communication and speed up the overall development of telemedicine (Stefano and Kream, 2018). These technologies have a lot of potential especially for the surgical specialties where augmented reality video at a local site and virtual reality video at a remote site could share an accurate visualization (Venkata et al. 2019).

3 RESEARCH MODEL AND HYPOTHESES

Medical doctors are among the primary users of telemedicine services and therefore have a profound influence on its success (Chau and Hu, 2002). Rho, Choi and Lee (2014) developed the telemedicine service acceptance model (TSA) based on the technology acceptance model (TAM) and included three predictive constructs from the previously published telemedicine literature: 1) accessibility of medical records and accessibility of patients as clinical factors, 2) self-efficacy as an individual factor and 3) perceived intentions as a regulatory factor. Taken together, the TSA model is an expanded TAM that is tailored to explain medical doctors' acceptance of telemedicine service. A survey was conducted, and data collected from 183 physicians in South Korea. The empirical validity of the model and causal relationships within the model were evaluated by applying a structural equation modeling. As a result, their study demonstrated that the telemedicine service acceptance model was feasible in explaining the acceptance of telemedicine services by physicians. They suggested that the TSA model can be applied to other countries. Therefore, I apply the same TSA model in this study. Figure 4 shows the research model of the concepts that are playing a role in telemedicine service adoption. The abbreviations and hypotheses are explained next in this chapter.

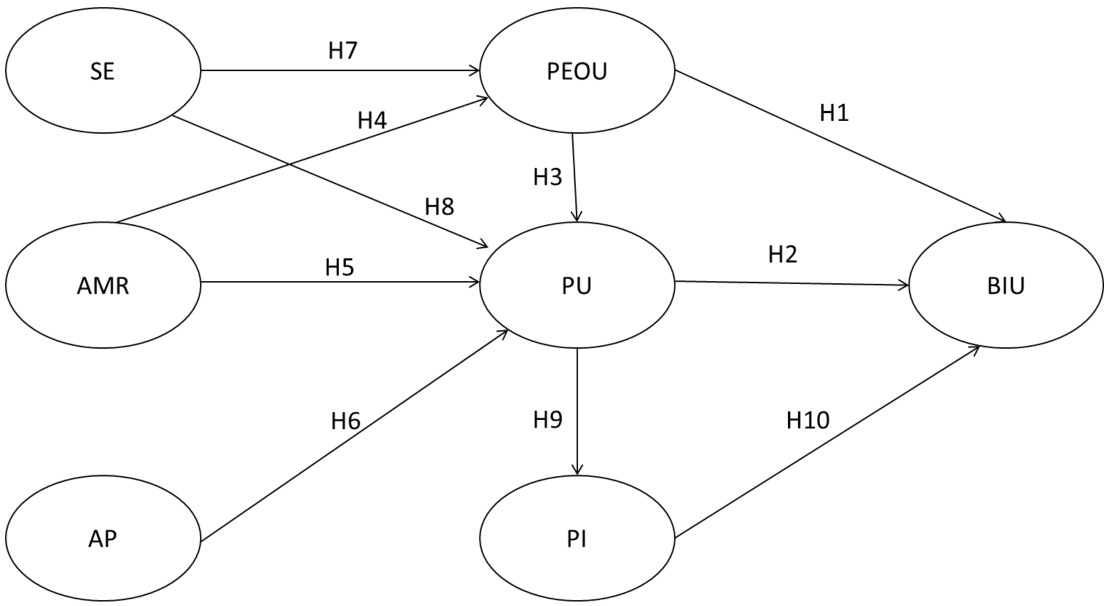

Figure 4. Research model. (Rho, Choi and Lee, 2014)

Definitions and abbreviations of the constructs are presented below in the Table 2 corresponding to the definitions in the original article (Rho, Choi and Lee, 2014).

Construct		**Definition**
Technology acceptance	Perceived usefulness (PU)	The degree to which a physician believes the use of telemedicine service would improve his or her health treatment outcomes and processes
	Perceived ease of use (PEOU)	The degree of ease that a physician associates with the use of telemedicine service
Clinical factors	Accessibility of medical records (AMR)	The degree to which a physician believes the use of telemedicine service would improve patients' health conditions and supply accurate and up-to-date information on patients
	Accessibility of patients (AP)	The degree to which a physician believes the use of telemedicine service would increase contact with underserved patients who live in regions remote to medical facilities
Invidivual factor	Self-efficacy (SE)	The physician's perception of his or her ability to use telemedicine devices
Regulatory factor	Perceived incentives (PI)	The degree to which a physician believes providing telemedicine service would be rewarded by financial support or medical fee compensation
Outcome	Behavioral intention to use (BIU)	The degree of a physician's behavioral intention to use telemedicine service

Table 2. Definition of constructs. (Rho, Choi and Lee, 2014)

As discussed in the Chapter 2.2.2 the perceived usefulness (PU) is originally defined as the degree to which a person believes that using a particular system would enhance his or her job performance. However, in this study PU is slightly re-defined because job performance in healthcare is meant to improve the quality and delivery of care per se. Perceived ease of use (PEOU) in this study suggests that the telemedicine service is easy to learn and use by medical doctors. According to several studies, PU and PEOU are seen crucial for the acceptance of new technology and influence the behavioral intention to use (Venkatesh and Davis, 2000; Wu et al. 2007). Therefore, hypotheses 1 and 2 are proposed:

H1. Perceived ease of use has a positive effect on medical doctors' behavioral intention to adopt telemedicine technologies.

H2. Perceived usefulness has a positive effect on medical doctors' behavioral intention to adopt telemedicine technologies.

Additionally, previous studies have proved that PEOU directly influences PU (Wu et al. 2007; Hung et al. 2012) meaning that greater ease of use of the service suggests that it is perceived more useful by the users. This is proposed for a telemedicine service as well, resulting in a hypothesis 3:

H3. Perceived ease of use has a positive effect on medical doctors' perceived usefulness of telemedicine technologies.

Clinical factors are related to the clinical aspects of telemedicine service. The accessibility of medical records and the accessibility of patients are critical factors that may increase the satisfaction of medical doctors and lead to improved health outcomes. Accessibility of medical records refers to "the degree to which a physician believes the use of telemedicine service would improve patients' health conditions and supply accurate and up-to-date information on patients". Accessibility of patients refers to "the degree to which a physician believes the use of telemedicine service would increase contact with underserved patients who live in regions remote to medical facilities". This is not only important but also an elemental feature of telemedicine service by its very nature. Rho, Choi and Lee (2014) suggested that physicians who have greater access to medical records through telemedicine service are likely to have more positive perceived ease of use and perceived usefulness, and that greater accessibility of patients would lead to increased perceived usefulness. Therefore, the following hypotheses are postulated:

H4. Greater accessibility of medical records has a positive effect on medical doctors' perceived ease of use of telemedicine technologies.

H5. Greater accessibility of medical records will have a positive effect on perceived usefulness.

H6. Accessibility of patients has a positive effect on medical doctors' perceived usefulness of telemedicine technologies.

As an individual factor, self-efficacy has been found to be dominant in telemedicine service acceptance. Even though medical doctors are professional healthcare experts, they have reported a lack of confidence when using new technology for their clinical practice (Hung et al. 2012). In this context, self-efficacy is defined as "the physician's perception of his or her ability to use telemedicine services". Greater self-efficacy is reported to lead to higher system usage and may affect behavioral intention through perceived ease of use and perceived usefulness (Thong et al. 2002). Consequently, the following hypotheses are proposed:

H7. Self-efficacy has a positive effect on medical doctors' perceived ease of use of telemedicine technologies.

H8. Self-efficacy has a positive effect on medical doctors' perceived usefulness of telemedicine technologies.

As a regulatory factor, the construct perceived incentives is defined as "the degree to which a physician believes providing telemedicine service would be rewarded by financial support or medical fee compensation". Perceived incentives have found to affect a physician's intention to use a telemedicine service (Katz and Moyer, 2004). It is also predicted that physicians would experience increased incentivization when telemedicine service is seen to be useful for the patient (Rho, Choi and Lee, 2014). The following hypotheses are proposed.

H9. Perceived usefulness has a positive effect on medical doctors' perceived incentives of telemedicine technologies.

H10. Perceived incentives has a positive effect on medical doctors' behavioral intention to adopt telemedicine technologies.

4 DATA AND METHODS

The previously validated telemedicine service acceptance -model (TSA) was applied in this study. The model consists of 24 items that are measured using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Demographic questions included gender, age, specialization, principal employer, and region. In addition to that, I also asked whether one has used telemedicine before the Covid-19 pandemic, started using it during the pandemic or has not used it yet. Then I asked whether the pandemic has affected one's attitude towards the use of telemedicine using a 5-point Likert scale; 1 meaning that the attitude has been affected very negatively, 3 meaning there is no change in attitude and 5 meaning that the attitude has been affected very positively.

The study data were obtained from the medical doctors working in Finland. The web-based survey questionnaire was distributed in two Facebook groups: "Lääkärien tutkimuspalsta", which translates freely into "Doctors' research group" and "Startup-lääkärit", which translates into "Startup-doctors". These Facebook groups are private, and qualifications are checked upon joining. Additionally, I distributed the survey through my personal connections who then also forwarded it to other medical doctors. This non-probabilistic sampling technique, "snowball sampling", where existing participants provided referrals to recruit more samples, was used for the convenience of sampling. The survey was open for one week in November 2020 resulting in 185 responses from medical doctors in Finland. All the responses were valid and fully completed due to the settings made in the survey. The statistical analysis of the data was assessed using IBM SPSS Statistics 27 (Statistical Package for the Social Sciences) and the structural equation modeling was performed using IBM SPSS Amos 27. First, descriptive statistics were analyzed using one-way ANOVA to examine potential biases and respondent characteristics. Then, I conducted a confirmatory factor analysis and assessed the model fit. Finally, hypothesis testing and structural equation modeling (SEM) was applied to link causal relationships between the model parameters.

5 FINDINGS

5.1 Respondent demographics

	Frequency	(%)	p-value (for ANOVA)
Gender			0.196
Male	97	52.4	
Female	88	47.6	
Age			0.123
29 or less	7	3.8	
30-39	51	27.6	
40-49	41	22.2	
50 or more	86	46.4	
Specialization			**0.001***
Diagnostic specialty	48	26.0	
Surgical specialty	22	11.9	
Internal medicine specialty	11	6.0	
Psychiatric specialty	3	1.6	
Other operative specialty	16	8.6	
Other traditional/conventional specialty	43	23.2	
Other specialty or unspecialized	42	22.7	
Career			0.148
Less than a year	6	3.2	
1-5 years	14	7.6	
6-10 years	33	17.8	
11-15 years	22	11.9	
More than 15 years	110	59.5	
Principal employer			0.270
University central hospital	105	56.8	
Central hospital	15	8.1	
Other hospital, healthcare center or school/student healthcare	29	15.7	
Private hospital or private healthcare center	36	19.4	
Region			0.335
Helsinki University Central Hospital	143	77.3	
Turku University Hospital	10	5.4	
Tampere University Hospital	8	4.3	
Oulu University Hospital	11	6.0	
Kuopio University Hospital	13	7.0	
TOTAL	185	100.0	
			*** p<0.05**

Table 3. Respondent demographics.

Table 3 summarizes the respondent characteristics. 52.4% of the respondents were male and the highest frequency was observed in the 50 or more -age group. Specialization groups were categorized based on the classification made by The Finnish Medical Association (2021). The diagnostic specialties (26.0% of the respondents) include radiology, pathology, medical genetics, clinical pharmacology and medication, clinical physiology and nuclear medicine, clinical chemistry, clinical microbiology, and clinical neurophysiology. The surgical specialties (11.9% of the respondents) include gastroenterological surgery, hand surgery, pediatric surgery, neurosurgery, orthopedics and traumatology, plastic surgery, oral and maxillofacial surgery, cardiothoracic surgery, urology, vascular surgery, and general surgery. The internal medicine specialties (6.0% of the respondents) include endocrinology, gastroenterology, infectious diseases, cardiology, clinical hematology, nephrology, rheumatology, and internal medicine. The psychiatric specialties (1.6% of the respondents) include pediatric and youth psychiatry, forensic psychiatry, and general psychiatry. Other operative specialties (8.6% of the respondents) include emergency medicine, anesthesiology and intensive care, otolaryngology, obstetrics and gynecology, phoniatrics and ophthalmology. Other traditional/conventional specialties (23.2% of the respondents) include physiatrics, pediatrics, neurology, dermatology and allergology, oncology, geriatrics, and pulmonology. Other specialties/unspecialized (22.7% of the respondents) include sports medicine, general medicine, occupational health care, public health care and forensic medicine. Respondents' career longevity was as follows: less than a year (3.2%), 1-5 years (7.6%), 6-10 years (17.8%), 11-15 years (11.9%) and 15 years or more (59.5%). Participants were employed by university central hospitals (56.8%), central hospitals (8.1%), other hospitals, healthcare centers or school/student healthcare (15.7%) and private hospitals or private healthcare centers (19.4%). Most respondents were located in the region of Helsinki University Central Hospital (77.3%).

A one-way ANOVA (analysis of variance) was conducted to examine potential biases and determine whether there are statistically significant differences between the means of different respondent groups. To minimize potential idiosyncratic effects, the groups internal medicine specialties (11 respondents) and psychiatric specialties (3 respondents) were combined during one-way ANOVA test. The construct "behavioral intention to use" was set as a dependent factor. It resulted that among specializations there is a statistically significant difference on the behavioral intention to use telemedicine services ($p=0.001$). The Tukey post hoc test was conducted to determine which categorical groups differed from each other. Between specialization groups, there was a statistically significant difference between diagnostic specialties and other operative specialties (p=0.001), as well as between other specialties or unspecialized and other operative specialties (p=0.024). Diagnostic specialty group had a 1.13 points higher mean score on behavioral intention to use than “other operative specialty” on a 1-5 Likert-scale. Other specialty or unspecialized group had a 0.89 points higher mean score on behavioral intention to use than “other operative specialty”.

5.2 Confirmatory factor analysis

The confirmatory factor analysis (CFA) was conducted to test whether the measures of a construct are in line with the understanding of the assumed nature of a certain construct. Table 4 shows the results of CFA. The analysis was performed using SPSS Amos 27. First, the analysis was run using the original model. The construct “Perceived incentives” turned out to be problematic due to its standardized factor loadings; PI01: “This service needs proper government policy and support” resulted in 0,059, PI02: “It needs monetary incentives” resulted in 0,516 and PI03: “It would be meaningful if financial support were given” resulted in a questionable 1,269. Consequently, the construct was eliminated from this study but the item PI02 was retained as a single item without summing it up in a scale. Naturally, this also led to the elimination of hypothesis 9: “Perceived usefulness has a positive effect on medical doctors’ perceived incentives of telemedicine technologies”. Due to this elimination, the hypothesis 10 had to be newly formed as follows:

H10*. The item PI02: “It needs monetary incentives” has a positive effect on medical doctors’ behavioral intention to adopt telemedicine services.

Additionally, the item BIU03: “I will gain accurate patient information and treatment histories” was dropped due to its low standardized factor loading (0,409).

The convergent validity for each construct was evaluated using the average variance extracted (AVE) and composite reliability (CR). All constructs resulted in a higher AVE than the recommended 0,50 as well as higher CR than the recommended 0,70 (Chin, 1998). Therefore, the validity level of each construct is acceptable. The internal consistency values measured by Cronbach’s alpha were significant for all constructs ranging from 0,714 to 0,938, all being greater than the recommended limit of 0,70 (Nunnally, 1978).

The correlation matrix in the Table 5 is demonstrated to support the discriminant validity of each construct. According to the Fornell-Larcker testing system (1981), the levels of the AVE for each construct should be greater than the inter-squared correlations involving the construct. The correlations between construct are shown first, and the squared correlations are shown in brackets. For instance, the AVE of SE (0,803) exceeds each of the squared correlation values between SE and other constructs.

Construct	Items	Unstandardized estimate	Standard error	Critical ratio	Standardized factor loadings	p-value	Average variance extracted	Composite reliability	Cronbach's alpha
SE	SE01	1,000	-	-	0,898				
	SE02	1,055	0,069	15,264	0,816	***	0,803	0,876	0,938
	SE03	1,101	0,055	20,110	0,921	***			
	SE04	1,073	0,050	21,343	0,944	***			
PEOU	PEOU01	1,000	-	-	0,855				
	PEOU02	0,993	0,092	10,745	0,856	***	0,578	0,734	0,714
	PEOU03	0,924	0,134	6,903	0,521	***			
BIU	BIU01	1,000	-	-	0,902				
	BIU02	1,070	0,057	18,883	0,912	***	0,800	0,799	0,764
	BIU04	1,094	0,064	17,019	0,868	***			
PU	PU01	1,000	-	-	0,645				
	PU02	0,997	0,119	8,361	0,520	***	0,505	0,768	0,813
	PU03	1,211	0,151	8,021	0,701	***			
	PU04	0,938	0,137	6,844	0,581	***			
AMR	AMR01	1,000	-	-	0,706				
	AMR02	1,484	0,205	7,232	0,938	***	0,556	0,725	0,766
	AMR03	0,801	0,117	6,826	0,537	***			
AP	AP01	1,000	-	-	0,562				
	AP02	3,249	0,802	4,052	0,823	***	0,606	0,744	0,789
	AP03	3,557	0,909	3,914	0,908	***			

SE: self-efficacy, PEOU: perceived ease of use, BIU: behavioral intention to use, PU: perceived usefulness, PI: perceived incentives, AMR: accessibility of medical records, AP: accessibility of patients

Table 4. Measurements and confirmatory factor analysis.

Construct	SE	PEOU	BIU	PU	AMR	AP
SE	1,000					
PEOU	0,539** (0,291)	1,000				
BIU	0,478** (0,228)	0,511** (0,261)	1,000			
PU	0,384** (0,147)	0,391** (0,153)	0,409** (0,167)	1,000		
AMR	0,353** (0,124)	0,299** (0,089)	0,291** (0,087)	0,125 (0,016)	1,000	
AP	0,409** (0,167)	0,298** (0,089)	0,390** (0,152)	0,272** (0,074)	0,363** (0,132)	1,000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5. Discriminant validity.

5.3. Model fit

The structural equation modeling was performed using SPSS Amos 27. First, the analysis was run using the original model. Then, some modification indices were applied to improve the fit and as a result, the original TSA model could not be applied per se, but a few changes were made. This chapter introduces the adjusted model.

Numerous goodness-of-fit indicators are used to assess the model fit. The fit indices used in this study were the chi-square/degree of freedom (χ^2/df), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), non-normed fit index (NNFI), comparative fit index (CFI), standardized root mean square residual (SRMR) and root mean square of error of approximation (RMSEA). Initially, the fit of the research model was somewhat poor but after applying deliberate modification indices, the model fit improved. The model improved by adding the following modification indices: 1) covariances between the error terms of items PU01 and PU02, 2) covariances between the error terms of items PU03 and PU04 and 3) regression weights from the construct "Perceived usefulness" to the item

AP01 and to the item PEOU03. Additionally, the items PI01, PI03 and BIU03 were eliminated as explained previously in the Chapter 5.2. After these modifications, the model fit results improved as follows: chi-square/df: 2,723 → 1,938; GFI: 0,778 → 0,853; AGFI: 0,725 → 0,808; NNFI: 0,830 → 0,923; CFI: 0,851 → 0,935; SRMR: 0,175 → 0,139; RMSEA: 0,097 → 0,071. These results show that GFI, AGFI and SRMR do not meet their recommended thresholds. However, GFI and AGFI are considered outdated versions of CFI can be overly influenced by the size of the sample (Byrne, 2010). Also, SRMR was not reported in the original study. Other fit measures are shown in the Table 6 and are within the acceptable levels, of which most critical ones are CFI and RMSEA.

Model-fit index	**Recommended value**	**Scores**
Chi-square/degree of freedom	≤3.00	1,938
Goodness-of-fit index (GFI)	≥0.90	0,853
Adjusted goodness-of-fit (AGFI)	≥0.90	0,808
Non-normed fit index (NNFI)	≥0.90	0,923
Comparative fit index (CFI)	≥0.90	0,935
SRMR	≤0.08	0,139
RMSEA	≤0.08	0,071

Table 6. Fit of the research model.

5.4 Hypothesis testing

Hypothesis 1 stated that there would be a positive relationship between the perceived ease of use and the behavioral intention to use telemedicine. It was strongly supported by a positive path coefficient ($\beta = 0.251$, $p < 0.001$). Hypothesis 2 predicted that perceived usefulness has a positive effect on the behavioral intention to use and was also strongly supported ($\beta = 0.680$, $p < 0.001$). Hypothesis 3 stated that perceived ease of use would have a positive effect on the perceived usefulness. A positive path coefficient supported this ($\beta = 0.350$, $p < 0.01$). Hypothesis 4 stated that the accessibility of medical records would have a positive effect on perceived ease of use, and it was supported by a positive path coefficient ($\beta = 0.198$, $p < 0.01$). Hypothesis 5 predicted that the accessibility of medical records would have a positive effect on perceived usefulness. This hypothesis was rejected due to a negative value of standardized estimate ($\beta = -0{,}168$). Hypothesis 6 stated that the accessibility of patients would have a positive effect on the perceived usefulness, and it was strongly supported by a positive path coefficient ($\beta = 0.372$, $p < 0.001$). Hypothesis 7 stated that self-efficacy would have a positive effect on perceived ease of use of telemedicine. It was strongly supported by a positive path coefficient ($\beta = 0.681$, $p < 0.001$). Hypothesis 8 stated that self-efficacy would have a positive effect on perceived usefulness. This hypothesis was not supported ($\beta = 0.117$, $p = 0.299$). As mentioned earlier in the Chapter 5.2., the Hypothesis 9 was eliminated due to its poor fit in the model. Finally, the newly formed hypothesis 10* consists of only one item of perceived incentives suggesting that the item PI02: "It needs monetary incentives" will have a positive effect on the behavioral intention to use telemedicine. This hypothesis was rejected ($\beta = 0.084$, $p = 0.113$). On the next page, Table 7 shows the structural model results and Figure 5 illustrates the hypotheses testing results in the research model.

Hypotheses	Path	Unstandardized estimate	Standard error	Critical ratio (C. R., t)	Standardized estimate	*p*-Value	Findings
H1	PEOU --> BIU	0,327	0,088	3,730	0,251	***	Supported
H2	PU --> BIU	0,853	0,102	8,364	0,680	***	Supported
H3	PEOU --> PU	0,363	0,130	2,782	0,350	**	Supported
H4	AMR --> PEOU	0,229	0,079	2,903	0,198	**	Supported
H5	AMR --> PU	-0,202	0,096	-2,107	-0,168	0,035	Not supported
H6	AP --> PU	0,405	0,097	4,184	0,372	***	Supported
H7	SE --> PEOU	0,546	0,060	9,097	0,681	***	Supported
H8	SE --> PU	0,097	0,093	1,038	0,117	0,299	Not supported
H9	PU --> PI02	-	-	-	-	-	-
H10	PI02 → BIU	0,080	0,050	1,585	0,084	0,113	Not supported

$p<0.05$. *$t_{0.05}=1,960$
*****$p<0.01$. **$t_{0.01}=2,576$***
******$p<0.001$. ***$t_{0.001}=3,291$***

Table 7. Structural model results.

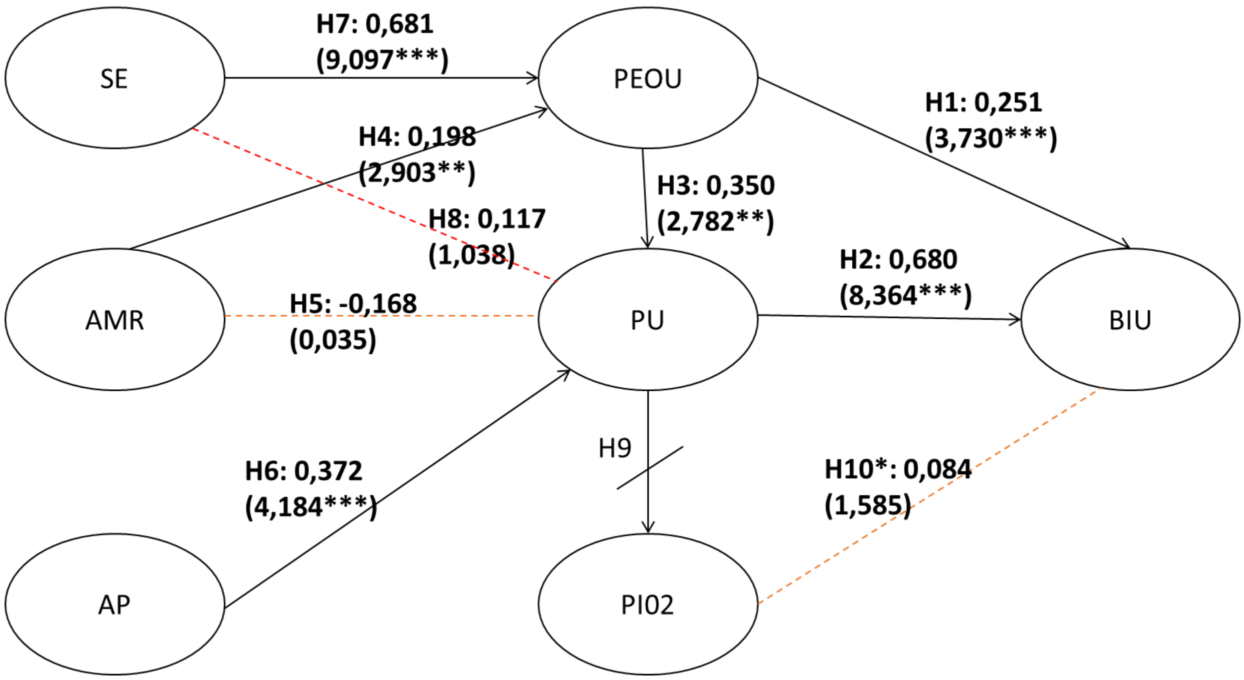

Figure 5. Hypotheses testing results in the research model.

5.5 Effects of the Covid-19 pandemic

As Covid-19 pandemic has increased the use of telemedicine (Mann et al., 2020), I also researched whether the acceptance of its use has improved among doctors during the pandemic. I asked two additional questions:

1. **"Have you used telemedicine services in your practice?"**

   Yes, before Covid-19 / Yes, I started during Covid-19 / No, I have not".

I conducted one-way ANOVA test to compare means of different categories and using behavioral intention to use as a dependent factor. From one-way ANOVA, I found that previous experience with telemedicine elicited a statistically significant effect on the behavioral intention to use telemedicine in the future. There was a statistically significant difference between having used telemedicine before the pandemic and having never used it (p=0.000). Having used telemedicine before the pandemic resulted in 0.75 points higher mean score on behavioral intention to use on a 1-5 Likert-scale than having never used telemedicine (see Table 8).

Those who had used telemedicine already before the pandemic scored a higher mean in behavioral intention to use (3,91) than those who had never used it (3,16). Those who started using telemedicine during the pandemic score a mean 3,58 on behavioral intention to use. Having used telemedicine services before the pandemic is therefore a predictor of a higher behavioral intention to use it and having started the use of telemedicine during the pandemic also predicts a higher behavioral intention to use (see Table 9).

Multiple Comparisons

Dependent Variable: Behavioral intention to use

(I) Have you used telemedicine services in your practice?	(J) Have you used telemedicine services in your practice?	Mean Difference (I-J)	Std. Error	Sig.
No, I haven't	Yes, before the pandemic	-,74663*	,19416	,000
	Yes, I started during the pandemic	-,41905	,20449	,104
Yes, before the pandemic	No, I haven't	,74663*	,19416	,000
	Yes, I started during the pandemic	,32759	,16047	,105
Yes, I started during the pandemic	No, I haven't	,41905	,20449	,104
	Yes, before the pandemic	-,32759	,16047	,105

*. The mean difference is significant at the 0.05 level.

Table 8. One-way ANOVA (experience).

Mean Score

Behavioral intention to use (Likert-scale 1-5)

Have you used telemedicine services in your practice?	Mean	N	Std. Deviation
No, I haven't	3,1643	35	1,15514
Yes, before the pandemic	3,9109	87	,89490
Yes, I started during the pandemic	3,5833	63	,95883
Total	3,6581	185	1,00458

Table 9. Mean scores on behavioral intention (experience).

2. **"How has the pandemic changed your attitude towards the use of telemedicine as an alternative?"** (on a Likert-scale from 1 to 5)

1. affected very negatively
2. affected a bit negatively
3. remained the same
4. affected a bit positively
5. affected very positively.

I conducted one-way ANOVA to see how behavioral intention to use telemedicine was influenced based on the changes in one's attitude towards telemedicine during the pandemic. I combined the choices 1. affected very negatively, 2. affected a bit negatively and 3. remained the same into one category to have a more reliable sample size. I found that there is a statistically significant effect ($p = 0.021$) on the behavioral intention to use telemedicine in the future if the pandemic has affected one's attitude very positively (5) compared to having affected very negatively (1), a bit negatively (2) or remained the same (3). Having had a very positive change in attitude resulted in 0.51 points higher mean score on behavioral intention to use telemedicine on a 1-5 Likert-scale compared to those whose attitude had been affected very negatively, a bit negatively or remained the same (see Table 10).

Those whose attitude towards telemedicine was affected very positively by the pandemic scored 3,98 on behavioral intention to use telemedicine, those whose attitude was affected a bit positively scored 3,60 on behavioral intention to use telemedicine and those whose attitude was affected very negatively, a bit negatively or remained the same scored 3,47 on behavioral intention to use telemedicine. Thus, it can be claimed that positive changes in attitude during the pandemic predict a higher behavioral intention to use telemedicine also in the future (see Table 11).

Multiple Comparisons

Dependent Variable: Behavioral intention to use

(I) How has the Covid-19 pandemic affected your attitude towards the use of telemedicine as an alternative?	(J) How has the Covid-19 pandemic affected your attitude towards the use of telemedicine as an alternative?	Mean Difference (I-J)	Std. Error	Sig.
1, 2 or 3	4	-,12723	,17213	,741
	5	-,50939*	,18912	,021
4	1, 2 or 3	,12723	,17213	,741
	5	-,38216	,17952	,087
5	1, 2 or 3	,50939*	,18912	,021
	4	,38216	,17952	,087

*. The mean difference is significant at the 0.05 level.

Table 10. One-way ANOVA (attitude).

Mean Score

Behavioral intention to use (Likert-scale 1-5)

How has the Covid-19 pandemic affected your attitude towards the use of telemedicine as an alternative?	Mean	N	Std. Deviation
1, 2 or 3	3,4661	59	1,14701
4	3,5933	75	,94330
5	3,9755	51	,84743
Total	3,6581	185	1,00458

Table 11. Mean scores on behavioral intention (attitude).

6 CONCLUSIONS

6.1 Discussion

This study attempted to identify the predictive factors that influence the usage of telemedicine services among medical doctors in Finland. The telemedicine service acceptance model (TSA), which is expanded from the technology acceptance model (TAM), has been first applied in South Korea and developed by Rho, Choi and Lee (2014). The applicability of the TSA model in Finland required some modifications to the model, however, the overall fit of the model turned out to be suitable.

One-way ANOVA test of the respondent demographics showed that among medical specializations there is a statistically significant difference on the behavioral intention to use telemedicine services. Between specialization groups, there was a statistically significant difference between diagnostic specialties and other operative specialties & between other specialties or unspecialized and other operative specialties. This may indicate that diagnostic specialties, such as radiology, already have existing prerequisites for the use of telemedicine as diagnostics can done from distance. On the other hand, due to practical reasons operative specialties may consider the use of telemedicine challenging since face-to-face contact is often required for operations. However, new augmented reality technologies are on their way to revolutionize medical operations through robotic surgery and other digital information systems, for example.

As suggested by the original TAM, perceived usefulness and perceived ease of use are considered two critical factors in technology acceptance (Davis, 1986), and they were also found to be dominant factors in telemedicine service acceptance based on the supported hypotheses 1 and 2. Additionally, a higher perceived ease of use has generally predicted a positive effect on perceived usefulness (Wu et al. 2007; Hung et al. 2012) and this was confirmed also in this study as the hypothesis 3 was supported. The original study conducted in South Korea (Rho, Choi and Lee, 2014) also supported these hypotheses. Technological matters are important in healthcare context and telemedicine service processes should be designed based on the actual needs and clinical environments in a way that they support perceived ease of use and perceived usefulness.

The accessibility of medical records as a predictor of higher perceived ease of use was supported (hypothesis 4), but the accessibility of medical records as a predictor of higher perceived usefulness was rejected (hypothesis 5). These results are exactly the opposite to those that elicited from the original study in South Korea. This can be explained due to the fact that in South Korea it is not allowed to access patient medical records from outside the hospital and therefore, the accessibility is limited. Thus, they first consider the accessibility of medical records to be useful per se and reflection of a prerequisite, whereas in Finland you can access medical records outside the hospital through secured network communications and can already perceive it as easing the use of telemedicine services. This demonstrates that a good accessibility of medical records leads to a better satisfaction with telemedicine services. Moreover, the accessibility of patients has a strong positive effect on perceived usefulness as hypothesis 6 suggested and was also accepted in the original study. This is obviously essential for providing telemedicine services in the first place.

Hypotheses 7 and 8 suggested that self-efficacy has a positive effect on perceived ease of use and perceived usefulness, respectively. This study supported that a higher self-efficacy would have a positive effect on perceived ease of use. One's own judgment of his or her good capability to use a new system is therefore related to a better perceived ease of use of a new system. However, the hypotheses 8 was rejected in this study since self-efficacy did not predict a higher perceived usefulness. This could indicate that many telemedicine services are yet unknown to medical doctors or they may have not had enough exposure for the opportunities that these services would offer. Educational programs should be established to make medical doctors more familiar with telemedicine services. The original study in South Korea supported both hypothesis 7 and hypothesis 8.

Hypothesis 9 suggesting that perceived usefulness has a positive effect on perceived incentives was eliminated from this study due to a poor fit. The hypothesis was also rejected in the original study. Taken together, this could suggest that the prediction of medical doctors experiencing increased incentivization when telemedicine service was seen to be useful to patient care, may not be accurate. Due to the elimination of hypothesis 9, the hypothesis 10 had to be modified in this study suggesting that a higher rating of the item PI02: "It needs monetary incentives" predicts a higher behavioral intention to use telemedicine services. The hypothesis was not supported in this study. This could suggest that medical doctors in Finland do not expect to be paid an additional fee for providing telemedicine services.

My final findings disclosed the effect of Covid-19 pandemic on the usage of telemedicine. First, having used telemedicine before the pandemic or having started using it during the pandemic both predicted a higher behavioral intention to use it in the future compared to not having used it at all. Experience with telemedicine services is likely to positively affect self-efficacy predicting a higher perceived ease of use (supported in hypothesis 7), which in turn predicts a higher behavioral intention (supported in the hypothesis 1). Second, if the attitude towards the usage of telemedicine services had positively improved during the Covid-19 pandemic, it predicted a higher behavioral intention to use telemedicine services in the future, compared to having negative changes or no change in the attitude during the pandemic. Nevertheless, most of the respondents (68,1 %) felt that the pandemic had affected their attitude towards telemedicine a bit or very positively. The pandemic has accelerated the implementation of telemedicine services (Mann et al. 2020), and these results predict that telemedicine has been relatively well welcomed.

6.2 Research summary and implications

Based on the telemedicine service acceptance model, this study showed predictive factors affecting medical doctors' willingness to use telemedicine services in their practice. The TSA model included factors specifically designed for medical doctors, such as accessibility of medical records, accessibility of patients and perceived incentives. The factor perceived incentives had to be modified into a single-item construct to fit the model. My primary research question was: "What are the major drivers influencing the intention of medical doctors to use telemedicine services in Finland?" As assumed, perceived ease of use and perceived usefulness are strong predictive factors ($p < 0.001$) in telemedicine service acceptance. Self-efficacy is another strong factor ($p < 0.001$) in predicting telemedicine service acceptance and affects behavioral intention through perceived ease of use. Moreover, accessibility of patients is a strong factor ($p < 0.001$) in predicting telemedicine service acceptance and affects behavioral intention through perceived ease of use. These four factors are therefore the most critical and play a major role in predicting the outcome of telemedicine service acceptance. According to this study, perceived incentives do not seem to play an important role in predicting telemedicine service acceptance. However, implications for telemedicine in a post-pandemic future are likely to reform the delivery of healthcare and this may lead to regulatory changes including matters in incentives and insurance, for instance. Thus, maintaining perceived incentives in the TSA model seems appropriate.

My secondary research question was: "What is the impact of Covid-19 pandemic on telemedicine service usage among medical doctors in Finland?" Covid-19 pandemic has had a massive influence on the expansion of telemedicine and based on this study, medical doctors' attitude towards telemedicine in Finland has mostly changed for positive. Medical doctors' experience with telemedicine has increased during the pandemic and this predicts a higher behavioral intention to use telemedicine services also in the future.

This empirical study demonstrated the important factors that must be considered when hospitals and other decision makers are designing strategies to implement new telemedicine services. Also, this study provides insights into the future of healthcare. It can be expected that the delivery of care will experience massive reforms in a few years' time as the pandemic is already accelerating the development of telemedicine. Intervention programs in healthcare for technology usage and telemedicine education already in medical universities are likely to be in demand.

6.3 Limitations of the study

There are some limitations to the generalizability of this study. First, the original TSA model was designed to fit in the South Korean environment and for the purpose of this study, it had to be modified a bit. Therefore, the results with the original article are not fully comparable. However, the most critical parts of the TSA model were applicable in the Finnish environment too. Second, this study examined the acceptance of telemedicine services as a phenomenon rather than focusing on a detailed and specific telemedicine service. Even so, telemedicine is now growing and finding its more established place in healthcare, so it is still important to first study it as an entity. Third, many of the respondents were over 50 years old (46,4 %) and had more than 15 years of experience as a doctor (59.,5 %), which may have skewed the results. Despite the respondents being older in age and having a longer career, the results turned out turned surprisingly positive and growth-minded towards telemedicine services. Fourth, this study focused only on medical doctors in healthcare system, even though other healthcare professionals' and patients' acceptance of telemedicine services is crucial as well. Still, it can be claimed that medical doctors have a very large influence on telemedicine service acceptance. Fifth, the unequal distribution of respondents from different medical specialties, which resulted from the non-probabilistic sampling technique (snowballing) is a limitation of this study. Diagnostic specialties covered 26.0 % of the respondents and as this specialty group is already accustomed to use technology for its very nature, it may have also skewed the results.

6.4 Suggestions for further research

As the pandemic is accelerating the rapid expansion of telemedicine services, it would be meaningful to study the acceptance of telemedicine services after the pandemic and compare the level of acceptance. Further study is also needed to examine other healthcare professionals' and patients' acceptance of telemedicine services. Additionally, as telemedicine services develop, further studies are needed to address the acceptance of a specific telemedicine service or medical technology. Further comparable studies are needed in other countries, too.

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APPENDIX

Appendice 1. List of questions

Gender: Male / *Female*

Age: 29 or less / *30-39* / 40-49 / *50 or more*

Specialization: Diagnostic specialty / *Surgical specialty* / Internal medicine specialty / *Psychiatric specialty* / Other operative specialty / *Other traditional or conventional specialty* / Other specialty or unspecialized

Career: Less than a year */ 1-5 years* / 6-10 years / *11-15 years* / More than 15 years

Principal employer: University central hospital / *Central hospital* / Other hospital, healthcare center or school/student healthcare / *Private hospital or private healthcare center*

Region: Helsinki University Central Hospital / *Turku University Hospital* / Tampere University Hospital / *Oulu University Hospital* / Kuopio University Hospital

Have you used telemedicine services in your practice?
Yes, before Covid-19 / *Yes, I started during Covid-19* / No, I have not.

How has the pandemic changed your attitude towards the use of telemedicine as an alternative?" (on a Likert-scale from 1 to 5)
1. affected very negatively
2. affected a bit negatively
3. remained the same
4. affected a bit positively
5. affected very positively.

Telemedicine Service Acceptance (TSA) -model

Self-efficacy *(Likert-scale 1-5: 1=strongly disagree, 5=strongly agree)*
1. I am proficient at using the device for telemedicine service.
2. I have rich experiences on the device.
3. I am good at the device.
4. I am able to use the device properly.

Accessibility of Medical Records *(Likert-scale 1-5: 1=strongly disagree, 5=strongly agree)*
1. I can gather correct information about the patient.
2. I can easily record a patient's health condition.
3. Because of the precise record of the patients, it enables me to provide proper healthcare service to my patients.

Accessibility to Patients ***(Likert-scale 1-5: 1=strongly disagree, 5=strongly agree)***
1. I am able to care for patients living at further distances.
2. I am able to be in contact with patients who seldom come to the clinic.
3. I am able to be in contact with patients who cannot be easily delivered to the clinic.

Perceived Ease of Use ***(Likert-scale 1-5: 1=strongly disagree, 5=strongly agree)***
1. It is easy to use the device for telemedicine service.
2. It is easy to learn how to use the new device for telemedicine.
3. It is easy to perform my job by using the telemedicine service.

Perceived Usefulness ***(Likert-scale 1-5: 1=strongly disagree, 5=strongly agree)***
1. It will positively affect the treatment plan.
2. It is possible to provide more comprehensive care service.
3. It is efficient for diagnosing patients and scheduling.
4. I can precisely monitor the patient's condition.

Perceived Incentives ***(Likert-scale 1-5: 1=strongly disagree, 5=strongly agree)***
1. This service needs proper government policy and support. *(eliminated from this study)*
2. It needs monetary incentives.
3. It would be meaningful if financial support were given. *(eliminated from this study)*

Behavioral Intention to Use ***(Likert-scale 1-5: 1=strongly disagree, 5=strongly agree)***
1. I have a positive intention to adopt the telemedicine service.
2. I will care for my patients through telemedicine service.
3. I will gain accurate patient information and treatment histories. *(eliminated from this study)*
4. I will provide telemedicine services and share the information through this service.