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E-HEALTH INDIVIDUAL ADOPTION: EMPIRICAL MODEL BASED ON UTAUT2

by

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RESUMO

O futuro dos sistemas de saúde está a tornar-se cada vez mais centralizado no cidadão, uma vez que hoje em dia são mais ativos, melhor informados e mais exigentes. A Comissão Europeia está a promover serviços de saúde *online* e, por este motivo, os estados membros precisam de estimular e desenvolver a utilização destes serviços. Neste sentido, o entendimento dos motivos que levam à adoção de serviços de saúde *online* torna-se uma área de estudo com grande importância.

Este estudo aplicou uma reconhecida teoria de aceitação e uso da tecnologia (UTAUT2) para explicar a adoção individual dos serviços de saúde *online* por parte do paciente. Foi administrado um questionário *online* em Portugal, utilizando maioritariamente o mesmo instrumento que o UTAUT2, adaptado para o contexto. Foram recolhidas 386 respostas válidas.

A expetativa de desempenho, expetativa de esforço, influência social e o hábito têm um poder explicativo estatisticamente significativo sobre a intenção de uso da tecnologia. O hábito e a intenção de uso têm um poder explicativo estatisticamente significativo sobre o uso da tecnologia. Na globalidade, modelo explicou 52% da variação na intenção de uso e 32% da variação no uso da tecnologia.

Esta investigação ajuda a compreender as características da tecnologia mais pretendidas pelos pacientes. Ao testar um modelo de aceitação de tecnologias de informação, foi possível determinar-se o que é mais valorizado pelos pacientes no momento de decidir utilizar, ou não, serviços de saúde *online*.

PALAVRAS-CHAVE

UTAUT2; Adoção de tecnologias; Saúde *online*; Consumidores de cuidados de saúde

ABSTRACT

The future of health care delivery is becoming more citizen-centred, as today's user is more active, better informed and more demanding. The European Commission is promoting online health services and, therefore, member states will need to boost deployment and use of online services. This makes e-health adoption an important field to be studied and understood.

This study applied the extended unified theory of acceptance and usage technology (UTAUT2) to explain patients' individual adoption of e-health. An online questionnaire was administrated Portugal using mostly the same instrument used in UTAUT2 adapted to e-health context. We collected 386 valid answers.

Performance expectancy, effort expectancy, social influence, and habit had the most significant explanatory power over behavioural intention and habit and behavioural intention over technology use. The model explained 52% of the variance in behavioural intention and 32% of the variance in technology use.

Our research helps to understand the desired technology characteristics of e-health. By testing an information technology acceptance model, we are able to determine what is more valued by patients when it comes to deciding whether to adopt e-health systems or not.

KEYWORDS

UTAUT2; Technology adoption; E-health; Health care consumers

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ABBREVIATIONS AND ACRONYMS LIST

AVE	Average variance extracted
BI	Behavioural intention
CA	Cronbach's alpha
CR	Composite reliability coefficient
D	Direct effects only
D+I	Direct and moderators effects
EC	European Commission
EE	Effort expectancy
EHR	Electronic health records
FC	Facilitating conditions
HM	Hedonic motivation
HT	Habit
IM	Integrated model
INE	Instituto Nacional de Estatística
IT	Information technology
KS	Kolmogorov-Smirnov test
MM	Motivational model
PE	Performance expectancy
PEOU	Perceived ease of use
PLS	Partial least squares
PU	Perceived usefulness
PV	Price value
SI	Social influence
TAM	Technology acceptance model
TPB	Theory of planned behavior
UB	Use behaviour
UTAUT	Unified theory of acceptance and usage technology
UTAUT2	Extended unified theory of acceptance and usage technology

1. INTRODUCTION

E-health can be defined as health services delivered through the Internet (Eysenbach, 2001). E-health systems and services can deliver considerable improvements to increase the productivity of the health sector (European Commission, 2004). They can offer governments and tax payers a means, with productivity gains, to cope with increasing demand in health care services. They can also help to reshape the future of health care delivery, making it more citizen-centred (European Commission, 2004). Some promising e-health goals are: greater efficiency and quality of care, evidence-based medicine (through access to web-available case repositories), education of physicians through online sources, widening the scope of health care, dealing with privacy and security contexts, having equal access to health care, and empowerment of consumers and patients (Wickramasinghe, Fadlalla, Geisler, & Schaffer, 2005). While the traditional user of health care services has had a passive role in the past, today's user is more active, better informed, and more demanding (Sørensen, 2008).

While earlier research has been more focused on information technology (IT) design and implementation or on electronic health records (EHR) adoption (Holden & Karsh, 2010), there is a lack of understanding of how these applications can help individuals to change lifestyle behaviours (Alpay, Henkemans, Otten, Rövekamp, & Dumay, 2010; Hoyo-barbolla, Arredondo, & Fernández, 2006). The aim of this study is to understand the factors that drive individuals to adopt e-Health. This study applies to e-health the extended unified theory of acceptance and use of technology (UTAUT2), in order to propose a model to explain individual's behavioural intention and technology use of e-health, in the patient or consumer point of view, building on earlier research. Venkatesh et al. (2012) suggested applying UTAUT2 to other technologies and as Angst and Agarwal (2009) suggested to including technology adoption constructs when investigating e-health adoption models.

The structure of this paper is the following one. In the next section, the concept of e-health is explained and the theoretical background used in this study, such as earlier research on e-health is discussed. In the second part of the paper, the research model, hypotheses, and the methodology are presented. Then, the results of measurement and the structural model are presented. Finally, the theoretical and managerial implications

are exposed and possible future research arising from this study is presented, followed by conclusions.

2. THEORETICAL BACKGROUND

2.1. THE CONCEPT OF E-HEALTH

According to the European Commission (EC) an e-health system allows for more efficient medical, pharmaceutical, and other health professionals' work. Access to digitalized patient data facilitates research and communication, making e-health initiatives very important in public health policies (European Commission, 2004). A recent study from Portugal's National Statistics Institute (INE) reveals that all Portuguese hospitals have access to internet, about 96% have broadband, and in 77% of the hospitals there are electronic clinical processes (Instituto Nacional de Estatística, 2012). However, even though 81% of the hospitals have a website, only 23% allow patients to make medical appointments online (Instituto Nacional de Estatística, 2012). The European Commission's flagship initiatives "A Digital Agenda for Europe" promote online health through a policy in which member states will need to promote deployment and use of modern accessible online services (European Commission, 2010). Portugal's National Health Plan to 2012-2016 follows EC policy of Information and Communication Technologies in the cross-sectional policies of the Procedures of The National Health Plan, combining e-health with Information Systems and with Media and Communication in Health (Gabinete Técnico do PNS, 2011).

Earlier research found 51 different concepts and recognizes that it is possible to find many definitions of e-health, all of which share clear references to health and technology (Oh, Rizo, Enkin, & Jadad, 2005). Although e-health thus lacks a single definition, in this paper we follow Eysenbach's (2001) definition: ***"e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies"***. Information technology is viewed as a tool to embody e-health itself (Oh et al., 2005) and this can be realized, for instance, as a website.

Our study focus on the specific technology of e-health portals provided by health institutions view the National Health System. Through an e-health portal patients can access and view their electronic health records (EHR), which are the patient's information in digital format, available to the patient and to health professionals (Angst & Agarwal, 2009). EHR can store socio-demographic data, medication records,

specialists' summaries, medical history, and laboratory results (Lomotey & Deters, 2013). Patients can also benefit from other convenience services including online scheduling of medical appointments, prescription refills, and physician-patient communication (Andreassen et al., 2007; Baur, Deering, & Hsu, 2001; Wilson & Lankton, 2003). Here in after e-health refers to e-health portals.

Even though e-health definitions diverge, the perceived benefits are consistent across the literature. The most mentioned e-health benefits are cost-saving stemming from reduced operating expenses of services, time-savings with data processing (e-prescriptions, for example), and the resulting overall improvements in productivity (Jordanova & Lievens, 2011). E-health systems also reduce administrative costs through, for instance, electronic billing (Alvarez, 2002; Danzon & Furukawa, 2001; OECD, 2010; Tang, Ash, Bates, Overhage, & Sands, 2006; Wilson & Lankton, 2003). Increasing quality and efficiency of care is also often mentioned in the literature, since e-health provides constant access to patient's medical data, which allows health professionals to monitor the effects of diseases and therapies over time and allows for better co-ordination between them (Angst & Agarwal, 2006; European Commission, 2004; OECD, 2010; Tang et al., 2006). E-health also provides more information to patients through the access to EHR (Alvarez, 2002; European Commission, 2004; Tang et al., 2006), improves communication between health professionals and patients, improving, for example, chronic care (OECD, 2010; Tang et al., 2006), and there is frequent mention in the literature that e-health mitigates the adverse effects of geographic isolation (Alvarez, 2002).

2.2. ADOPTION MODELS AT INDIVIDUAL LEVEL

2.2.1. E-health adoption models

Not many studies have been made relating health, information technology, and individual adoption models. The need for a better understanding of the factors that influence the use of the internet in health related matters has already been recognized (Angst & Agarwal, 2006; Wilson & Lankton, 2004). Even though this area of research is not widely explored, several studies have been made to investigate these factors, and although the target technology may vary, and for that reason the dependent variables vary as well, some conclusions can be taken, as shown in Table 2.1.

Table 2.1 summarizes some of the studies made in the area of e-health, the theory or the theories behind the studies, the dependent variable that is being explained by the study, and the most important findings. The target population in all studies was patients.

Theory	Dependent variable	Findings	Reference
TAM, motivational model (MM), integrated model (IM)	e-health behavioural intention	• PEOU (from TAM), PU (from TAM), Intrinsic Motivation (from IM) and Extrinsic Motivation (from MM) have significant positive influence on behavioural Intention. • IM does not have a better performance than TAM or than MM when predicting behavioural Intention.	(Wilson & Lankton, 2004)
Elaboration likelihood model (ELM), concern for information privacy (CFIP)	EHR behavioural intention	• Positively framed arguments and Issue Involvement generate more favourable attitudes toward EHR behavioural intention. • CFIP is negatively associated with likelihood of adoption.	(Angst & Agarwal, 2009)
TAM (qualitative study)	E-health services behavioural Intention	• PU seemed to be important. • PEOU did not seem to be an issue. • Although Experience is not a TAM construct, it seemed to have influenced behavioural Intention.	(Jung & Loria, 2010)
TAM, plus several other constructs	Internet use behaviour as a source of information	• PU, importance given to written media in searches for health information, concern for personal health, importance given to the opinions of physicians and other health professionals, and the trust placed in the information available are the best predictors to use behaviour.	(Lemire, Paré, et al., 2008)
Personal empowerment	Internet use behaviour as a source of information	• There are 3 types of attitudes encouraging Internet use to seek health information: Professional, Consumer Logic and Community Logic.	(Lemire, Sicotte, & Paré, 2008)

Table 2.1 - E-Health adoption models

Most of the research in this area (Jung & Loria, 2010; Lemire, Paré, Sicotte, & Harvey, 2008; Wilson & Lankton, 2004) uses the technology acceptance model (TAM) in order to help explain behavioural intention or use behaviour. TAM proposes two

constructs as key explanatory variables: users' perceived technology usefulness (PU) and user's perceived ease of use (PEOU) of a technology (Davis, 1989). For instance, Wilson and Lankton (2004) studied the three different models (TAM, motivational model, and integrated model) in order to predict patients' behavioural intention on e-health; Jung and Loria (2010) made a qualitative study to understand if TAM could be a good model to predict patients' e-health adoption; and Lemire et al. (2008) also used TAM to predict patients' use, but also extended it by incorporating other constructs: quality of information, trust in the information, importance given to the opinions of health professionals, importance given to health information in media, and concern for one's health.

2.2.2. Extended unified theory of acceptance and usage technology (UTAUT2)

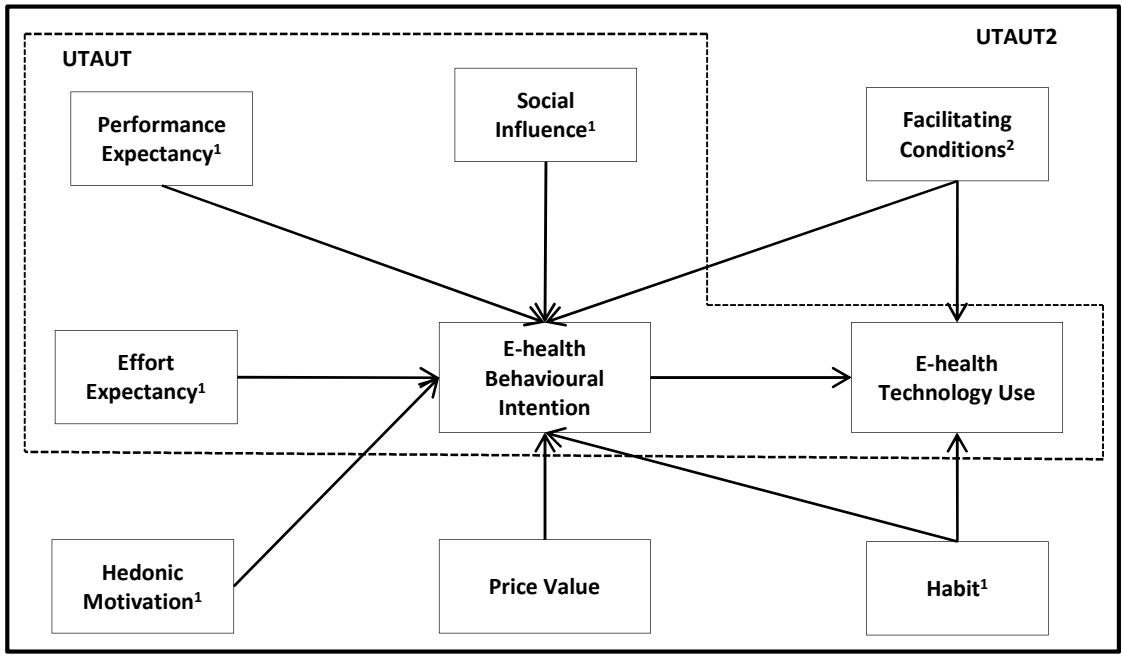
In 2003 Venkatesh et al. reviewed eight different models and combined them into the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003). The models used this construction were the theory of reasoned action (Fishbein & Ajzen, 1975), the technology acceptance model (TAM) (Davis, 1989) , the motivation model (Davis, 1989), the theory of planned behaviour (TPB) (Ajzen, 1991), the combined TAM and TPB (Taylor & Todd, 1995), the model of PC utilization (Thompson, Higgins, & Howell, 1991), innovation diffusion theory (Moore & Benbasat, 1996), and social cognitive theory (Compeau & Higgins, 1995). To predict behavioural intention Venkatesh used performance expectancy, effort expectancy, social influence, and facilitating conditions, and to predict use behaviour he drew on behavioural intention and facilitating conditions. These constructs were moderated by age, gender, experience, and voluntariness of use. Since its publication UTAUT has been used in several studies and tested in different countries, such as Saudi Arabia (Al-Gahtani, Hubona, & Wang, 2007) or comparing Korea and U.S. (Im, Hong, & Kang, 2011), and in different technologies, such as e-Government (Gupta, Dasgupta, & Gupta, 2008) or m-Commerce (Min, Ji, & Qu, 2008).

In 2012 Venkatesh et al. modified the UTAUT model for a more consumer centred context model, developing the extended unified theory of acceptance and usage technology (UTAUT2). UTAUT2 is tailored to the context of consumer acceptance and use of a technology. This new model includes the same four UTAUT constructs, but

differently moderated. The constructs are now moderated only by age, gender, and experience. The moderator voluntariness of use was dropped since the target population was not obligated to use the technology. UTAUT2 also introduces three new constructs: hedonic motivation, price value, and habit. Hedonic motivation and price value explain behavioural intention, and habit explains both (behavioural intention and use behaviour). Compared to UTAUT, the extensions proposed in UTAUT2 produced a substantial improvement in the variance explained in behavioural intention (56% to 74%) and technology use (40% to 52%) (Venkatesh et al., 2012).

3. RESEARCH MODEL

To explain individual's behavioural intention and technology use of e-health, the model proposed here in is an application of the UTAUT2 model to a health related area (Figure 3.1). The aim of our study is to determine if this model also fits this emerging technology from the patient or consumer point of view, as proposed by Venkatesh et al. (2012). Since the UTAUT model has been so successfully applied to predict intention and actual use of so many different types of technologies, we test it on e-health. We follow the model proposed by Venkatesh et al. (2012), to understand if it can also be applicable to an e-health environment. For this we propose the same constructs that exist in the original model of UTAUT2 and make some adjustments to the hypotheses in order to a better fit to e-health environment. Experience was not measured since our questionnaire was applied at just one moment in time.



Notes: 1. Moderated by age and gender;

2. Effect on behavioural intention is moderated by age and gender; effect on technology use is moderated by age.

Figure 3.1 - Research model adapted from Venkatesh et al. (2012)

3.1.1. UTAUT2 Model

Performance expectancy (perceived usefulness from TAM (Miltgen, Popovič, & Oliveira, 2013)) is defined as the perceived benefits that an individual obtains by using a

technology in a certain activity (Venkatesh et al., 2003). Performance expectancy is a very valuable behavioural intention predictor, in both the UTAUT and UTAUT2 models. When applied to health environments it has also proved to be a good predictor of behavioural intention, which indicates that patients who consider that e-health is useful and provide important and meaningful information are more receptive to e-health adoption (Lemire, Paré, et al., 2008; Wilson & Lankton, 2004).

Effort expectancy (perceived ease of use from TAM (Miltgen et al., 2013)) is associated with how easy it seems to be to use a certain technology activity (Venkatesh et al., 2003). Earlier research has already pointed out the usability of e-health (i.e. how easy and simple it is to use an e-health platform) as an important variable (Keselman, Logan, Smith, Leroy, & Zeng-Treitler, 2008; Wilson & Lankton, 2004), suggesting that patients tend to adopt more e-health technologies if they find the technology easy to use.

Social influence is the effect that a person held to be important to an individual has on the decision of that individual to use a technology activity (Venkatesh et al., 2003). In the case of e-health there are many communities of peer-support and online forums that can influence consumers' behaviour in their decision to use or not to use e-health technologies. These communities allow sharing of experiences and opinions of persons in similar health conditions and situations (Lemire, Sicotte, et al., 2008; Rodrigues, Lopes, & Tavares, 2013).

The last UTAUT construct is facilitating conditions, defined as the individual perception of the support available in order to use a technology activity (Venkatesh et al., 2003). One of the barriers to consumers' use of health services over the internet is the consumers' resources to access these platforms (Keselman et al., 2008), suggesting that users with better conditions to use e-health technologies favour e-health services adoption.

Hedonic motivation or perceived enjoyment is defined as the intrinsic motivation of an individual to obtain fun or pleasure from using a technology activity (Venkatesh et al., 2012). Hedonic motivation is considered to be a strong predictor of behavioural intention (Venkatesh et al., 2012). Earlier research found that this construct is also

important to e-health consumers and that it could even be a sufficient reason for adoption (Cocosila & Archer, 2010).

In UTAUT2 price value is defined as the perceived benefits of using a technology given its costs (Venkatesh et al., 2012). Even though the cost and time savings may have influence over individuals (Or & Karsh, 2009), the target technology of our study are e-health platforms, and most hospitals or health institutions have free internet health services, so the price value could be not significant on behavioural intention (Venkatesh et al., 2003).

The last construct from UTAUT2 is habit. This construct refers to the automation of a behaviour resulting from learning (Venkatesh et al., 2012). Habit has proved to be a good predictor of different technologies adoptions, since it is a result of prior experiences (Venkatesh et al., 2012). We therefore test it in e-health adoption as well.

All moderators, except for price value, were used accordingly to UTAUT2 (Venkatesh et al., 2012).
Our hypotheses are:

H1: Performance expectancy (PE) will positively influence behavioural intention. Age and gender will moderate the effect of PE on behavioural intention, such that the effect will be stronger among younger men.

H2: Effort expectancy (EE) will positively influence behavioural intention. Age and gender will moderate the effect of EE on behavioural intention, such that the effect will be stronger among younger women.

H3: Social influence (SI) will positively influence behavioural intention. Age and gender will moderate the effect of SI on behavioural intention, such that the effect will be stronger amongst older women.

H4(a): Facilitating conditions (FC) will positively influence behavioural intention. Age and gender will moderate the effect of FC on behavioural intention, such that the effect will be stronger amongst older women.

H4(b): Facilitating conditions (FC) will have a significant influence on use behaviour. Age will moderate the effect of FC on technology use, such that the effect will be stronger amongst older people.

H5: Hedonic motivation (HM) will positively influence behavioural intention. Age and gender will moderate the effect of HM on behavioural intention, such that the effect will be stronger amongst younger men.

H6: Price value (PV) will have no influence behavioural intention.

H7(a): Habit (HT) will positively influence behavioural intention. Age and gender will moderate the effect of HT on behavioural intention, such that the effect will be stronger for older men.

H7(b): Habit (HT) will positively influence technology use. Age and gender will moderate the effect of HT on technology use, such that the effect will be stronger for older men.

H8: Behavioural intention will have a significant and positive influence on technology use.

4. METHODS

4.1. MEASUREMENT

All of the items were adopted from Venkatesh et al. (Venkatesh et al., 2012), Wilson and Lankton (2004), and Martins and Oliveira (2014), with small modifications, in order to adjust to e-health technology. The items are shown in Table 9.1, in appendix section. The questionnaire was administrated in Portuguese through a web hosting service after being translated by a professional translator. In order to validate that the content did not lose its original meaning, a back-translation was made from the Portuguese instrument to English, again by a professional translator and compared to the original (Brislin, 1970).

The scales' items were measured on a seven-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (7). Use was measured on a different scale. The scale from UTAUT2 (from "never" to "many times per day") was adapted to "never" to "every time I need", since e-health usage is not as regular as a mobile internet usage. Demographic questions about age and gender were also included; age was measured in years and gender was coded as a dummy variable (0 or 1), women were represented by 0.

Before the respondents could see any of the questions an introduction was made explaining the concept of e-health. The aim of this introduction was to ensure that respondents were aware of this concept.

4.2. DATA COLLECTION

To test the instrument, a pilot survey was conducted in June 2013 to validate the questions and scale of the survey. From the pilot survey we had 31 responses demonstrating that all of the items were reliable and valid. The data from the pilot survey were not included in the main survey.

The survey was sent by email, with the hyperlink of the survey, to a total of 1223 people at three different universities, including teachers, students, and other administrative personnel, in September of 2013, from which we obtained 363

responses. A reminder was sent two weeks after the first email, only to those who had not responded to the first email, in order to improve the response rate. Following the reminder, we had a total of 505 respondents (41% response rate). After removing the invalid responses, the final sample had 386.

To test for nonresponse bias we compared the sample distribution of the first and second respondents groups, using the Kolmogorov-Smirnov (K-S) test to compare the sample distributions of the two groups (Ryans, 1974). The K-S test suggests that the sample distributions of the two independent groups are not statistically different (Ryans, 1974). This means that nonresponse bias is not present. The common method bias was examined using Harman's one-factor test (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). No significant common method bias was detected in the dataset.

More than half of our sample was less than 30 years old. About 62% of the respondents were women, 37% were undergraduates and 41% were full-time students. Our sample characteristics are shown on Table 4.2 in more detail.

Variable	Category	Frequency	%
Age	18-23	149	38.6%
	24-30	91	23.6%
	31-40	93	24.1%
	41-50	33	8.5%
	>50	20	5.2%
Gender	Male	147	38.1%
	Female	239	61.9%
Chronic Illness	No	328	85.0%
	Yes	58	15.0%
Education	Undergraduate	141	36.5%
	Bachelor's degree and post-graduate	174	45.1%
	Master Degree or more	71	18.4%
Industry Employed	Healthcare and/or social services	56	17.2%
	Not employed/retired	16	4.9%
	Student	133	40.8%
	Education	21	6.4%
	Retail trade	22	6.7%
	Consultant, scientific activities	56	17.2%
	Finance, insurance, real estate	22	6.7%
	Other	60	15.5%

Table 4.1 - Sample characteristics

5. RESULTS

To test the research model we used the partial least squares (PLS), which is a causal modelling approach that represents a variance-based technique path modelling (Hair, Ringle, & Sarstedt, 2011). The complexity of the model (i.e., many moderators), the ability of using the PLS method as theory-building method, and the fact that the PLS method is orientated to explain variance of the research model were the main reasons to choose this method (Henseler, Ringle, & Sinkovics, 2009). In addition, PLS was applied in both UTAUT and UTAUT2 models (Venkatesh et al., 2003, 2012). We used SmartPLS 2.0.M3 (Ringle, Wende, & Will, 2005), a software to estimate the PLS. Before testing the structural model we examined the measurement model to assess construct reliability, indicator reliability, convergent validity, and discriminant validity.

5.1. MEASUREMENT MODEL

The results of the measurement model are shown on Tables 5.1 and 5.2. To evaluate construct reliability, one can be use the Cronbach's alpha (CA) or the composite reliability coefficient (CR). The most common measure to estimate the internal consistency reliability of the measures is CA, which assumes that all indicators of a construct are equally reliable (Henseler et al., 2009). Although CA is more used, CR is more appropriate for PLS, since it prioritizes indicators according to their individual reliability and also takes into account that indicators have different loadings, unlike CA. Table 5.1 reports that all constructs have both CA and CR greater than 0.70, showing evidence of internal consistency (Mackenzie, Podsakoff, & Podsakoff, 2011).

In order to have good indicator reliability it is desired that the latent variable explains more than half of the indicators' variance. The correlation between the constructs and its indicators should thus be greater than 0.7 ($\sqrt{0.5} \approx 0.7$) (Henseler et al., 2009; Mackenzie et al., 2011). However, an item is recommended to be eliminated only if its outer standardized loadings are lower than 0.4 (Churchill, 1979). The measurement model has no issues with the indicators' reliability; only FC4 is lower than 0.7, but still greater than 0.4 (Table 5.1).

Construct	Item	PE	EE	SI	FC	HM	PV	HT	BI

Performance expectancy (PE) CR=0.94 CA=0.90	**PE1**	**0.86**	0.39	0.19	0.17	0.39	0.27	0.30	0.37
	PE2	**0.95**	0.45	0.31	0.25	0.47	0.30	0.42	0.51
	PE3	**0.93**	0.45	0.36	0.23	0.45	0.33	0.45	0.49
Effort expectancy (EE) CR=0.94 CA=0.91	**EE1**	0.36	**0.87**	0.16	0.52	0.32	0.26	0.20	0.37
	EE2	0.48	**0.92**	0.26	0.51	0.44	0.33	0.29	0.42
	EE3	0.42	**0.86**	0.26	0.49	0.44	0.34	0.30	0.36
	EE4	0.43	**0.91**	0.21	0.53	0.37	0.29	0.28	0.41
Social influence (SI) CR=0.98 CA=0.97	**SI1**	0.31	0.25	**0.97**	0.22	0.26	0.34	0.56	0.43
	SI2	0.31	0.23	**0.98**	0.20	0.30	0.34	0.55	0.43
	SI3	0.31	0.25	**0.98**	0.22	0.32	0.34	0.56	0.45
Facilitating conditions (FC) CR=0.88 CA=0.81	**FC1**	0.16	0.43	0.10	**0.82**	0.17	0.17	0.16	0.22
	FC2	0.20	0.51	0.20	**0.90**	0.24	0.25	0.21	0.26
	FC3	0.26	0.54	0.14	**0.84**	0.28	0.18	0.18	0.29
	FC4	0.14	0.34	0.28	**0.63**	0.32	0.27	0.28	0.18
Hedonic motivation (HM) CR=0.96 CA=0.93	**HM1**	0.44	0.36	0.29	0.25	**0.96**	0.41	0.45	0.40
	HM2	0.49	0.50	0.28	0.38	**0.91**	0.37	0.43	0.41
	HM3	0.42	0.38	0.29	0.24	**0.96**	0.41	0.44	0.40
Price value (PV) CR=0.96 CA=0.94	**PV1**	0.23	0.28	0.28	0.22	0.33	**0.91**	0.38	0.31
	PV2	0.35	0.35	0.34	0.28	0.43	**0.96**	0.46	0.36
	PV3	0.34	0.33	0.35	0.25	0.41	**0.95**	0.47	0.37
Habit (HT) CR=0.85 CA=0.73	**HT1**	0.31	0.24	0.59	0.24	0.33	0.43	**0.88**	0.53
	HT2	0.25	0.13	0.44	0.14	0.39	0.36	**0.80**	0.40
	HT3	0.50	0.34	0.33	0.21	0.44	0.33	**0.74**	0.54
Behaviour intention (BI) CR=0.94 CA=0.91	**BI1**	0.54	0.48	0.36	0.33	0.45	0.34	0.57	**0.90**
	BI2	0.44	0.39	0.41	0.25	0.38	0.32	0.54	**0.94**
	BI3	0.41	0.34	0.45	0.24	0.36	0.36	0.57	**0.91**

Table 5.1 - PLS loadings and cross-loadings

In order to assess the convergent validity we used average variance extracted (AVE). The AVE should be greater than 0.50, so that the latent variable explains, on average, more than 50% of its own indicators (Fornell & Larcker, 1981). As shown in Table 5.2, none of the constructs have the AVEs lower than 0.63, so all of the indicators respect this criterion.

Finally, discriminant validity can be evaluated with the Fornell-Larcker criterion (Fornell & Larcker, 1981). This criterion claims that a latent variable shares more variance with its indicators than with the other latent variables, so that the square root of AVEs should be greater than the correlations between the construct (Fornell & Larcker, 1981; Henseler et al., 2009). As seen in Table 5.2, all diagonal elements (square root of AVEs) are greater than the correlation between constructs (off diagonal elements). In addition, another criterion can be assessed, although it is a more liberal criterion (Henseler et al., 2009). We also examined for each construct if loadings are greater than all of its cross-loadings (Chin, 1998; Götz, Liehr-Gobbers, & Krafft, 2010). This criterion is also met, as seen in Table 5.1.

	Mean	SD	PE	EE	SI	FC	HM	PV	BI	Gender	Age	HT	UB
PE	5.30	1.33	**0.91**										
EE	5.53	1.09	0.47***	**0.88**									
SI	2.97	1.62	0.32***	0.25***	**0.98**								
FC	5.76	1.19	0.24***	0.57***	0.22***	**0.80**							
HM	4.48	1.53	0.48***	0.44***	0.31***	0.31***	**0.94**						
PV	4.32	1.39	0.33***	0.34***	0.35***	0.27***	0.42***	**0.94**					
BI	4.87	1.34	0.53***	0.44***	0.38***	0.34***	0.47***	0.33***	**0.80**				
Gender	0.62	0.49	-0.01	-0.05	0.05	-0.01	-0.06	0.06	-0.04	**N.A.**			
Age	29.46	10.06	0.00	-0.05	0.12*	-0.02	-0.03	0.06	0.04	-0.12*	**N.A.**		
HT	3.07	1.38	0.44***	0.29***	0.57***	0.25***	0.47***	0.47***	0.58***	-0.01	0.10	**0.81**	
UB	2.56	1.75	0.25***	0.20***	0.43***	0.22***	0.16**	0.25***	0.42	0.01	0.23***	0.50***	**N.A.**

Notes:
1. PE: Performance expectancy; EE: Effort expectancy; SI: Social influence; FC: Facilitating conditions; HM: Hedonic motivation; PV: Price value; BI: Behavioural intention; Gender: Gender; Age: Age; HT: Habit.
2. *** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$
3. Diagonal elements are square roots of AVEs and off-diagonal elements are correlations.

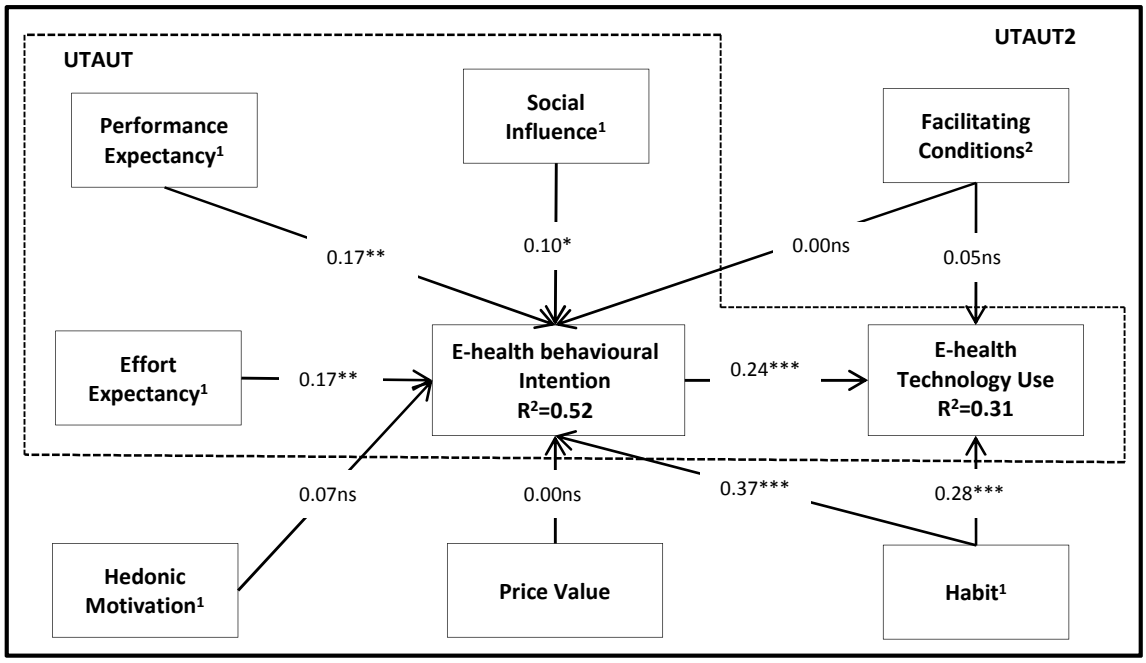
Table 5.2 - Descriptive statistics, correlations, and square root of AVEs

In sum, all assessments are satisfactory. This means that the constructs can be used to test the conceptual model.

5.2. STRUCTURAL MODEL

The structural model was run in two separated models: direct effects only, and direct and moderated effects. The path significance levels were estimated using a bootstrap with 500 iterations of resampling.

Figure 5.1 shows the path coefficients, their significance levels, and R^2. For a better understanding and reading of the figure, we do not show the path model of the moderators (age and gender). The R^2 was used to evaluate the structural model. Overall, the model explains 52% and 31% of the variance in behavioural intention and technology use, respectively.



Notes: 1. Moderated by age and gender;
2. Effect on behavioural intention is moderated by age and gender; effect on technology use is moderated by age.
3. *** = p < 0.001; ** = p < 0.01; * = p < 0.05; ns = non-significant.

Figure 5.1 - Structural model results

As Table 5.3 (D+I) shows, the predictors of behavioural intention are performance expectancy ($\hat{\beta}$=0.17; p<0.01), effort expectancy ($\hat{\beta}$=0.17; p<0.01), social influence ($\hat{\beta}$=0.10; p<0.05), and habit ($\hat{\beta}$=0.37; p<0.001). These constructs partially support hypotheses H1, H2, and H3, since age and gender have no significant influence while moderating the effect of each construct on behavioural intention. H7(a) is fully supported, as age and gender do moderate the influence of habit on intention ($\hat{\beta}$=0.12; p<0.05), which means that it is more important for older men. Price value ($\hat{\beta}$=0.00; p>0.05) proved to be non-significant. This means that price value has no influence on behavioural intention and, hence, supports H6. On the other hand, facilitating conditions ($\hat{\beta}$=0.00; p>0.05) and hedonic motivation ($\hat{\beta}$=0.07; p>0.05) are non-significant in predicting behavioural intention. Hence, hypotheses H4(a) and H5 are not supported.

As a predictor of technology use, we found that habit is positive and statistically significant ($\hat{\beta}$=0.28; p<0.001). However, age and gender do not moderate the influence of habit on use ($\hat{\beta}$=0.01; p>0.05), and therefore H7(b) is only partially supported. Behavioural intention also has a significant and positive influence on technology use ($\hat{\beta}$=0.24; p<0.001). Hypothesis H8 is supported. Age also has a positive and significant effect on technology use. This finding suggests that older individuals use more e-health technologies than the younger individuals. Only facilitating conditions has no statistically significant impact on use ($\hat{\beta}$=0.05; p>0.05) and for that reason H4(b) is not supported.

	Behavioural intention		**Technology use**	
	D only	**D+I**	**D only**	**D+I**
R^2	0.48	0.52	0.26	0.31
Adj. R^2	0.47	0.51	0.25	0.30
Performance expectancy (PE)	0.20***	0.17**	--	--
Effort expectancy (EE)	0.18**	0.17**	--	--
Social influence (SI)	0.10*	0.10*	--	--
Facilitating conditions (FC)	0.02	0.00	0.05	0.05
Hedonic motivation (HM)	0.03	0.07	--	--
Price value (PV)	0.01	0.00	--	--
Habit (HT)	0.39***	0.37***	0.32***	0.28***
Behavioural intention (BI)	--	--	0.23***	0.24***
Age	--	0.04	--	0.17***
Gender	--	-0.03	--	-0.06
Gender x Age	--	-0.03	--	--
PE x Age	--	-0.02	--	--
PE x Gender	--	0.03	--	--
PE x Gender x Age	--	-0.05	--	--
EE x Age	--	-0.01	--	--
EE x Gender	--	-0.04	--	--
EE x Gender x Age	--	0.00	--	--
SI x Age	--	-0.03	--	--
SI x Gender	--	-0.06	--	--
SI x Gender x Age	--	-0.05	--	--
FC x Age	--	0.02	--	0.04
FC x Gender	--	-0.07	--	--

FC x Gender x Age	--	0.03	--	--
HM x Age	--	-0.09	--	--
HM x Gender	--	-0.10	--	--
HM x Gender x Age	--	-0.08	--	--
PV x Age	--	0.09*	--	--
PV x Gender	--	0.01	--	--
PV x Gender x Age	--	0.05	--	--
HT x Age	--	0.03	--	-0.12*
HT x Gender	--	0.08	--	0.03
HT x Gender x Age	--	0.12*	--	0.01

Notes:
1. D only: Direct effects only; D+I: Direct and moderated effects
2. *** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$

Table 5.3 - Structural model results

6. DISCUSSION

Our study has sought to apply the extended unified theory of acceptance and usage technology – UTAUT2 (Venkatesh et al., 2012) – to the special case of patients e-health acceptance, in order to find out if the constructs proposed in this model help to explain behavioural intention and technology use of e-health. E-health is still an emerging field and can be viewed from many different perspectives: health IT adoption, electronic personal health records adoption, health related professionals' adoption, and patient's adoption. This study contributes to a better understanding of what patients think is important to an e-health system from a consumer or client point of view.

6.1. THEORETICAL IMPLICATIONS

Our results suggest that using UTAUT2 in a health related area yields good results, explaining 52% of the variance in behavioural intention and 31% of the variance in technology use. The most important contributors are performance expectancy, effort expectancy, social influence, and habit. Both performance expectancy and effort expectancy are originally from TAM (Davis, 1989) and have already been tested and found to obtain good results among other individual adoption models in e-health related studies (Lemire, Paré, et al., 2008; Wilson & Lankton, 2004). This was also found to be the case in our research model. Social influence also has a statically positive influence on behavioural intention. Habit, one of the new constructs that come from UTAUT2, proved to have the most significant effect on behavioural intention and on technology use as well.

Table 6.1 presents a summary of all the tested hypotheses, and their support (or not) supported based on statistical tests. Overall, most of our hypotheses were supported or partially supported. In most cases age or gender did not moderate the effects of the constructs on the dependent variables, except for the effect of habit (which is moderated by age and gender) and price value (which is moderated by age) on behavioural intention; and habit (which is moderated by age) on technology use.

The rejection of the facilitating conditions' hypotheses suggests that the subjects in our sample consider that the resources or knowledge to use e-health are not an issue. This can be explained by the facility of having access to a computer and to the internet.

In 2013 62% of Portuguese individuals, between 16 and 74 years old, had access to internet in their households (Eurostat, 2013a), and almost every individual (96.2%) had access to the internet in their workplace in 2013 (Eurostat, 2013b). Hedonic motivation also has no significant importance on behavioural intention.

On the other hand, our subjects give much importance to the usefulness in their daily life and also to the simplicity of the e-health system, suggesting that individuals care about the result and the necessary effort it takes to use the system. When it comes to price value, it did not have a significant impact on the intention of our respondents, but when price value is moderated by age, this effect is significant specifically in older individuals. It seems that older individuals, who usually are likely to have more health problems, attribute greater value to the benefits of e-health systems. Social influence is also an important variable in the intention to use e-health. Individuals are apparently influenced by important people in their lives to use an e-health system. This influence may come from support groups on the internet, as revealed in other studies (Lemire, Sicotte, et al., 2008).

The study's results also point out that those individuals who are already accustomed using e-health are more likely to use the system. The same applies to behavioural intention effect on use, which indicates that subjects who have the intention to use e-health will more likely actually use it.

Path	Beta	t-value	Hypotheses	Result
PE → BI	0.17	3.15**	H1	Partially supported
PE x Gender x Age → BI	-0.05	0.80ns		
EE → BI	0.17	2.67**	H2	Partially supported
EE x Gender x Age → BI	0.00	0.04ns		
SI → BI	0.10	1.90*	H3	Partially supported
SI x Gender x Age → BI	-0.05	0.94ns		
FC → BI	0.00	0.00ns	H4(a)	Not supported
FC x Gender x Age → BI	0.03	0.46ns		
FC → UB	0.05	1.14ns	H4(b)	Not supported
FC x Age → UB	0.04	0.83ns		
HM → BI	0.07	1.44ns	H5	Not supported
HM x Gender x Age → BI	-0.08	1.24ns		
PV → BI	0.00	0.07ns	H6	Supported
HT → BI	0.37	6.54***	H7(a)	Supported
HT x Gender x Age → BI	0.12	1.98*		
HT → UB	0.28	4.67***	H7(b)	Partially supported
HT x Gender x Age → UB	0.01	0.20ns		
BI	0.24	3.90***	H8	Supported

Notes:
1. PE: Performance expectancy; EE: Effort expectancy; SI: Social influence; FC: Facilitating conditions; HM: Hedonic motivation; PV: Price value; BI: Behavioural intention; Gender: Gender; Age: Age; HT: Habit.
2. *** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$; ns = non-significant

Table 6.1 - Hypotheses' results summary

6.2. MANAGERIAL IMPLICATIONS

As we have seen, e-health portals have many perceived benefits for health institutions. They have major implications for public health and it is the European Commission's intention to increase this type of technology in health environments (European Commission, 2004). E-health helps to reduce costs and increase productivity and quality of service, which have become priorities of the health system (Angst & Agarwal, 2009; Renahy, Parizot, & Chauvin, 2008; Tang et al., 2006). In the ten-year period between 2002 and 2012 Portugal's expenditure on the health system increased by almost 30% (PORDATA, 2013), rising to 10.4 billion of euros in 2012. The findings of this study should generate important managerial implications on the conceptualization,

design and implementation of an e-health system, as they show which aspects are more valuable to patients when deciding whether to use e-health or not.

For instance, according to a National Health Inquiry from 2005/2006, about 52% of the population in Portugal had at least one chronic disease (Dias & Paixão, 2010), and in the 2º International Forum about the chronic patient, in Lisbon, a presentation revealed that 60% to 80% of this health expenditure was on chronic diseases (Campos, 2010). It was also demonstrated that using information systems and supporting self-management of the patients can translate into better outcomes (Epping-Jordan, 2004). Therefore, e-health may be a good tool to help reduce costs and give a better life to patients who suffer from chronic disease (Alpay et al., 2010).

Since the usability and functionality significantly affect e-health systems adoption, hospitals, clinics, and other health related institutions, wishing to implement these platforms, should design a simple and clean platform that is intuitive and harmonious for patients to use it (Kelders, Pots, Oskam, Bohlmeijer, & van Gemert-Pijnen, 2013). Simple dashboards about patients' medical indicators over time can also encourage the system usage as it becomes a more enjoyable and fun process (Trevena et al., 2013).

Institutions also need to promote this kind of platform usage, explaining the benefits of becoming a more independent and educated patient and the gains in convenience, efficiency, and possibly cost reduction (Alpay et al., 2010). The cost reduction topic is important especially amongst the elderly, who are likely to have more diseases and believe in the value of using e-health systems, as demonstrated by the results in this study. Promoting the system usage by showing patients their own website or platform what it is like to use an e-health system should also be a priority to health related institutions (Alpay et al., 2010).

Social influence is also an important variable in the intention to use e-health, as demonstrated by the results of this study. Because this influence may come from online support groups, as seen in other studies (Lemire, Sicotte, et al., 2008), digital strategies to promote e-health tools by using social networks, like Facebook, should be useful in promoting the adoption and use of e-health.

6.3. LIMITATIONS AND FUTURE RESEARCH

The study has its limitations. We acknowledge that this research is limited by the geographic location, as it pertains to Portugal only. Future research should apply UTAUT2 to e-health in other countries. However, because of the current financial crisis in Portugal, and throughout Europe, e-health becomes more important to manage investments and to seek for better and more efficient public health systems, betting more on prevention, promoting, and providing to patients with self-management tools.

Our study sample characteristics have limitations as well. Our respondents were mainly young (almost 60% of our sample was old less than 30 years). Since we have acknowledged that older individuals are more likely to use e-health than younger individuals, this sample may skew our results. Our advice is to use a more balanced sample. An interesting research would be to compare younger and older individuals' adoption likelihood, in order to analyse if there are statistically significant differences between age groups.

Regarding the tested model (UTAUT2), it has no health related construct. We suggest that future research include and test patients' personal empowerment variables, associated with technology acceptance and use, in order to improve the explained variance of behavioural intention and use of e-health (Lemire, Sicotte, et al., 2008). Furthermore, and also regarding UTAUT2, the experience moderator could bring more explanatory power to the model, since habit has a major impact on the dependent variables. Future research should therefore also collect experience information, at least in a self-reported way.

Finally, another very interesting and actual research topic would be e-health applied to mobile phones, that is, m-health. Although there are some studies in this field (Handel, 2011; Kharrazi, Chisholm, VanNasdale, & Thompson, 2012; Lim et al., 2011), applying UTAUT2 might yield results of great interest.

7. CONCLUSIONS

E-health adoption by patients is a new and important field of study. This is supported by European Commission guidelines to the member states that are implementing information technology systems, so that their patients may easily access their electronic health records. Therefore, this research sought to understand the acceptance of e-health technology by patients. For that, we used a new model proposed by Venkatesh et al. (2012) – UTAUT2 – which has a well-tested basis of technology acceptance constructs combined with more consumer centred variables.

The research model was tested in a Portuguese context and found to explain 52% of the variance in behavioural intention and 31% of the variance in e-health technology use. Of all the constructs tested, performance expectancy, effort expectancy, social influence, and habit had the most significant effect over behavioural intention. Habit is more important for older men and is price value for older individuals on behaviour intention. Habit and behavioural intention had the most significant effect over technology use; age is also a facilitator to explain technology use, older individuals tend to use more, most probably because health concerns and problems increase with age and habit is attenuated by age. It seems that habit is more important for younger individuals in explaining technology use. Furthermore, facilitating conditions and hedonic motivation had no significant impact on e-health adoption. Price value also did not influence adoption, as we hypothesized, except when moderated by age.

Research in this area still has many hypotheses yet to be proposed and different possibilities of models to be tested and integrated, especially when it comes to finding out what really drives patients to actual e-health usage. Our study helps to understand the technology side of e-health adoption. Further research should combine technology with health drivers, and with more evidence-based theory, in order to improve the knowledge in this field of study.

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9. APPENDIX

Construct	Code	Items	Reference
Performance Expectancy	**PE1**	Using e-health will support critical aspects of my health care.	(Wilson & Lankton, 2004)
	PE2	Using e-health will enhance my effectiveness in managing my health care.	
	PE3	Overall, e-health will be useful in managing my health care.	
Effort Expectancy	**EE1**	Learning how to use e-health is easy for me.	(Venkatesh et al., 2012)
	EE2	My interaction with e-health is clear and understandable.	
	EE3	I find e-health easy to use.	
	EE4	It is easy for me to become skilful at using e-health.	
Social Influence	**SI1**	People who are important to me think that I should use e-health.	(Venkatesh et al., 2012)
	SI2	People who influence my behaviour think that I should use e-health.	
	SI3	People whose opinions that I value prefer that I use e-health.	
Facilitating Conditions	**FC1**	I have the resources necessary to use e-health.	(Venkatesh et al., 2012)
	FC2	I have the knowledge necessary to use e-health.	
	FC3	E-health is compatible with other technologies I use.	
	FC4	I can get help from others when I have difficulties using e-health.	
Hedonic Motivation	**HM1**	Using e-health is fun.	(Wilson & Lankton, 2004)
	HM2	Using e-health is enjoyable.	
	HM3	Using e-health is very entertaining.	
Price Value	**PV1**	E-health is reasonably priced.	(Venkatesh et al., 2012)
	PV2	E-health is a good value for the money.	
	PV3	At the current price, e-health provides a good value.	
Habit	**HT1**	The use of e-health has become a habit for me.	(Venkatesh et al., 2012)
	HT2	I am addicted to using e-health.	
	HT3	I must use e-health.	
Behavioural Intention	**BI1**	I intend to use e-health.	(Venkatesh et al., 2012)
	BI2	I intend to use e-health in the next months.	
	BI3	I plan to use e-health frequently.	

Technology use	**UB1**	What is your actual frequency of use of e-health services? (i) Never; to (vii) every time I need it.	(Martins & Oliveira, 2014)

Table 9.1 - Questionnaire's items