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Analyzing older users' home telehealth services acceptance behavior – applying an Extended UTAUT model

Abstract

Background

Although telehealth offers an improved approach to providing healthcare services, its adoption by end users remains slow. With an older population as the main target, these traditionally conservative users pose a big challenge to the successful implementation of innovative telehealth services.

Objectives

The objective of this study was to develop and empirically test a model for predicting the factors affecting older users' acceptance of Home Telehealth Services (HTS).

Methods

A survey instrument was administered to 400 participants aged 50 years and above from both rural and urban environments in Slovenia. Structural equation modeling was applied to analyze the causal effect of seven hypothesized predicting factors. HTS were introduced as a bundle of functionalities, representing future services that currently do not exist. This enabled users' perceptions to be measured on the conceptual level, rather than attitudes to a specific technical solution.

Results

Six relevant predictors were confirmed in older users' HTS acceptance behavior, with Performance Expectancy ($r=0.30$), Effort Expectancy ($r=0.49$), Facilitating Conditions ($r=0.12$), and Perceived Security ($r=0.16$) having a direct impact on behavioral intention to use HTS. In addition, Computer Anxiety is positioned as an antecedent of Effort Expectancy with a strong negative influence ($r=-0.61$), and Doctor's Opinion influence showed a strong impact on Performance Expectancy ($r=0.31$). The results also indicate Social Influence as an irrelevant predictor of acceptance behavior. The model of six predictors yielded 77% of the total variance explained in the final measured Behavioral Intention to Use HTS by older adults.

Conclusion

The level at which HTS are perceived as easy to use and manage is the leading acceptance predictor in older users' HTS acceptance. Together with Perceived Usefulness and Perceived Security, these three factors represent the key influence on older people's HTS acceptance behavior. When promoting HTS, interventions should focus to portray it as

secure. Marketing interventions should focus also on promoting HTS among health professionals, using them as social agents to frame the services as useful and beneficial. The important role of computer anxiety may result in a need to use different equipment such as a tablet computer to access HTS. Finally, this paper introduces important methodological guidelines for measuring perceptions on a conceptual level of future services that currently do not exist.

Keywords: home telehealth services, older adults' decision-making, technology acceptance prediction

Introduction

Increasing pressure in the health care sector is driving the need for changes in the way health services are delivered and organized [1,2]. Users are altering their traditionally hierarchical attitude to health service providers, causing a fundamental change from physician-oriented to patient-centered healthcare systems [3]. Within this challenging context, emerging information and communication technology (ICT) appears very promising by using tools such as the digitalization of data collection, advanced diagnostics, and monitoring for patient-centered and personalized care [3–5].

The older population (aged 50 years and above) is the main target of emerging telehealth solutions development as it generates a large share of service demand [6–8]. Many different health ICT solutions have been developed to address older users' specific needs: advanced diagnostics, biosensors and vital signs measurement, electronic health records, home access to healthcare services, and assistive living services [9–12]. In our study, services including this broad spectrum of functionalities are referred to as Home Telehealth Services ("HTS").

Despite rapid technological advancement, HTS adoption rates remain slow due to their disruptive nature and traditionally conservative older users. A review of current HTS research puts engaging the end users at the frontier of successful telehealth implementation [13,14]. Understanding the process of how and why people develop relationships with technology and integrate it into their life plays a pivotal role [15]. People age biologically, psychologically, socially, and even spiritually, influencing the way they form and induce perceptions [16]. Older users tend to show behavioral specifics which have to be considered in the development and marketing of health ICT for this specific group [17]. Understanding older users' needs, behavioral specifics, technology use behavior, and their interrelation in their decision-making is thus at the forefront of telehealth services development [6,14,18,19].

This study's key objective is to analyze two main questions: Firstly, what are the dimensions underlying older adults' HTS acceptance behavior and what is the underlying model? And secondly, how does such model perform in an empirical setting?

An important challenge is to analyze the behavior of users with respect to future HTS services that currently do not exist. There is clearly a lack of a conceptual approach in acceptance modeling since studies usually focus on a specific technology or service

[5,6,20]. However, our study concentrates on factors that influence HTS acceptance as a concept and not as a specific telehealth product or service. This approach offers a basic framework for understanding acceptance behavior of HTS on a conceptual level, which is essential for the future development of HTS.

The structure of this paper is as follows: first, the factors affecting technology acceptance of older users are analyzed. The hypotheses of our model are theoretically grounded and the model is conceptualized. The methodology of the study is then described, followed by statistical analysis and results with the final model. In the discussion, implications for theoretical and practical implications are described, along with limitations and opportunities for further research.

Theoretical background and model development

Background

Telemedicine industry and technology have been developing rapidly for over two decades with its benefits being lauded [21,22]. Many different concepts had been developed and tested, usually to address a certain specific need in the context of disease management, security, easier access, preventive services integration, or enhancing general quality of daily living for older users in their home environment [9–12].

Most of the studies have used a specific solution to address the needs of the patients/users, such as chronic disease management, independent living, communication, preventive care, social services [6,7,21,23], or a specific area of technologies, such as mobile, wireless, web applications, cloud solutions, biosensors or diagnostic software [24–28]. There is little understanding regarding which factors should be considered when patients accept telemedicine [29]. Often, a very specific telemedicine solution is considered such as the research about electronic medical records in [30] which identified 78 factors in 8 categories affecting the adoption.

Van Gemert-Pinjen et al. [18] reviewed the uptake of HTS, finding that one of the most frequent root causes in low adoption ratios is the lack of holistic approach in designing HTS solutions. Most of the past research and development often disregards the interdependency between human characteristics, technology and socio-economic background in designing and planning new technology, which usually leads to low impact on healthcare practices. There is a clear mismatch between users' expectations and technology development and services provisioned [5,18].

Home Telehealth Services (HTS) are new, innovative and complex ICT-based services in the conservative field of healthcare, targeted to the conservative older users [31]. While technology, regulations and physician buy-in are often cited reasons, patient acceptance has not received much consideration [32] and few studies have examined this area from the users' perspective [33]. Thus despite the high and increasing technological development, the end-user adoption of technology-based healthcare services is becoming the main

barrier for HTS implementation [18] and further quantitative studies are needed to explore patients' intentions to use [34].

When considering older users' acceptance of ICT based services, such as conceptualized HTS, user engagement is especially challenging, since the older users are traditionally highly reluctant to innovative solutions acceptance [35]. Understanding older users' behavior and decision making in the context of innovative HTS adoption presents the main challenge in successful HTS acceptance and commercialization [5,15,36]. The market response suggests that older adults' adoption of technology is not simply a matter of performance and price, but a complex issue that is affected by multiple factors [36]. Van Gemert-Pinjen et al. [18] reviewed the uptake of HTS, finding that one of the most frequent root causes in low adoption ratios is the lack of holistic approach in designing HTS solutions. Most of the past research and development often disregards the interdependency between human characteristics, technology and socio-economic background in designing and planning new technology, which usually leads to low impact on healthcare practices. There is a clear mismatch between users' expectations and technology development and services provisioned [5,18].

Therefore, previously developed theories about technology acceptance should be used to study those factors. The Technology Acceptance Model ("TAM") is the leading theory in health ICT acceptance analyses [37]. As shown in a recent literature review TAM has evolved to become a key model in understanding predictors of human behavior toward potential acceptance or rejection of the technology [38]. The Unified Theory of Acceptance and Use of Technology (UTAUT) is the latest derivative of TAM [39]. Since being introduced, the UTAUT model has been tested extensively in various fields and promises to be a great tool for analyzing users' acceptance of health technology [40–42].

The final measured construct in UTAUT model is Behavioral Intention to Use (BI) defined as "a measure of the strength of one's intention to perform a specified behavior" [43]. It is, influenced by four main constructs: Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC).

The UTAUT model is usually supplemented with additional contextual constructs that integrate specific elements of the field of use [44,45], such as the addition of the physician-patient relationship construct [42] or the social capital factors (social trust, institutional trust, and social participation) [46]. Introducing additional contextual predictors enables a more accurate understanding of users' acceptance of technology, which is always domain-specific [37,44,47]. Based on review of previous research in the field of older adults' health technology acceptance, the three context-specific predictors were added to the original model, namely Doctor's Opinion (DOC), Computer Anxiety (CA), and Perceived Security (PS) [48]. The augmented model therefore includes two groups of predictors: universal (technology acceptance) predictors and context-specific predictors.

Universal Technology Acceptance predictors

Performance Expectancy (PE) and Effort Expectancy (EE) are posed as the two most relevant predictors, derived from perceived usefulness and perceived ease of use introduced in the original TAM model [49]. PE is defined as: “the degree to which using a technology will provide benefits in performing certain activities” [39]. The perception of technology as beneficial and useful has strong predictive power regarding older users’ BI [50]. The fear of technology not performing as desired typically influences older users’ behavior towards reluctance to use a technology [51,52], while perceived usefulness has a direct impact on BI to use healthcare technology [49]. Higher performance expectancy of HTS by older users, such as perceived better management of their health, better access to healthcare services, and increasing quality of life in general, will positively affect older users’ intention to use HTS. Therefore, we hypothesize:

H1: An increase in Performance Expectancy will increase Behavioral Intention to use HTS by the older users.

Effort Expectancy (EE) is an important predictor of technology acceptance. It is defined as “the degree of ease associated with the use of the system”. The antecedents of EE are ease of use, complexity, and perceived ease of use [39]. Especially in the initial use of a technology, such as the acceptance of an innovation, the level of ease associated with using that technology strongly affects the acceptance behavior. EE is thus posited to hold increasingly strong predictive power for BI [45,49–51], particularly for the older users. A review of factors influencing older users’ acceptance of telehealth technology in community centers found EE to be the main predictor of acceptance behavior [45].

In addition to the direct influence of PE and EE on BI, the degree to which users perceive a technology as easy to learn use influences their perception of the usefulness of that technology, presenting EE as the antecedent of PE. Especially in the context of older users’ BI to use HTS, higher perceived ease of use increases the perception of a technology as more beneficial and useful [49,50]. With higher EE, the use of technology is perceived as demanding less effort and input energy for managing the system [51]. We therefore hypothesize:

H2a: An increase in Effort Expectancy will increase Behavioral Intention to Use HTS by the older users.

H2b: An increase in Effort Expectancy will increase Performance Expectancy of the older users.

Social Influence (SI) is defined as “the degree to which an individual believes that important others believe he or she should use the system” [39]. Studies predicting users’ (patients’) behavior in health ICT acceptance report SI as an important predictor since peers and colleagues’ opinions have a strong influence on users’ behavior [45,49,51]. Patients might be more or less likely to accept technology, depending on the extent to which their homecare nurse, children, or grandchildren urge them to use it [5]. Positive social support to use the technology increases users’ acceptance and intention to use health

ICT [39,49]. When considering technology acceptance by health professionals, some studies report a significant role of SI [52–55], while others disagree [40,48,56,57]. Although a review of previous studies revealed that SI has a volatile role in predicting acceptance behavior [45], it is still considered a main predictor of general technology acceptance behavior [39] and we therefore hypothesize:

H3: An increase in Social Influence will increase Behavioral Intention to use HTS by the older users.

The construct Facilitating Conditions (FC) is defined as “the degree to which an individual believes that technical and organizational infrastructure exists to support use of the system” [39]. In the context of older users of ICT, facilitators such as access and availability of technical support significantly increase BI [45,51,58]. Further, a higher level of organizational support (approvals from health institutions, government, etc.) promotes more favorable beliefs regarding health technology use [29,59]. Similarly, studies testing health ICT acceptance amongst older users report that an increase in FC influences increased BI to use telehealth services [45]. Therefore, we hypothesize:

H4: An increase in Technical support will increase Behavioral Intention to Use HTS by the older users.

Context-specific predictors

HTS are ICT-based services using Internet connections and computers or mobile devices in the conservative field of healthcare, targeted at traditionally conservative older users. This brings in issues of the role of Computer Anxiety (CA) in HTS use by the older users. CA is defined as “evoking anxious or emotional reactions when it comes to performing a behavior (using a computer)” [39]. It is an important predictor of technology acceptance by the older users [51,60]. They tend to have lower abilities for managing their use of ICT, which in turn results in their reluctance to use ICT-related products. Older users rely more on the existing patterns based on gained experience, making them resistant to use new things such as ICT [61]. A higher level of CA negatively influences the perceived ease of participation in ICT-related technologies, such as on-line content creation [60], where an increase in CA led to decreases in the level at which using a technology is perceived as effortless [51]. Therefore, we hypothesize:

H5: An increase in Computer Anxiety will decrease Effort Expectancy by the older users.

HTS includes the transfer, management and analysis of personal health data. This raises questions regarding security. Li et al. [62] describe initial trust formation as particularly relevant in an ICT-use context as users must overcome perceptions of risk before using a novel technology. Not surprisingly, elders have negative views about technology performing inaccurately, which can impact their BI [59]. Previous studies defined security issues as a major concern of older users [5,15,50]. Although the impact of security has not yet been properly tested, it is reported to be gaining in importance in the context of older users' acceptance of telehealth [63]. Issues such as safety (data security) and reliability (whether technology functions properly) are essential [15].

Moreover, trust in technology also has a strong positive influence on perceived usefulness and perceived ease of use [64]. Based on the previous literature findings, the perception of HTS enabling secure transactions and personal data integrity should increase older users' BI to use HTS. In addition, an increase in PS should increase the level at which HTS are perceived as free of effort (EE) and useful (PE). Therefore, we hypothesize:

H6a: An increase in Perceived Security will increase Behavioral Intention to Use HTS by the older users.

H6b: An increase in Perceived Security will increase Effort Expectancy of the older users.

H6c: An increase in Perceived Security will increase Performance Expectancy of the older users.

Olders tend to use heuristic methods in their decision-making process. This makes them rely more on external information than on internal semantic processing [61]. Since physicians are perceived as an expert authority, this holds interesting implications about the role of a doctor's opinion (DOC). For example, Mazur et al. [65] reported that most patients relied heavily on their physician's preferences. The recommendation of one's general practitioner also played a pivotal role in enrolment in preventive healthcare services and in using the Internet as a resource for medical information [66]. In the healthcare domain, users tend to defer their decision to the physician's authority [67]. Physicians' opinion influences BI through perceived usefulness as an increase in trust in a doctor's expertise increases the perception of technology as useful [68]. Therefore, we hypothesize:

H7: An increase in the Doctor's expert authority will increase Performance Expectancy of the older users.

The final construct measured is BI to use Home Telehealth Services, which is directly influenced by PE, EE, SI, FC, and PS. With CA additionally influencing the level of EE, and DOC influencing PE, these eight predictors form an Extended UTAUT model for predicting behavioral intention, as shown in Figure 1.

Figure 1: Conceptualized Extended UTAUT model for measuring older users' acceptance of HTS

PE=Performance Expectancy, EE=Effort Expectancy, FC=Facilitating Conditions, SI=Social Influence, DOC=Doctor's Opinion, CA=Computer Anxiety, PS=Perceived Security, BI=Behavioral Intention to use.

Methodology

The empirical analysis uses data from a survey of 400 participants aged 50 years and above from both rural and urban environments in Slovenia. Structural equation modeling was used to analyze the causal effect of seven hypothesized predicting factors. For study sample analysis and descriptive statistics SPSS 20.0 was applied, while in analyzing causal relationships and hypotheses testing, LISREL 8.8 was used for parameter estimation and structural equation model ('SEM') evaluation.

Measurement instrument

Since UTAUT was originally used to measure the acceptance of technology in an organizational environment, the consumer perspective and the HTS context have to be considered when adapting the measurement scales. The following adaptations were made for each construct.

To measure Performance and Effort Expectancy, we used a scale from Huang et al. which proved to be a reliable measure in the field of telehealth technology acceptance with high item loadings and high variance explained in the measured construct [69]. The constructs measure the level to which users perceive that a telehealth remote monitoring application is

useful and beneficial. Both scales for PE and EE were used with minor adaptations for the field of use.

The role of Social Influence has often been operationalized in the broad context of family and friends' influence on users' behavior [47,53,69]. We used Hung et al.'s scale of subjective norm to measure SI [69].

Facilitating conditions have been operationalized variously in previous research [60,70,71]. Facilitating conditions in the context of HTS use can be regarded as technical support provided [48]. We thus used the scale from Thompson et al. where they measured the facilitators of technical support and training provided [71]. Computer Anxiety is a well-known construct in the ICT adoption domain and has been measured extensively [39,60,72]. We employed Rosen and Weil's scale with four items without any adaptations [73].

The concept of Perceived Security has previously been tested in various contexts, e. g. telecare and remote monitoring, e-commerce, Internet use, and electronic banking [69,72–74]. We followed a more generalized approach using the scale from Cheng et al., adapting the term “Internet banking” to “computer and Internet use” [75].

The Doctor's Opinion Influence has been measured through the proxy of expert authority power influence. The expert power scale was introduced by Swasy [76], offering a validated and reliable measure for measuring expert power influence in general. The scale was adapted for the field of Doctor's opinion influence measurement. For the Behavioral Intention to use, Thompson et al.'s [71] measure of BI was employed, offering a validated and reliable measure.

In order to obtain quality data, a minimum of three items per scale was used to avoid problems with the measurement model's reliability and validity in further statistical analysis [77]. All items were measured with a seven-point Likert scale. All of the selected scales are reflective, where the constructs are treated as causes of their measures [78]. The scales were coded as an ordinal type for statistical analysis. In addition, participants' demographic data of age, gender, education and monthly income were included in the questionnaire.

Finally, as the olders are more prone to use heuristic processing, additional questions were needed to trigger semantic processing in cognitive reasoning [61]. We thus added a list of key functionalities of HTS and asked the respondents to rate their usefulness on a seven-point Likert scale. This has previously proven to be a very useful tool, allowing the efficient introduction (fast and holistic comprehension) of the HTS system [48].

For consistent introduction of conceptualized HTS, the survey included additional materials: cover letter with a short description of the purpose of the research, graphical presentation of HTS and a list of key functionalities. The translation version of these materials is provided as supplementary material.

Study sample

A printed version of the questionnaire was administered to the population aged 50 years and above in Slovenia, in their household environment. Respondents had the opportunity to complete the questionnaire without assistance. Participants were selected randomly, while dispersed equally across all regions of the country, both rural and urban environment. In total, 400 surveys were administered to randomly selected informants; 42% of the respondents were from a rural and 58% from an urban environment. Males and females were represented almost equally (49.25% females and 50.75% males) and monthly income and education were equally dispersed. The participants' age were distributed across the interval from 50 to 86 years, with the median age of the respondents 61.13 years.

Results

A review of the items loading parameters in Table 2 shows that the values for four measured variables are below the recommended threshold of 0.7 [79]. Items with a low loading (EE2, CA2, DOC1, and DOC7) were omitted from further analysis to increase the reliability and validity of the measured factors (internal reliability, composite reliability, and overall measurement model fit). All factor loadings are significant at the confidence level $p < 0.001$ (99% confidence interval) and all of the Cronbach's Alpha (α) values are above 0.9, which is well above the threshold value of 0.7.

Table 2. Measurement instrument with items' mean values, standard deviations (SD), and factor loadings (β)				
Variable	Mean	SD	β	Items used in questionnaire
Performance Expectancy (PE) – the degree to which an individual believes that using the HTS will help him or her increase their health performance/quality [69].				
PE1	5.11	1.86	0.75	I find that using HTS would be helpful in monitoring my health.
PE2	3.91	1.94	0.83	I find that using HTS would make me feel safer in my daily life.
PE3	4.72	1.89	0.85	HTS could enhance the level of convenience in accessing medical care services.
PE4	4.00	2.03	0.88	HTS could enhance the quality of my life.
PE5	4.77	1.85	0.87	Overall, I find HTS would be highly useful.
Effort Expectancy (EE) – the degree of ease associated with use of an HTS system [69].				
EE1	4.01	2.03	0.86	I find that using HTS would be simple.
EE2	4.07	2.03	0.18*	I find that using HTS would be easy to learn.
EE3	4.15	1.96	0.96	I find that HTS would be easily understandable and clear for me.
EE4	3.85	1.9	0.94	Overall, I find that using HTS would be convenient.
Social Influence (SI) – influence of peers and colleagues' opinion [53].				
SI1	3.51	1.95	0.72	Peers and colleagues would support me in using HTS.
SI2	3.85	1.86	0.92	People who influence my behavior would support me using HTS.
SI3	4.14	1.8	0.92	People who are important to me would support my use of HTS.
Facilitating Conditions (FC) – technical support for using a HTS system [71].				
FC1	5.63	1.66	0.85	I believe guidance will be available to me when deciding whether to use the system.

FC2	5.56	1.66	0.86	I believe specialized instructions concerning use of the system will be available to me.
FC3	5.80	1.64	0.89	I believe specific persons (or a group) will be available for assistance with system difficulties (a call center).
Computer Anxiety (CA) – anxiety to use ICT-based services [73].				
(-) CA1	5.21	1.83	0.78	Anyone can learn to use a computer if they are patient and motivated.
CA2	4.08	2.03	0.20*	I hesitate to use a computer for fear of making mistakes.
(-) CA3	5.07	1.89	0.73	If given the opportunity, I would like to learn about and use computers.
(-) CA4	5.23	1.93	0.77	I feel computers are necessary tools in both educational and work settings.
Perceived Security (PS) – the degree to which using information technology enables the administration of personal health information [75].				
PS1	3.47	1.91	0.89	I would feel secure sending personal health information using the Internet and computers.
PS2	3.38	1.84	0.90	The Internet offers a secure means through which to send sensitive personal information.
PS3	3.29	1.80	0.96	I would feel totally safe providing sensitive personal information about myself over the Internet.
PS4	3.32	1.83	0.94	Overall, using computers and an Internet connection is a safe way to transmit sensitive personal health information.
Doctor's Opinion (DOC) – doctor's expert power influence [76].				
DOC1	5.36	1.35	0.58*	I trust my doctor's judgment.
DOC2	4.38	1.89	0.90	The doctors' expertise makes him/her more likely to be right.
DOC3	4.18	1.64	0.92	The doctor has a lot of experience and usually knows best.
DOC4	4.68	1.58	0.74	The doctor's knowledge usually makes him/her right.
DOC5	4.99	1.94	0.72	I trust my doctor's judgment about HTS use.
DOC6	4.11	1.47	0.86	In case of deciding to use HTS, I don't know as much about what should be done as the doctor does.
DOC7	5.10	1.47	0.54*	Doctors are intelligent.
Behavioral Intention to Use (BI) – the degree to which an individual intends to use HTS [71].				
BI1	4.67	2.00	0.89	Assuming I had access to an HTS system, I would intend to use it.
BI2	4.13	2.03	0.90	I predict I will use an HTS system on a regular basis in the future.
BI3	4.51	2.02	0.95	I intend to use an HTS system in the future.
BI4	4.35	2.05	0.94	Given that I had access to an HTS system, I would use the services.

As indicated in Table 3, the model yielded acceptable discriminant validity (higher average variance extracted (AVE) values compared to cross loadings). In light of the reliability of the measurement model, the minimum factors loading indicates Composite Reliability (CR) has a value of 0.78, showing it is a good reliability measure of the selected scales. This confirms the overall acceptable measurement model's reliability and validity.

Table 3: Latent variables' reliability parameters and cross loadings

Construct	AVE	CR	α	PE	EE	SI	FC	PS	CA	DOC	BI
Performance Expectancy (PE)	0.76	0.94	0.92	1.00							
Effort Expectancy (EE)	0.87	0.95	0.93	0.61	1.00						
Social Influence (SI)	0.81	0.93	0.88	0.57	0.56	1.00					
Facilitating Conditions (FC)	0.85	0.94	0.91	0.43	0.44	0.38	1.00				
Perceived Security (PS)	0.89	0.97	0.96	0.65	0.61	0.58	0.22	1.00			
Computer Anxiety (CA)	0.72	0.78	0.80	0.66	0.68	0.49	0.63	0.44	1.00		
Doctor's Opinion Influence (DOC)	0.75	0.82	0.91	0.41	0.13	0.43	0.14	0.38	0.12	1.00	
Behavioral Intention to Use (BI)	0.89	0.92	0.96	0.67	0.68	0.55	0.48	0.65	0.62	0.20	1.00

Fit measures of the structural model are presented in Table 4. Both reflective and comparative fit measures yield a good model fit.

Table 4: Extended UTAUT model fit indices

Index	Model value	Recommended value	Acceptance
χ^2/df	3.09 $\chi^2=1190.83$ df=385	< 3 good fit < 5 reasonable fit	Good
RMSEA	0.075	< 0.05 good fit < 0.10 reasonable fit	Reasonable
NFI	0.968	Above 0.9	Good
NNFI	0.975	Above 0.9	Good
CFI	0.978	Above 0.9	Good
IFI	0.978	Above 0.9	Good
SRMR	0.057	< 0.05 good fit < 0.10 reasonable fit	Reasonable

Table 5 shows the path coefficients' estimates and test statistics. Results of the path analysis offer insights into the factors' influence on the structural level or effect size, where correlation estimators β with values higher than 0.30 reflect strong impact. All hypotheses, with the exception of the SI impact on BI, were confirmed with a high level of statistical significance of $p < 0.001$. This poses causal relationships in hypotheses H2a, H2b and H5 with a strong effect size, while the hypotheses H1, H4, H6 and H7 yield a moderate effect. Finally, total variance explained (R^2) of the latent constructs yield values of 0.649 for PE, 0.718 for EE and 0.776 for BI, respectively.

Table 5: SEM path analysis and test statistics

Hypothesis	β	t-test	Sig. level	Acceptance
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H1a: PE => BI	0.25	5.85	$p < 0.001$	Accepted
H2a: EE => BI	0.52	9.45	$p < 0.001$	Accepted
H2b: EE => PE	0.55	10.20	$p < 0.001$	Accepted
H3: SI => BI	-0.03	0.58	$p > 0.05$	Not Significant
H4: FC => BI	0.13	3.70	$p < 0.001$	Accepted
H5: CA => EE	0.61	13.21	$p < 0.001$	Accepted
H6a: PS => BI	0.15	3.82	$p < 0.001$	Accepted
H6b: PS => EE	0.38	8.18	$p < 0.001$	Accepted
H6c: PS => PE	0.21	4.32	$p < 0.001$	Accepted
H7: DOC => PE	0.25	6.04	$p < 0.001$	Accepted

Note: β = standardized correlation coefficient. All β are significant at $p < 0.001$ (2-tailed t -test) with the exception of hypothesis H3.

Since older population is typically heterogeneous [80], the model was tested for the influence of age on BI to use HTS, using age as a control variable. Results yield values $\beta = -0.03$ and $p > 0.05$ which means there is no significant influence of control variable age on BI. This indicates consistency of the model throughout the study sample age span. Similarly, the control variables of education ($\beta = -0.03$ and $p > 0.05$) and gender ($\beta = 0.02$ and $p > 0.05$) had no significant influence on BI.

In summary, our research yields a six-factor model for predicting the acceptance behavior of older users in the context of HTS use, as shown in Figure 2.

Figure 2: Extended UTAUT with Latent Variables and path coefficients

Note: PE=Performance Expectancy, EE=Effort Expectancy, FC=Facilitating Conditions, DOC=Doctor's Opinion, CA=Computer Anxiety, PS=Perceived Security, BI=Behavioral Intention to use.

Discussion

Theoretical implications

The analysis yielded six significant predictors in the final Extended UTAUT model, with 77% of total variance explained in the final measured construct BI to use HTS by older users. BI is asserted to have a direct influence on the actual use of technology as the antecedent of actual use [39,81]. This indicates the strong predictive power of the model. Further, the results offer important insights into the older users' acceptance behavior in the healthcare domain.

While previous studies showed that PE is the main predictor of acceptance behavior [45], the results of our analysis clearly indicate a more important role of EE. These findings are consistent with general older users' behavioral characteristics since this specific group

show cognitive declines in the speed of information processing and tend to use heuristic algorithms in their decision-making [61]. Therefore, unlike in other fields of technology acceptance, the level of effort to learn and manage HTS is more essential than the perceived benefit and usefulness of the system.

The roles of Perceived Security and Doctor's Opinion have not been previously analyzed in the context of HTS acceptance. Our study reveals the important role of both predictors. The role of PS is grounded in older users cognitive declines, where learning to understand and manage risks associated with an HTS represents a great barrier to HTS use [61]. An increase in the perception that HTS enables secure operations and data integrity has a direct influence on BI, as well as an impact by way of increasing the perception that HTS is more beneficial and easier to use.

Older minds tend to compensate for their reduced risk tolerance by avoiding decision-making and using decision referrals [61]. Older users tend to seek objective and validated sources of information, rooted in their security perception (reduced risk tolerance). This brings in the important influence of the role of the Doctor's opinion, where affirmation by a physician will influence the level at which HTS are perceived as useful and beneficial.

In addition, the older users' needs for privacy and integrity mean that sharing personal health information with family members or colleagues is not desired. Accordingly, independent technical support (such as a call center) will be an important source of information. Increased Facilitating Conditions (technical support available) will directly impact BI.

Interestingly, the role of SI was not confirmed. The UTAUT model was initially introduced to measure users' technology acceptance in organizations where the influence of co-workers is more relevant. Moreover, previous studies show that the situational context of technology use can change the role of SI [82]. Older users tend to disregard the influence of societal pressure, image, and social status and tend to pursue more emotionally meaningful goals [83]. This results in an insignificant role of Social Influence. The other root cause may be related to the previously mentioned needs for privacy and data integrity. The social environment can be perceived as a potential threat (revealing personal health information to close family members, colleagues, or peers).

Methodological implications

From the methodological perspective, our study offers important insights into analyzing acceptance behavior. There is a lack of a conceptual approach in technology acceptance modeling since studies usually concentrate on a specific technology or service [5,20,63]. Technology acceptance studies should focus more on the conceptual, general perception of users' acceptance behavior. Our study thus introduces an approach to measure the perception of nonexistent (future) services. The ability to predict acceptance rather than to retrospectively analyze the cause of failed projects offers added value for the successful introduction of HTS to the market.

Managerial implications and policy guidelines

Using a specific solution could create a biased perception and would not allow participants' subjective interpretation of the services. We therefore used a »List of key functionalities« [48] to trigger semantic processing in older minds [61]. When participants rated the usefulness of individual functionalities on the seven-point Likert scale, it enabled a deeper engagement with the new concept. In such a way, it introduced HTS on a conceptual level rather than benchmarking with existing services or by using a demo unit presentation.

In terms of service design and development, several practical implications arise as guidance for HTS development. The influence of CA will most probably result in the need to use different technical equipment, such as a tablet computer, to reduce the perception of HTS as a computer-based service. Furthermore, the presence of secure mechanisms must be clearly visible so as to create a trustworthy environment. The simplicity and intuitiveness of graphical user interfaces and perceived security will probably be the key factors determining the success of the initial adoption of HTS. Marketing interventions should focus on promoting HTS among health professionals, using healthcare professionals as social agents. Early adopters of HTS will probably be advanced users and have a more favorable attitude to computers use, which could speed up HTS implementation in the initial phase. However, due to the insignificant role of SI it is unlikely that pioneer users will importantly contribute to the diffusion of HTS among others.

Limitations and further research

Our research was conducted measuring older users' perceptions of a future HTS system. Subsequent research should address the issue of measuring the actual acceptance of technology (the step following BI) to analyze the conversion rate between behavioral intention and actual acceptance of technology.

The results of our analysis reveal the important role of Perceived Security in older users HTS acceptance. Further research should investigate possible antecedents of this factor since it will clearly be one of the most relevant acceptance predictors in the HTS domain. This includes data integrity and technology reliability, which could be further analyzed to create a more in-depth understanding of the underlying mechanisms forming users' acceptance behaviors.

Our analysis yielded no moderating effect of control variables on BI. However, older adults are traditionally heterogeneous population segment. The study sample included also people in the 50-65, which still partake for a great part in the production process and is often active on social media and use ICT for communication with children and grandchildren. Therefore, further research should conduct a more in-depth analysis of the moderating effect of age on causal relationships in the model.

Conclusion

The study positions older adults' acceptance behavior at the crux of successful HTS development. As a result, the Extended UTAUT model with six predictors was derived and empirically tested, yielding strong predicting power of acceptance intention behavior. The model offers a basic framework for testing and developing HTS in the domain field.

More importantly, the study showed that behavioral intention can be studied at a conceptual level rather than in relation to a specific technology. This important methodological approach enables to predict acceptance behavior for future, currently nonexistent services and technology, which is essential for the implementation of new innovative health technologies.

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References

1. Hailey D, Roine R, Ohinmaa A. Systematic review of evidence for the benefits of telemedicine. *J Telemed Telecare* 2002 Mar;8(Supplement 1):1–7.
2. Heinzlmann PJ, Lugin NE, Kvedar JC. Telemedicine in the future. *J Telemed Telecare* 2005 Dec;11(8):384–390.
3. Edgren L. Health consumer diversity and its implications. *J Syst Sci Syst Eng* 2006 Mar 1;15(1):34–47.
4. Gammon D, Berntsen GKR, Koricho AT, Sygna K, Ruland C. The Chronic Care Model and Technological Research and Innovation: A Scoping Review at the Crossroads. *J Med Internet Res* 2015 Feb 6;17(2):e25.
5. Or CKL, Karsh B-T. A Systematic Review of Patient Acceptance of Consumer Health Information Technology. *J Am Med Inform Assoc* 2009 Jul 1;16(4):550–560.
6. Barlow J, Singh D, Bayer S, Curry R. A systematic review of the benefits of home telecare for frail elderly people and those with long-term conditions. *J Telemed Telecare* 2007 Jan 6;13(4):172–179.
7. Botsis T, Demiris G, Pedersen S, Hartvigsen G. Home telecare technologies for the elderly. *J Telemed Telecare* 2008 Jan 10;14(7):333–337.
8. Czaja SJ, Lee CC, Nair SN, Sharit J. Older Adults and Technology Adoption. *Proc Hum Factors Ergon Soc Annu Meet* 2008 Sep 1;52(2):139–143.
9. Ackerman MJ, Filart R, Burgess LP, Lee I, Poropatich RK. Developing next-generation telehealth tools and technologies: patients, systems, and data perspectives. *Telemed J E-Health Off J Am Telemed Assoc* 2010 Feb;16(1):93–95. PMID: 20043711

10. Bashshur RL. On the definition and evaluation of telemedicine. *Telemed J Off J Am Telemed Assoc* 1995;1(1):19–30. PMID: 10165319
11. Botsis T, Hartvigsen G. Current status and future perspectives in telecare for elderly people suffering from chronic diseases. *J Telemed Telecare* 2008 Jan 6;14(4):195–203.
12. Koch S. Home telehealth--Current state and future trends. *Int J Med Inf* 2006 Aug;75(8):565–576.
13. Sutcliffe A, Thew S, Bruijn OD, Buchan I, Jarvis P, McNaught J, et al. User engagement by user-centred design in e-Health. *Philos Trans R Soc Math Phys Eng Sci* 2010 Sep 13;368(1926):4209–4224.
14. Peek STM, Wouters EJM, van Hoof J, Luijkx KG, Boeije HR, Vrijhoef HJM. Factors influencing acceptance of technology for aging in place: a systematic review. *Int J Med Inf* 2014 Apr;83(4):235–248. PMID: 24529817
15. Mitzner TL, Boron JB, Fausset CB, Adams AE, Charness N, Czaja SJ, et al. Older adults talk technology: Technology usage and attitudes. *Comput Hum Behav* 2010 Nov;26(6):1710–1721.
16. Moschis GP. Marketing to older consumers: a handbook of information for strategy development. Greenwood Publishing Group; 1992.
17. Drolet A, Schwartz N, Yoon C. The Aging Consumer: Perspectives From Psychology and Economics. Taylor & Francis; 2010.
18. van Gemert-Pijnen JE, Nijland N, van Limburg M, Ossebaard HC, Kelders SM, Eysenbach G, et al. A Holistic Framework to Improve the Uptake and Impact of eHealth Technologies. *J Med Internet Res* 2011 Dec 13;13(4). PMID: 22155738
19. Hawley-Hague H, Boulton E, Hall A, Pfeiffer K, Todd C. Older adults' perceptions of technologies aimed at falls prevention, detection or monitoring: A systematic review. *Int J Med Inf* 2014 Jun 1;83(6):416–426. PMID: 24798946
20. Kim MJ, Oh MW, Cho ME, Lee H, Kim JT. A Critical Review of User Studies on Healthy Smart Homes. *Indoor Built Environ* 2013 Feb 1;22(1):260–270.
21. Koch S. Meeting the challenges--the role of medical informatics in an ageing society. *Stud Health Technol Inform* 2006;124:25–31. PMID: 17108500
22. Bensink M, Hailey D, Wootton R. A systematic review of successes and failures in home telehealth: preliminary results. *J Telemed Telecare* 2006 Nov 1;12(7):8–16.
23. Alaiad A, Zhou L. The determinants of home healthcare robots adoption: An empirical investigation. *Int J Med Inf* 2014 Nov;83(11):825–840.
24. Chan M, Estève D, Escriba C, Campo E. A review of smart homes--Present state and future challenges. *Comput Methods Programs Biomed* 2008 Jul;91(1):55–81.
25. Eklund JM, Hansen TR, Sprinkle J, Sastry S. Information Technology for Assisted Living at Home: building a wireless infrastructure for assisted living. *Eng Med Biol Soc 2005 IEEE-EMBS 2005 27th Annu Int Conf Of 2005*. p. 3931 –3934.
26. Marschollek M, Gietzelt M, Schulze M, Kohlmann M, Song B, Wolf K-H. Wearable Sensors in Healthcare and Sensor-Enhanced Health Information Systems: All Our Tomorrows? *Healthc Inform Res* 2012 Jun;18(2):97–104. PMID: 22844645
27. Mosa ASM, Yoo I, Sheets L. A Systematic Review of Healthcare Applications for Smartphones. *BMC Med Inform Decis Mak* 2012 Dec 1;12(1):1–31.
28. Raad MW, Yang LT. A ubiquitous smart home for elderly. *Inf Syst Front* 2009 Nov 1;11(5):529–536.

29. Rho MJ, Kim HS, Chung K, Choi IY. Factors influencing the acceptance of telemedicine for diabetes management. *Clust Comput* 2014 Mar 12;18(1):321–331.
30. Najaftorkaman M, Ghapanchi AH, Talaei-Khoei A, Ray P. A taxonomy of antecedents to user adoption of health information systems: A synthesis of thirty years of research. *J Assoc Inf Sci Technol* 2015 Mar 1;66(3):576–598.
31. Truett KR. Age differences in conservatism. *Personal Individ Differ* 1993 Mar;14(3):405–411.
32. Call VRA, Erickson LD, Dailey NK, Hicken BL, Rupper R, Yorgason JB, et al. Attitudes Toward Telemedicine in Urban, Rural, and Highly Rural Communities. *Telemed J E-Health Off J Am Telemed Assoc* 2015 Aug;21(8):644–651. PMID: 25839334
33. Yuan S, Ma W, Kanthawala S, Peng W. Keep Using My Health Apps: Discover Users' Perception of Health and Fitness Apps with the UTAUT2 Model. *Telemed J E-Health Off J Am Telemed Assoc* 2015 Sep;21(9):735–741. PMID: 25919238
34. Cranen K, Drossaert CHC, Brinkman ES, Braakman-Jansen ALM, Ijzerman MJ, Vollenbroek-Hutten MMR. An exploration of chronic pain patients' perceptions of home telerehabilitation services. *Health Expect Int J Public Particip Health Care Health Policy* 2012 Dec;15(4):339–350. PMID: 21348905
35. Coughlin JF, D'Ambrosio LA, Reimer B, Pratt MR. Older Adult Perceptions of Smart Home Technologies: Implications for Research, Policy & Market Innovations in Healthcare. 29th Annu Int Conf IEEE Eng Med Biol Soc 2007 EMBS 2007 2007. p. 1810–1815.
36. Lee C, Coughlin JF. Perspective: Older Adults' Adoption of Technology: An Integrated Approach to Identifying Determinants and Barriers. *J Prod Innov Manag* 2015 Sep 1;32(5):747–759.
37. Holden RJ, Karsh B-T. Methodological Review: The Technology Acceptance Model: Its past and its future in health care. *J Biomed Inform* 2010;43(1):159–172.
38. Marangunić N, Granić A. Technology acceptance model: a literature review from 1986 to 2013. *Univers Access Inf Soc* 2014 Feb 16;14(1):81–95.
39. Venkatesh V, Morris MG, Gordon B. Davis, Davis FD. User Acceptance of Information Technology: Toward a Unified View. *MIS Q* 2003;27(3):425–478.
40. Veer AJE de, Peeters JM, Brabers AE, Schellevis FG, Rademakers JJ, Francke AL. Determinants of the intention to use e-Health by community dwelling older people. *BMC Health Serv Res* 2015 Mar 15;15(1):103.
41. Kohnke A, Cole ML, Bush RG. Incorporating UTAUT Predictors for Understanding Home Care Patients' and Clinician's Acceptance of Healthcare Telemedicine Equipment. *J Technol Manag Innov* 2014 Jun 19;9(2):29–41.
42. Liu C-F, Tsai Y-C, Jang F-L. Patients' Acceptance towards a Web-Based Personal Health Record System: An Empirical Study in Taiwan. *Int J Environ Res Public Health* 2013 Oct 17;10(10):5191–5208.
43. Davis FD, Bagozzi RP, Warshaw PR. Extrinsic and Intrinsic Motivation to Use Computers in the Workplace. *J Appl Soc Psychol* 1992 Jul 1;22(14):1111–1132.
44. Venkatesh V, Thong JYL, Chan FKY, Hu PJ-H, Brown SA. Extending the two-stage information systems continuance model: incorporating UTAUT predictors and the role of context. *Inf Syst J* 2011;21(6):527–555.
45. Kijisanayotin B, Pannarunothai S, Speedie SM. Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model. *Int J Med Inf* 2009 Jun;78(6):404–416.

46. Tsai C-H. Integrating Social Capital Theory, Social Cognitive Theory, and the Technology Acceptance Model to Explore a Behavioral Model of Telehealth Systems. *Int J Environ Res Public Health* 2014 May 7;11(5):4905–4925.
47. Venkatesh V, Thong JYL, Xu X. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Q* 2012 Mar;36(1):157–178.
48. Cimperman M, Brenčič MM, Trkman P, Stanonik M de L. Older Adults' Perceptions of Home Telehealth Services. *Telemed E-Health* 2013 Aug 9;19(10):786–790.
49. Kim J, Park H-A. Development of a Health Information Technology Acceptance Model Using Consumers' Health Behavior Intention. *J Med Internet Res* 2012 Oct 1;14(5):e133.
50. Arning K, Ziefle M. Different Perspectives on Technology Acceptance: The Role of Technology Type and Age. In: Holzinger A, Miesenberger K, editors. *HCI Usability E-Incl Berlin, Heidelberg: Springer Berlin Heidelberg*; 2009. p. 20–41.
51. Or CKL, Karsh B-T, Severtson DJ, Burke LJ, Brown RL, Brennan PF. Factors affecting home care patients' acceptance of a web-based interactive self-management technology. *J Am Med Inform Assoc* 2011 Jan 1;18(1):51–59.
52. Duyck P, Pynoo B, Devolder P, Voet T, Adang L, Vercruysse J. User Acceptance of a Picture Archiving and Communication System. *Methods Inf Med* 2008;
56. Hung S-Y, Ku Y-C, Chien J-C. Understanding physicians' acceptance of the Medline system for practicing evidence-based medicine: A decomposed TPB model. *Int J Med Inf*, 2011 Oct 31
54. Ketikidis P, Dimitrovski T, Lazuras L, Bath PA. Acceptance of health information technology in health professionals: An application of the revised technology acceptance model. *Health Informatics J* 2012 Jun 1;18(2):124–134.
55. Schepers J, Wetzels M. A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects. *Inf Manage* 2007;44(1):90–103.
56. Chau PYK, Hu PJ-H. Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories. *Inf Manage* 2002 Jan;39(4):297–311.
57. Schaper LK, Pervan GP. ICT and OTs: A model of information and communication technology acceptance and utilisation by occupational therapists. *Int J Med Inf* 2007 Jun;76(Supplement 1):S212–S221.
58. Heinz M, Martin P, Margrett JA, Yearns M, Franke W, Yang H-I, et al. Perceptions of Technology among Older Adults. *J Gerontol Nurs* 2013 Jan 1;39(1):42–51.
59. Steele R, Lo A, Secombe C, Wong YK. Elderly persons' perception and acceptance of using wireless sensor networks to assist healthcare. *Int J Med Inf* 2009 Dec;78(12):788–801.
60. Ryu M-H, Kim S, Lee E. Understanding the factors affecting online elderly user's participation in video UCC services. *Comput Hum Behav* 2009 May;25(3):619–632.
61. Yoon C, Cole CA, Lee M. Consumer Decision Making and Aging: Current Knowledge and Future Directions. *J Consum Psychol* 2009;19(1):2–16.
62. Li X, Hess TJ, Valacich JS. Why do we trust new technology? A study of initial trust formation with organizational information systems. *J Strateg Inf Syst* 2008 Mar;17(1):39–71.
63. Rahimpour M, Lovell NH, Celler BG, McCormick J. Patients' perceptions of a home telecare system. *Int J Med Inf* 2008 Jul;77(7):486–498.

67. Weaver McCloskey D, editor. The Importance of Ease of Use, Usefulness, and Trust to Online Consumers: An Examination of the Technology Acceptance Model with Older Consumers. *Electron Commer Concepts Methodol Tools Appl*; 2008. p. 1400–1417.
65. Mazur DJ, Hickam DH, Mazur MD, Mazur MD. The role of doctor's opinion in shared decision making: what does shared decision making really mean when considering invasive medical procedures? *Health Expect Int J Public Particip Health Care Health Policy* 2005 Jun;8(2):97–102. PMID: 15860050
66. Abramson ZH, Cohen-Naor V. Factors associated with performance of influenza immunization among the elderly. *Isr Med Assoc J IMAJ* 2000;2(12):902–907.
67. Steginga SK, Occhipinti S. Decision Making About Treatment of Hypothetical Prostate Cancer. *J Psychosoc Oncol* 2002;20(3):69–84.
68. Shah SGS, Barnett, Kuljis J, Kate, Richard. Factors determining patients' intentions to use point-of-care testing medical devices for self-monitoring: the case of international normalized ratio self-testing. *Patient Prefer Adherence* 2012 Dec;1.
69. Huang J-C. Remote health monitoring adoption model based on artificial neural networks. *Expert Syst Appl* 2010 Jan;37(1):307–314.
70. Porter CE, Donthu N. Using the technology acceptance model to explain how attitudes determine Internet usage: The role of perceived access barriers and demographics. *J Bus Res* 2006 Sep;59(9):999–1007.
71. Thompson RL, Higgins CA, Howell JM. Personal Computing: Toward a Conceptual Model of Utilization. *MIS Q* 1991 Mar 1;15(1):125–143.
72. Phang CW, Sutanto J, Kankanhalli A, Yan Li, Tan BC., Hock-Hai Teo. Senior Citizens' Acceptance of Information Systems: A Study in the Context of e-Government Services. *IEEE Trans Eng Manag* 2006 Nov;53(4):555–569.
73. Rosen LD, Weil MM. Computer anxiety: A cross-cultural comparison of university students in ten countries. *Comput Hum Behav* 1995 Spring;11(1):45–64.
74. Cerpa A, Estrin D. ASCENT: Adaptive Self-Configuring sEnsor Networks Topologies. *IEEE Trans Mob Comput* 2004;3(3):272–285.
75. Cheng TCE, Lam DY, Yeung ACL. Adoption of internet banking: An empirical study in Hong Kong. *Decis Support Syst* 2006 Dec;42(3):1558–1572.
76. Swasy JL. Measuring the Bases of Social Power. *Adv Consum Res* 1979;06:340–346.
77. Baumgartner H, Homburg C. Applications of structural equation modeling in marketing and consumer research: A review. *Int J Res Mark* 1996 Apr;13(2):139–161.
78. Edwards JR, Bagozzi RP. On the nature and direction of relationships between constructs and measures. *Psychol Methods* 2000;5(2):155–174.
79. Hair JF, Black WC, Babin BJ, Anderson RE. *Multivariate data analysis*, Seventh Edition. Prentice Hall Higher Education; 2010.
80. Czaja SJ, Lee CC. The impact of aging on access to technology. *Univers Access Inf Soc* 2006 Dec;5(4):341–349.
81. Janz BD, Hennington A. Information Systems and Healthcare XVI: Physician Adoption of Electronic Medical Records: Applying the UTAUT Model in a Healthcare Context. *Commun Assoc Inf Syst [Internet]* 2007 Mar 21;19(1). Available from: <http://aisel.aisnet.org/cais/vol19/iss1/5>
82. Lewis W, Agarwal R, Sambamurthy V. Sources of Influence on Beliefs about Information Technology Use: An Empirical Study of Knowledge Workers. *MIS Q* 2003 Dec 1;27(4):657–678.

83. Carstensen LL, Fung HH, Charles ST. Socioemotional Selectivity Theory and the Regulation of Emotion in the Second Half of Life. *Motiv Emot* 2003 Jun;27(2):103–123.

Supplementary material – Questionnaire used in the study, including cover letter and graphical presentation of HTS

INFORMATION TECHNOLOGY AND HEALTH CARE IN YOUR HOME

Dear Sirs/Madame,

Below you are presented with the questionnaire with regard to the use of healthcare services from your home, i.e. remotely. We are interested in your opinion regarding the use of healthcare services which demand using a computer. The predicted time to complete the questionnaire is 15 minutes, and the questionnaire is anonymous. All information will be processed confidentially and used for the purpose of scientific research only.

Thank you for your time and effort in advance.

What is Home Telemedicine System?

Home Telemedicine system is a computer system that enables access to healthcare system from your home. It enables access to physician's office, access to the network of pharmacies and access to your personal health record. For this purpose, you can use standard computer equipment and internet connection, which enables communication with all participants in the network. The system enables connection to measurement medical devices, (blood pressure, blood glucose, weight, etc.) for self-monitoring of vital signs and self-disease management (for chronic patients) and access to personal physician's office. The picture shows the basic principles of system operations.

HOME TELEMEDICINE SYSTEM

NEW ACCESS TO HEALTHCARE

EMERGENCY INTERVENTION

REMOTE PATIENT MONITORING

The questionnaire below refers to the use of computer and internet for accessing healthcare services from home. We are interested in your opinion regarding the use of HTS services. Please rate statements listed below on the scales presented. For the purpose of our analysis, a completed questionnaire is needed, therefore you are asked to kindly rate all of the statements. Thank you for your time and help in advance.

Home Telemedicine system presents computer based system enabling access to healthcare services from your home settings, using internet connection.

LIST OF KEY FUNCTIONALITES

Please rate your opinion on scale from **1 (not useful)** to **7 (very useful)**

Please rate your opinion on scale from 1 (not useful) to 7 (very useful)		Not Useful			→	Very useful		
		1	2	3	4	5	6	7
1.	Access to personal health record							
2.	Access to general health related information (published papers, updated information, etc.)							
3.	Up-dates about recent changes, received medical reports and laboratory tests							
4.	Overview of waiting lists							
5.	Access to information in case of traveling (vaccination, preventive interventions, etc.)							
6.	Communication with personal doctor's/GP's office (consultations)							
7.	On-line referrals for examinations and laboratory testing							
8.	E-prescription and E-prescription extension (for chronic disease patients)							
9.	E-pharmacy (for ordering medications and pharmaceuticals)							
10.	Access to second medical opinion							
11.	E-medical triage (after hospital discharge)							
12.	Home monitoring (vital signs measuring – blood pressure, glucose, weight, etc.), using a computer							
13.	Communicating with other users, who have similar problems (sharing experience, opinion, etc.)							

Please rate your opinion on scale from **1 (Strongly Disagree)** to **7 (Strongly Agree)**

		Strongly Disagree → Strongly Agree						
1.	I find that using HTS would be helpful in monitoring my health.	1	2	3	4	5	6	7
2.	I find that using HTS would make me feel safer in my daily life.	1	2	3	4	5	6	7
3.	HTS could enhance the level of convenience in accessing medical care service.	1	2	3	4	5	6	7
4.	HTS could enhance the quality of my life.	1	2	3	4	5	6	7
5.	Overall, I find HTS would be highly useful.	1	2	3	4	5	6	7

Please rate your opinion on scale from **1 (Strongly Disagree)** to **7 (Strongly Agree)**

		Strongly Disagree → Strongly Agree						
1.	I trust doctor's judgment.	1	2	3	4	5	6	7
2.	Doctor's expertise makes him/her more likely to be right.	1	2	3	4	5	6	7
3.	Doctor has a lot of experience and usually knows best.	1	2	3	4	5	6	7
4.	Doctor's knowledge usually makes him/her right.	1	2	3	4	5	6	7
5.	I trust doctor's judgment in using home telemedicine system.	1	2	3	4	5	6	7
5.	In case of using home telemedicine system, I don't know as much about	1	2	3	4	5	6	7

	what should be done as doctor does.	
7.	Doctors are intelligent.	1 2 3 4 5 6 7

Please rate your opinion on scale from 1 (Strongly Disagree) to 7 (Strongly Agree)

Strongly Disagree → Strongly Agree		
1.	Anyone can learn to use a computer if they are patient and motivated.	1 2 3 4 5 6 7
2.	I hesitate to use a computer for fear of making mistakes.	1 2 3 4 5 6 7
3.	If given the opportunity, I would like to learn about and use computers.	1 2 3 4 5 6 7
4.	I feel computers are necessary tools in both educational and work settings.	1 2 3 4 5 6 7
5.	I would feel secure sending personal health information using internet and computers.	1 2 3 4 5 6 7
6.	The internet offers a secure means through which to send sensitive personal information.	1 2 3 4 5 6 7
7.	I would feel totally safe providing sensitive personal information about myself over the internet.	1 2 3 4 5 6 7
8.	Overall, using computers and internet connection is a safe way to transmit sensitive personal health information.	1 2 3 4 5 6 7

Please rate your opinion on scale from 1 (Strongly Disagree) to 7 (Strongly Agree)

Strongly Disagree → Strongly Agree		
1.	I find that using home telemedicine system would be simple.	1 2 3 4 5 6 7
2.	I find that using home telemedicine system would be easy to learn.	1 2 3 4 5 6 7
3.	I find that using home telemedicine system would be easily understandable and clear for me.	1 2 3 4 5 6 7
4.	Overall, I find that using home telemedicine system would be convenient.	1 2 3 4 5 6 7
5.	Peers and colleagues would support me for using home telemedicine system.	1 2 3 4 5 6 7
6.	People who influence my decisions would support me for using home telemedicine system.	1 2 3 4 5 6 7
7.	People who are important to me would support me using home telemedicine system.	1 2 3 4 5 6 7
8.	I believe guidance will be available to me when deciding to use home telemedicine system.	1 2 3 4 5 6 7
9.	I believe specialized instructions concerning the use of home telemedicine system will be available to me.	1 2 3 4 5 6 7
10.	I believe a specific person or group will be available for assistance with system difficulties (call center).	1 2 3 4 5 6 7

Please rate your opinion on scale from 1 (Strongly Disagree) to 7 (Strongly Agree)

Strongly Disagree → Strongly Agree		
1.	Assuming I had access to HTS system, I intend to use it.	1 2 3 4 5 6 7
2.	I predict I will use the HTS system on a regular basis in the future.	1 2 3 4 5 6 7
3.	I intend to use HTS system in the future.	1 2 3 4 5 6 7
4.	Given that I had access to HTS system, I would use the services.	1 2 3 4 5 6 7

Please write your demographic data (select the appropriate choice or write the number)

DEMOGRAPHIC DATA

Date of birth _____	Gender: M F
Income: ● Less than 300€ ● 300-600 € ● 600-900€ ● more than 900€	Education: ● Elementary School ● Vocational High school ● High school ● College degree or more