DEVELOPMENT OF A MOBILE HEALTH ACCEPTANCE MODEL: AN EMPIRICAL INVESTIGATION ON PHYSICIANS

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ABSTRACT

DEVELOPMENT OF A MOBILE HEALTH ACCEPTANCE MODEL: AN EMPIRICAL INVESTIGATION ON PHYSICIANS

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The study aims to investigate physicians' intentions towards using mobile health (mHealth) applications. In order to understand and to reveal the influencing factors, a systematic method was followed. At the first phase, a literature research was conducted to identify studies in eHealth and mHealth domains. Literature research helped to reach to the studies about adoption and acceptance of health information systems by healthcare providers, employing behavioral acceptance theories. Following that, the conceptual model was developed using behavioral theories. Testing of the model completed by using explanatory sequential mixed method. Quantitative stage included a structured survey (questionnaire), and it was followed by a qualitative stage was completed by focus group interviews. Reliability test, confirmatory factor analysis and structural equation modeling were used in the analysis of quantitative data. Contextual analysis, memoing and coding methods were used to analyze focus group interviews. Pilot studies were conducted in order to assess the reliability, integrity and context of the questionnaire of quantitative stage, and to assess understandability of the questions of qualitative stage. The results of the study revealed the significant and non-significant influences on mHealth use by the physicians. The results were evaluated in two categories (user physicians and non-user physicians). The relations of factors in the model were supported with the qualitative insight. It was found that behavioral intention was influenced by PE and PI for users, and EE and TT for non-user physicians. The findings of the study expected present valuable insight about factors affecting healthcare providers' use of mobile health applications. The implications of the study would contribute to the health informatics literature, as well as to assist managers and the system developers of mobile health applications in order to understand user needs and to develop effective systems.

Keywords: Mobile Health, Physicians, Technology Acceptance, Mixed method

ÖZ

MOBİL SAĞLIK BENİMSEME MODELİ GELİŞTİRME: DOKTORLAR ÜZERİNE AMPRİK BİR İNCELEME

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Bu araştırmada doktorların mobil sağlık (mSağlık) uygulamalarını kullanımına yönelik davranışlarının incelenmesi amaçlanmaktadır. Bu davranışları etkileyen faktörleri anlamak için sistematik bir yöntem izlenmiştir. İlk aşamada, literatür taraması yapılmıştır ve eSağlık ve mSağlık alanında çalışmalar tespit edilmiştir. Literatür taraması, sağlık bilgi sistemlerinin sağlık çalışanları tarafından benimsenmesine yönelik araştırmalar erişmede yardımcı olmuştur. Taramadan sonra davranış teorileri benimsenerek bir konsept model oluşturulmuştur. Modelin testi ikili metot (kantitatif ve kalitatif metotlar) kullanılarak yapılmıştır. Kantitatif aşamada anket yöntemi ile ve kalitatif aşamada odak grup görüşmeleri ile veri toplanmıştır. İçerik analizi, alıntı ve kodlama yöntemleriyle odak grup görüşmeleri analiz edilmiştir. Güvenirlik testi, doğrulayıcı faktör analizi ve yapısal eşitlik modeli ile kantitatif veri analiz edilmiştir. Pilot uygulamalar, güvenirlik, bütünlük ve çalışmada kullanılan soruların içeriğini değerlendirmek için yapılmıştır. Çalışmanın sonuçları doktorların mSağlık kullanımına yönelik etkili ve etkili olmayan faktörleri açığa çıkarmıştır. Sonuçlar iki kategoride incelenmiştir (mSağlık kullanan doktorlar ve kullanmayan doktorlar). Modelde yer alan faktörlerin ilişkileri kalitatif bilgilerle desteklenmiştir. Çalışmada, kullanıma yönelik niyetin PE ve PI faktörleri (kullanıcılar için) ve EE ve TT faktörleri (kullanmayanlar için) tarafından etkilendiği gözlemlenmiştir. Çalışma bulgularının, sağlık çalışanlarının mobil sağlık uygulamalarını kullanıma yönelik etken faktörlerin belirlenmesi adına değerli bilgiler sunması beklenmektedir. Çalışma çıktıları sağlık enformatiği literatürüne katkıda bulunacağı gibi yöneticilere yol gösterici ve sistem geliştiricilere mobil sağlık uygulamalarında kullanıcı ihtiyaçlarını anlamak adına bir kılavuz sunacaktır.

Anahtar Sözcükler: Mobil Sağlık, Doktor, Teknoloji benimseme, İkili metot

Dedicated to my wife, Yasemin.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

mHealth:	Mobile Health
HIS:	Health Information Systems
BI:	Behavioral Intention
PU:	Perceived Usefulness
PEOU:	Perceived Ease of Use
PBC:	Perceived Behavioral Control
SN:	Social Norms
EE:	Effort Expectancy
PE:	Performance Expectancy
SI:	Social Influence
HB:	Habit
PI:	Personal Innovativeness
RD:	Result Demonstrability
MS:	Mobil Self-efficacy
MA:	Mobile Anxiety
TT:	Training and Technical Support
PS:	Perceived Service Availability
CO:	Compatibility

CHAPTER 1

INTRODUCTION

Providing healthcare services on the mobile platform is a promising technological development. It has increased reachability, accessibility and ability for effectively performing tasks (Nah & Siau, 2005; Sarker, 2003). Even though the health issues were the emphasized concerns related to mobile device use (IEGMP, 2000; Repacholi, 2001), yet, it has not shadowed the increasing use of mobile devices. Gartner's report presented that worldwide smart phone use have been rapidly increasing since 2007 (Gartner Inc., 2012) as well as the use of mobile applications. In addition to that, use of mobile platform in health service technologies, within the context of Health Information Systems (HIS), gained importance (Tachakra, Wang, Istepanian, & Song, 2003).

Today, mobile health (mHealth) can be considered as the umbrella term which covers mobile information communication and network technologies for systems and services of healthcare (Adibi, 2015). It includes the mobile devices and peripherals which are used by healthcare providers, patients and customers in order to gather, store and analyze data in the decision making process (Sezgin & Özkan-Yildirim, 2014). According to Wolters Kluwer and Deloitte reports, health services embraced the mobile technologies as well as its use by the healthcare professionals (Deloitte, 2013; *Wolters Kluwer Health 2013 Physician Outlook Survey*, 2013). Thus, there were number of mobile healthcare services in particular use for diagnostic stages and health management, such as smart phone applications, emergency services, echography and telemedicine applications (R. S. H. Istepanian, Laxminarayan, & Pattichis, 2010; WHO, 2011). Similarly there were studies in the literature about the use of mobile devices and applications in healthcare services (Hampton, 2012; R. S. H. Istepanian et al., 2010). However, in the light of these developments, there has been a puzzle that the mobile healthcare services might not have reached to the expected level of quality (Visvanathan, Gibb, & Brady, 2011). Here, plenty of approaches can be proposed to assess mobile health services, but technology acceptance theories provide a socio-technical perspective which has been embraced for being highly adaptive for the researches on the new technologies (Fanta, Pretorius, & Erasmus, 2016; Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003). Acceptance studies have proved their influence in terms of assessing user intentions towards technologies and assisting to improvement of technology and its use (Venkatesh & Davis, 2000). In this context, it is a need to figure the influencing factors for mobile health services in order to assess the its use of technology in healthcare services. Recent studies presented that the acceptance of mobile health services including management and monitoring systems for patients and professionals has been a highly interested field of study (J.

Chen, Park, & Putzer, 2010; Han, Mustonen, Seppanen, & Kallio, 2006; M.-C. Hung & Jen, 2010; Iredale, Hilgart, & Hayward, 2011; S. P. Lin, 2011; S.-P. Lin & Yang, 2009; Piette, Blaya, Sanchis, Box, & Arbor, 2011; I. Wu, Li, Fu, & Wu, 2010).

Considering the current state of mHealth, applications for mHealth services have an important role in practice. Thus, the problem is that the use of mHealth applications may not be utilized effectively in practice due to their perceptions and intentions towards the technology, and this problem requires attention from a socio-technical aspect in order to understand intentions of users as well as the state of the technology (J.-H. Wu, Wang, & Lin, 2007). Here, focusing on the physicians, emerging question is that to what degree does the physicians utilize from the mobile health applications, and (even if they are not using mHealth applications) what are the factors influencing their intentions and perceptions to use mobile applications? These questions need responses in order to improve the quality of the services by investigating the influential factors of intention to use of mobile health services (Delone, 2003).

1.1.Purpose of the Research

The purpose of the research is to understand the influencing factors for physicians in using mobile health applications by developing and using Mobile Health Acceptance Model (M-TAM). In other terms, physicians' intentions and perceptions were investigated considering the factors influencing their attitudes towards mHealth applications. Here, a research model, which provides a frame to investigate physicians' intentions to use mHealth applications, was developed. The current state of the literature provided that there were limited studies on physicians' acceptance of mobile health technologies, and it presented that there is no study comprehensively investigating physicians' intention or perception to use mHealth applications (Fiordelli, Diviani, & Schulz, 2013). Hence, to fill this gap, this research focused on to investigate physicians' intentions to use mHealth applications. In that regard, a Mobile Health Acceptance Model (M-TAM) was proposed in order to provide a framework to investigate the influencing factors in mHealth applications' use.

1.2.Background

The use of information systems in healthcare services was emerged by the extensive use of information technologies in the industries (Reichertz, 2006). However, the use of Health Information Systems (HIS) has increased rapidly in the early 90s by the developments of information and communication technologies in healthcare services. HIS defined as healthcare service applications and technologies which have electronic background to provide basis for communication and processes of healthcare services (Haux, 2006). By the increasing use of HIS in different branches of healthcare services, researches on HIS gained importance (Haux, 2006). In that regard, studies about assessing acceptance of HIS also increased (Holden & Karsh, 2010; Pai & Huang, 2011). Even though there were a vast number of studies in HIS acceptance, various branches of healthcare services mostly remained intact fields in the literature. Because of this reason, it was difficult to reach literature knowledge about HIS acceptance studies in a broader perspective (M.-P. Gagnon, Ngangue, Payne-Gagnon, & Desmartis, 2015; Marie-Pierre Gagnon et al., 2012; Holden & Karsh, 2010).

Over the time, use of mobile technology increased in healthcare services, and the service quality was depending on the degree of relation between the user and the system (Dünnebeil, Sunyaev, Blohm, Leimeister, & Krcmar, 2012). Thus, in parallel to developments in health information systems, there have been questions raised regarding the success of the transformation projects: What does the success of the healthcare services depend on? The studies demonstrated that success level of health services highly depends on the level of user acceptance and adoption (Holden & Karsh, 2010; Walter & Lopez, 2008). Thus, the degree of acceptance of mobile HIS technologies by end users constitute an important aspect to assess.

In the following sections, a brief overview was given about theoretical structure and mHealth in order to provide background information regarding to purpose of the study.

1.2.1. Mobile health

Mobile health is used as a term which refers to the medical practice and healthcare services delivered by mobile devices (R. S. H. Istepanian et al., 2010). The report of Wolters Kluwer Health 2013 Physician Outlook Survey presented that 8 out of 10 health professionals use smartphones in daily practice, and 6 out of 10 are using tablet PCs. In total, 55% of the users use smartphones and tablet PCs in daily practice. Thus, the term- mHealth, is commonly associated with mobile communication devices as tablet PCs, PDAs, laptops and mobile phones. However, it was a sub-domain of e-health, and mHealth also refers to the use of mobile devices and peripherals in storing health records, distribution of health related information to healthcare providers and patients, as well as enabling real-time monitoring of patients and providing telemedicine (Whitten, Holtz, & Nguyen, 2010). Ventola (2014) stated that mobile devices and applications has improved productivity and efficiency, and also enhanced accuracy and data convenience. In addition to that, Ventola (2014) categorized the mobile health applications into the eight groups regarding to their field of use. The detailed documentation of groups of mHealth applications is given in the Table 1.

mHealth is located in a position that provides a promising technology integration opportunity within the healthcare services. It provides a platform to increase healthcare quality, to improve decision-making processes of professionals and patients, and to enhance access to healthcare services (Becker et al., 2014). The adaptive structure of mHealth concept provides number of fields to operate mobile healthcare services. It includes remote monitoring and data collection, patient tracking, disease control, training healthcare providers, communications among professionals and patients, decision making assistance, help center and providing health education content (Adibi, 2015). Moreover, the very concept of health services being provided to developing countries by affordable mobile services is an indicator of the importance of mobile health (Chib, van Velthoven, & Car, 2015; Vital Wave Consulting, 2009).

Table 1: Use of m-health devices and applications by health care professionals (Ventola, 2014)

Information Management	**Reference and Information Gathering**
▪ Write notes ▪ Dictate notes ▪ Record audio ▪ Take photographs ▪ Organize information and images ▪ Use e-book reader ▪ Access cloud service time	▪ Medical textbooks ▪ Medical journals ▪ Medical literature ▪ Literature search portals ▪ Drug reference guides ▪ Medical news
Time Management	**Clinical decision-Making**
▪ Schedule appointments ▪ Schedule meetings ▪ Record call schedule	▪ Clinical decision support systems ▪ Clinical treatment guidelines ▪ Disease diagnosis aids ▪ Differential diagnosis aids ▪ Medical calculators ▪ Laboratory test ordering & interpretation ▪ Medical exams
Health record Maintenance and access	**Patient Monitoring**
▪ Access EHRs and EMRs ▪ Access images and scans ▪ Electronic prescribing ▪ Coding and billing	▪ Monitor patient health ▪ Monitor patient location ▪ Monitor patient rehabilitation ▪ Collect clinical data ▪ Monitor heart function
Communications and consulting	**Medical education and training**
▪ Voice calling ▪ Video calling ▪ Texting ▪ E-mail ▪ Multimedia messaging ▪ Video conferencing ▪ Social networking	▪ Continuing medical education ▪ Knowledge assessment tests ▪ Board exam preparation ▪ Case studies ▪ E-learning and teaching ▪ Surgical simulation ▪ Skill assessment tests

Considering the current state of physicians in Turkey, mobile health platform would be beneficial in practical use. Ministry of health reported that there are over 135 thousand physicians in Turkey. Number of persons per physician is around 600, and there are more than 4600 patients per physicians who are visiting hospitals in a year. Thus, there is an excessive workload on physicians. To maintain the standards and quality in healthcare delivery, assistive technologies would help to physicians, such as mobile health applications (Kahn, Yang, & Kahn, 2010).

An instance about significance of Mobile Health: Non-communicable health diseases constituted an important part of health services due to their high degree of fatal results (WHO, 2008) and their continuous need of management and maintenance. In this context, cardiovascular diseases were estimated to cause death of 17.3 million people in 2008, and it was forecasted that this number will be over 23 million by 2030 (WHO, 2011). So it is a fact that cardiologist have a burden to deal with diagnosis and recovery of mortal diseases of cardiovascular system. Fortunately, by the developments in HIS, health technologies have been assisted to cardiologist for diagnostic processes as well as the other healthcare providers (Piette et al., 2011). In that regard, a study about patient safety provided that information technologies in cardiac health services have been assisted physicians in diagnoses as well as vitally reduced risks in patient security (Daudelin, Kwong, & Beshansky, 2005).

State of Mobile Health Applications

Global reports presented that in 2025, the use of mobile internet as well as applications were estimated to have an economic impact around 3.7 trillion to 10.8 trillion dollars per year (Manyika, Chui, Bughin, & Dobbs, 2013). As an instance, potential value gain was estimated to be 10% to 20% cost reduction only in chronic disease treatment via telemedicine. Considering the current developments and estimations, the dissemination and use of mobile health technologies are constantly increasing. In that regard, the literature provided that mobile technologies and applications were widely used by healthcare providers (Ventola, 2014). The mobile application markets (App stores) presented over thousands of applications related to healthcare services, such as checking tests, keeping records and taking assistance in diagnoses. These applications aimed to assist physicians or patients to manage and maintain healthcare related data by enabling storing, recording, and accessing information. Some of the examples are referencing applications (Up-to-date), ECG guide, clinical calculators (medCalc) and terminology databanks. However, the extent of use of those applications may vary with their popularity, and there exist a potential risk due to lack of regulations (Barton, 2012)

Mobile Health Applications- An Example: The application of AirStrip Cardiology was selected as the representative application of mobile health in cardiology. The application "digitizes and mobilizes 12- and 15- lead waveforms and measurements to support enhanced analytics, easier visual interpretation, and serial presentation of current and historic tracings"(Figure 1)("AirStrip Cardiology," 2012).

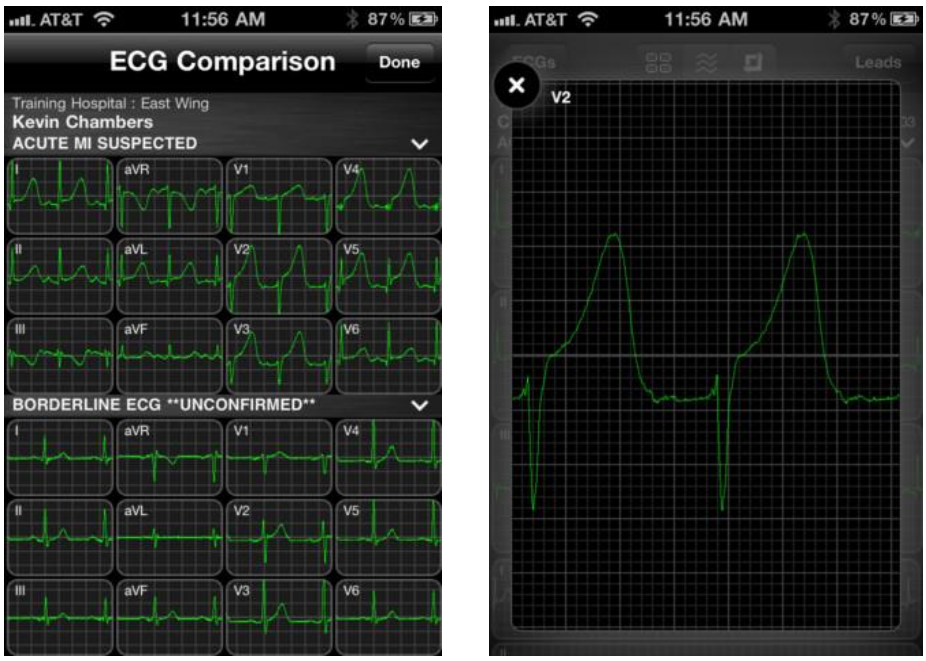


Figure 1: An example mHealth Application screenshots

In the web resources, the functionality and benefits of the application were outlined that "instead of relying on a verbal description of the data from the nurse on duty, or perhaps a low resolution transmission of the image, to determine the severity of a cardiac problem, doctors who are on call or outside the reach of the hospital network can now use the AirStrip Cardiology app to access high resolution images with scan, scroll and zoom features at very high precision levels. That image clarity provides an enormous advantage when it comes to determining the severity of a cardiac emergency and deciding on treatment options or the need for further testing as quickly as possible" ("GE Healthcare and AirStrip Cardiology Connect Cardiologists with Diagnostic Heart Data," 2012). Thus, considering the benefits, the mobile health applications were estimated to provide quality in healthcare services.

1.2.2. Theoretical structure

The assessment of individual's behavior or intention has been studied in psychology for a long time (Bandura, 1977; M Fishbein & Ajzen, 1975). However, its employment for assessing technology acceptance by the users emerged in the last quarter of century, and the studies on acceptance of technologies increased dramatically (Ajzen, 1991; Davis, 1989; Venkatesh & Davis, 2000; Venkatesh et al., 2003; Wood & Bandura, 1989). One of the pioneering studies in technology acceptance was technology acceptance model (TAM) (Davis, 1989). TAM has been used for understanding attitudes and behaviors of users toward particular technologies. The model proposed that actual system use is affected by two main elements, perceived ease of use (PEOU) and perceived usefulness (PU). Thus, these constructs are reflection of an individual's behavioral intention (BI) towards using a system. Addition to that, the model has been expanded with new constructs in order to measure effects of different behavioral factors on different technologies (R P Bagozzi & Warshaw, 1992). It was observed that TAM theory has been successfully applied in variety of HIS studies (Marie-Pierre Gagnon et al., 2012; Holden & Karsh, 2010). The model was modified and expanded by the changes of technologies and user needs (Venkatesh & Davis, 2000; Venkatesh et al., 2003). However, TAM was criticized due to its shortcomings, such as difficulties in generalization, explanatory power and inconsistent relationships between constructs (Legris, Ingham, & Collerette, 2003; H. Sun & Zhang, 2006; Venkatesh et al., 2003). Regardless of shortcomings, the significance of behavioral studies increased with the implementation of new ICTs on different industries. In that regard, UTAUT has been another theory being widely used in researches. The UTAUT proposed a model which helps to understand likelihood of success of new technologies and determine drivers of acceptance. UTAUT was developed by Vankatesh (2003) in the field of information systems, and it has been validated by many studies (Aggelidis & Chatzoglou, 2009; Chang, Hwang, Hung, & Li, 2007; Dünnebeil et al., 2012; Kijsanayotin, Pannarunothai, & Speedie, 2009; Pynoo et al., 2012; L. K. Schaper & Pervan, 2007). These theories have been modified and updated over the time, yet the urge of understanding attitudes and intentions of individuals still goes on.

In the study, M-TAM was developed by employing Unified Theory of Acceptance and Use of Technology- UTAUT (Venkatesh et al., 2003) as basis of theoretical structure. Literature research revealed that UTAUT provides a comprehensive and integrated platform, and it was taken as the basis which can be expanded by integrating other pioneering behavioral theories as Technology Acceptance Model-TAM (Davis, 1989;

Venkatesh & Davis, 2000), Theory of Planned Behavior -TPB(Ajzen, 1991) and Innovation Diffusion Theory-IDT (Rogers & Shoemaker, 1971).

1.3.Significance of study

The research was important in terms of socio-technical perspective in healthcare literature in following ways:

a) In the literature, to our knowledge, there have not been researches investigating physicians' acceptance of mobile health applications, neither with a mixed method nor employing an integrated approach as in M-TAM. In addition to that, assessing mobile health applications has been a need (Fiordelli et al., 2013). Existing studies focused on patients' or physicians' use of information systems, which provides insight about user behavior in specific branches of technology use. By this research it was aimed to conduct a research in an intact field of health informatics. In addition to that, by embracing behavior theories and models, the proposed model was comprehensive to include the knowledge in mHealth and e-health studies so far. Also, broader set of predictors was tested including moderating factors to increase the power in explaining intentions (Melas, Zampetakis, Dimopoulou, & Moustakis, 2011; Venkatesh & Davis, 2000)
b) Currently developed mHealth or e-health technology acceptance models may lack in explaining user behavior of physicians towards mHealth applications due to the fact that differences in population, technologies and its use. It is possible that in particular branches, physicians may have different perceptions on the mHealth applications due to different environmental and individual characteristics. In addition to that, user and non-user physicians can present different attitudes toward mHealth. Thus, the proposed model has potential to reveal these differences within the Turkish physician population with its implementation on different set of participants.
c) The research provided implications for development, design and implementation of m-health applications. The relationships between factors affecting use of the mHealth applications would be valuable asset for mobile application developers to design effective user interface. Furthermore, it would be resourceful for managers and policy makers to evaluate mobile health technologies, to develop market strategies and regulations and to improve processes. Eventually, it would provide assistance to the physicians as well as increasing the quality of healthcare delivery for the patients.
d) Current trajectory of mobile health in use in communities (Adibi, 2015; Deloitte, 2011; Vital Wave Consulting, 2009), and the usability studies (Brown, Yen, Rojas, & Schnall, 2013; Vélez, Okyere, Kanter, & Bakken, 2014) on mobile health services provided that current state of the mobile health is needed to be investigated in terms of understanding the concept and to increase its use for the benefits of the society.

1.4.Research Questions

The research questions of the study are:

- What are the factors influencing physicians' intention to use mHealth applications in practice?

  The question focuses on physicians who are using mHealth applications and non-user physicians in order to seek for the influence on their perceptions in use.

- What are the relationships among the factors influencing the use of mHealth applications?

  The factors influencing the use may vary for users and non-users. However, their relations would reveal facts and differences between two groups.

1.5.Assumptions

Since the research was based on subjective data collected from participants, it was assumed that:

- The selected samples for the study and the participants did reflect the behavior of the population.
- The participants did provide unbiased, accurate and reliable information

1.6.Limitations and Delimitations

Limitations provided the elements that restrict the study which cannot be controlled, and delimitations provided the boundaries that were set for the study.

1.6.1. Limitations

There are number of limitations in the study that the readers should take into account while interpreting the results and findings about the research. The first limitation in the study was about the study design. A self-reported and cross-sectional survey was conducted on physicians based on voluntary participating conditions in Turkey, which may affect generalization of the results based on several independent factors, such as timing of the study, cultural impact or sample characteristics. Furthermore, participation to the study was on voluntary-basis, so self-selection biases were possible. In addition to that, online survey and quantitative approach limit capturing all relevant data due to its self-reported nature. Another argument about the limitation of the study would be the size of the sample size. Even though the literature provides that the sample size was in acceptable limits (Goodhue, Lewis, & Thompson, 2012), it can be argued that the study had limited data to represent the population. Finally, the study was able to explain behavioral intention at ~50% variance, and the model was unable to predict remaining factors in explaining perceptions of using mHealth applications. The sample size also limited the study to capture differences among different specialties of physicians.

1.6.2. Delimitations

In order to increase strength of the study, longitudinal approach is needed to be employed. However, longitudinal studies require particular span of time. Since, the required time was not available, the research designed to be a cross sectional study.

Theory of reasoned actions TRA was excluded from the literature of the study due to the fact that there are no studies about TRA and technology acceptance which can be utilized in mobile health and e-health domain. In addition to that, since TAM is an extension of TRA, including TRA would be redundant. In qualitative approach, individual interviews were also excluded due to limitations in number of participants.

1.7.Definition of terms

Health Information Systems/ e-health (Health Informatics): Interdisciplinary field of healthcare, computer science and information science (Haux, 2006)

Mobile health (mHealth): The delivery of healthcare services using mobile communication devices and technologies (R. S. H. Istepanian et al., 2010)

Mobile Health Applications: Mobile device software which are used for healthcare communications and delivery.

Structural Equation modeling: "A statistical technique for testing and estimating causal relations using a combination of statistical data and qualitative causal assumptions" (Pearl, 2000).

Behavioral intention (BI): "The degree to which a person has formulated conscious plans to perform or not perform some specified future behavior" (Venkatesh et al., 2003)

Technology Acceptance Model: A theory that was proposed to understand technology use by individuals based on behavioral and psychological attributes.

Physician: Medical doctor who is professionally practicing medicine.

CHAPTER 2

LITERATURE REVIEW

This chapter presented the studies in the literature about acceptance of e-Health and mHealth technologies by healthcare professionals. A systematic procedure was followed in the literature research. The following section provided the method of literature review. After that, information about acceptance theories as well as the findings about HIS and mHealth domains were provided.

2.1.Review Method

In the literature review, a procedure was outlined in order to conduct the review systematically. Different approaches were investigated in conducting literature review, and they contributed to the framework in order to build the procedure (Brereton et al, 2007; Creswell, 2003; Kitchenham, 2004). The steps of literature review were (Figure 2) as the followings:

i. Identification of keywords and database search

Within the context of the study, keywords for database research were selected in order to reach studies in relevant fields of health information systems. The keyword search was detailed considering the first coming results for increasing accuracy in the search. In total, combinations of following keywords were used: “health information system”, “e-health”, m-health”, “mobile health”, “health informatics”, “medical”, “medicine” combined with “acceptance”, “information system acceptance”, “adoption”, “technology acceptance”, “technology adoption” and “doctor”, “practitioner”, “healthcare provider”, “professional”, “personnel”, “worker”, “physician”, “nurse”.

The search was conducted on scholar databases which have large repository of academic studies and high popularity in web based academic researches. In this context, Scopus, Sciencedirect, Pubmed and Webofknowledge databases were used. The initial search resulted with over a thousand articles.

ii. Refining results: Phase 1

In this phase, the keywords of the articles as well as the titles were read. The relevance to the context was investigated. In addition to that, a set of inclusion criteria was followed in order to reach to the researches from reliable sources, and to ensure that they suit to the context of the research. Thus, inclusion criteria were determined as followings:

a. Researches should be published in English language

b. Researches should be published within 14 years (2002-2016)
c. Researches should be published in peer reviewed indexed journals (In case of low rate of return in searches, peer reviewed conference proceedings were selected considering conference reputation and paper citations)
d. Objective of the researches should be about acceptance or adoption of HIS as well as mobile health.
e. The target sample of the researches should be healthcare professionals including physicians and doctors.
f. Researches should present information about quantitative results

At the end of phase 1, the studies were refined to 386 articles.

iii. Refining results: Phase 2

At the phase 2, abstracts of 398 articles were reviewed. They were read considering the relevance of the study and the inclusion criteria. 317 papers were eliminated due to context mismatch defined in these criteria.

iv. Refining results: Phase 3

The remaining 81 articles were reviewed. 34 articles were eliminated as a result of inclusion criteria (method of the use of acceptance theories and irrelevant to context results). At the end, 47 papers were included to the literature of the study.

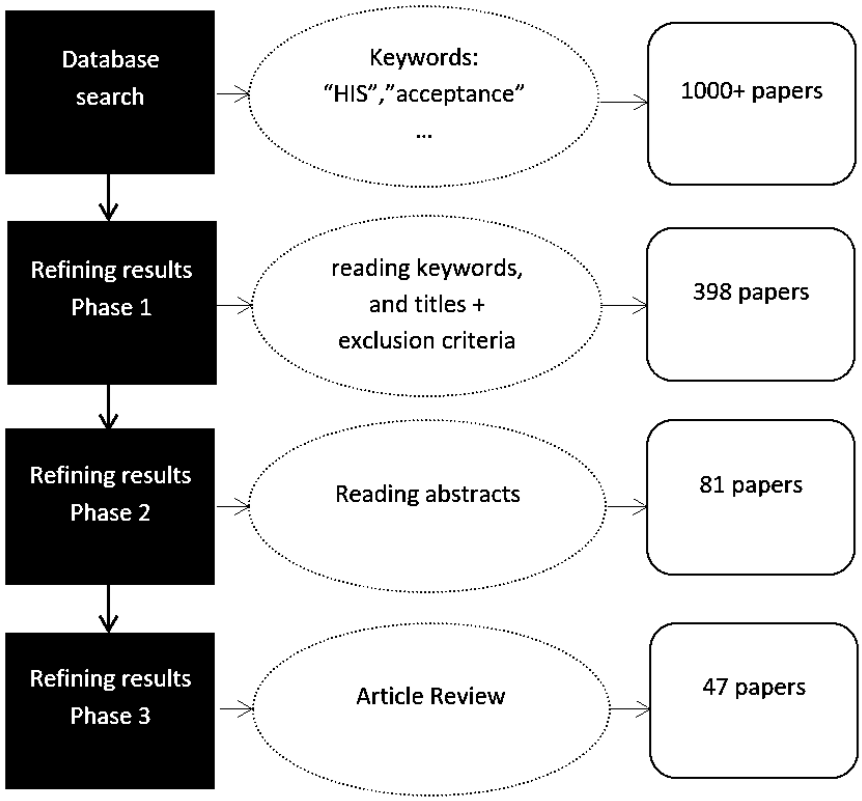


Figure 2: Flow diagram of selection process of articles

2.2. Review Results

Following the procedure of literature research, the review was conducted accordingly. Appendix A presents the list of the literature research. It provided title of the study, significant variables in each study, sample type and size, theory and variance explained. Appendix D provided abbreviations of constructs and their definitions. The review demonstrated that there were number of theories for investigating technology acceptance as well as their implementation in health informatics. In the following sections, literature of these theories and the implementations in healthcare domain were presented under the sections of acceptance studies, health information studies and mobile health studies.

2.2.1. Overview of the Theories

Theory of Reasoned Action

The theory of reasoned action (TRA) was proposed (M Fishbein & Ajzen, 1975) to investigate the relationship between attitudes and behavior. TRA was considered as the basis of widely used technology acceptance model, and it investigates behavioral intentions as the essential predictors of behavior. It was argued that attitudes toward a behavior (a forthcoming outcome) and subjective norms (the influence of other people on one's attitudes and behavior) are the main predictors of intention (Figure 3).

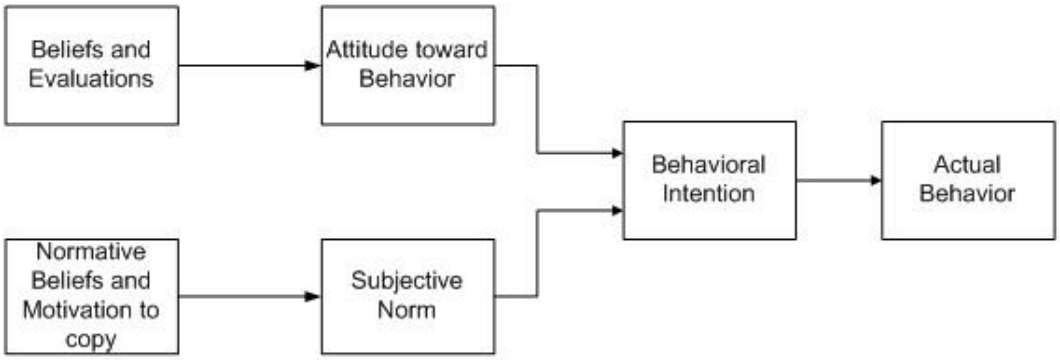


Figure 3: TRA model (M Fishbein & Ajzen, 1975)

Technology Acceptance Model

The model was developed by Davis (1989) and based on sciences of psychology and human behaviors (Figure 4). In the literature, the studies demonstrated that theories developed which investigated human behavior and those theories were adapted to other disciplines as technology acceptance. The roots of TAM were grounded to Theory of reasoned actions -TRA of Fishbein ve Ajzen (1972) and TPB of Ajzen (1991). The theory assess user intentions based on two main constructs which are perceived usefulness ("the degree to which a person believes that using a particular system would be free from effort") and perceived ease of use ("the degree to which a person believes that using a particular system would enhance his or her job performance").

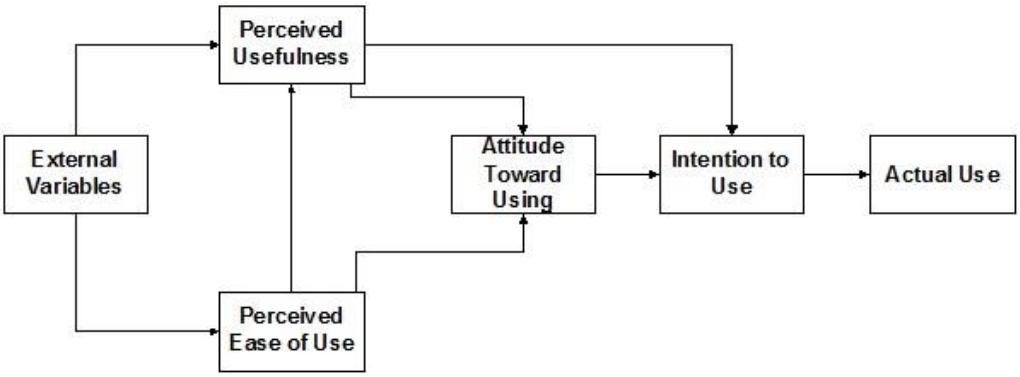


Figure 4: TAM model (Davis, 1989)

In sum, the aim of TAM is to determine behaviors of users towards particular technologies. The model argues that actual system use is affected by two main elements, perceived ease of use (PEOU) and perceived usefulness (PU). However, in e-health domain, it was observed that TAM theory has been successfully applied in variety of studies (Holden & Karsh, 2010).

Over the time, TAM was extended to investigate influencing factors of new technologies. TAM 2 (Venkatesh & Davis, 2000) and TAM 3 (Venkatesh & Bala, 2008) were proposed in the following years. The original TAM model was modified to explain perceived usefulness and intentions to use considering subjective norms, voluntariness, image, job relevance, output quality, result demonstrability and perceived ease of use (Figure 5).

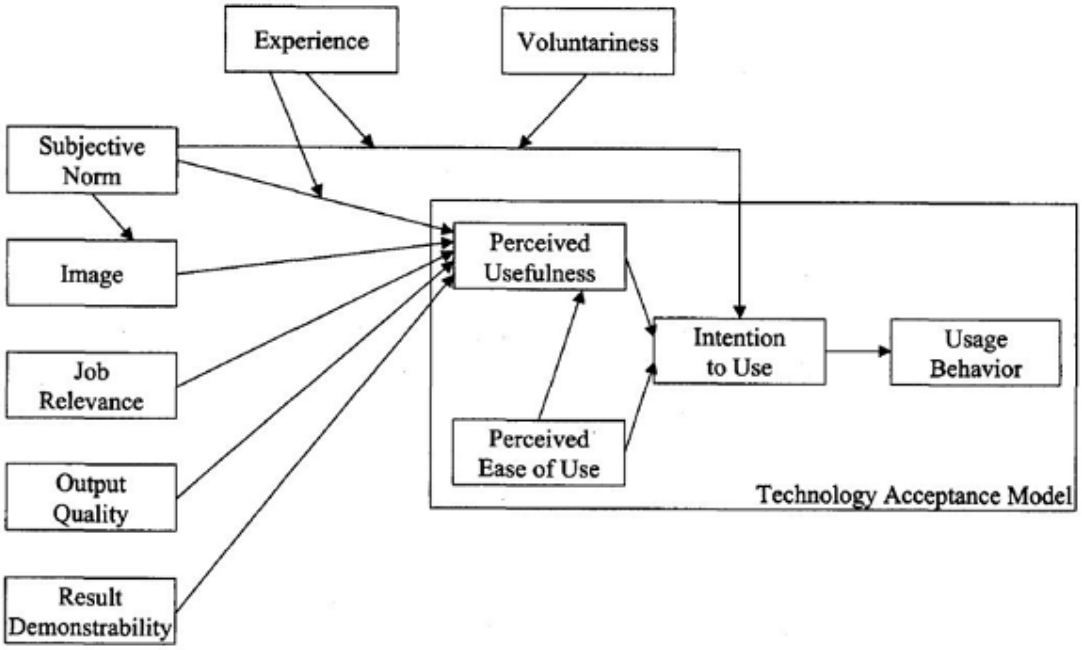


Figure 5: TAM 2 Model (Venkatesh & Davis, 2000)

TAM 2 and TAM 3 also used the power of moderating factors. Experience and voluntariness were investigated in terms of their effect on subjective norms to influence perceived usefulness and intention to use. TAM 3 proposed one step further extension of TAM 2 including the effects of trust and perceived risk on system use (Figure 6).

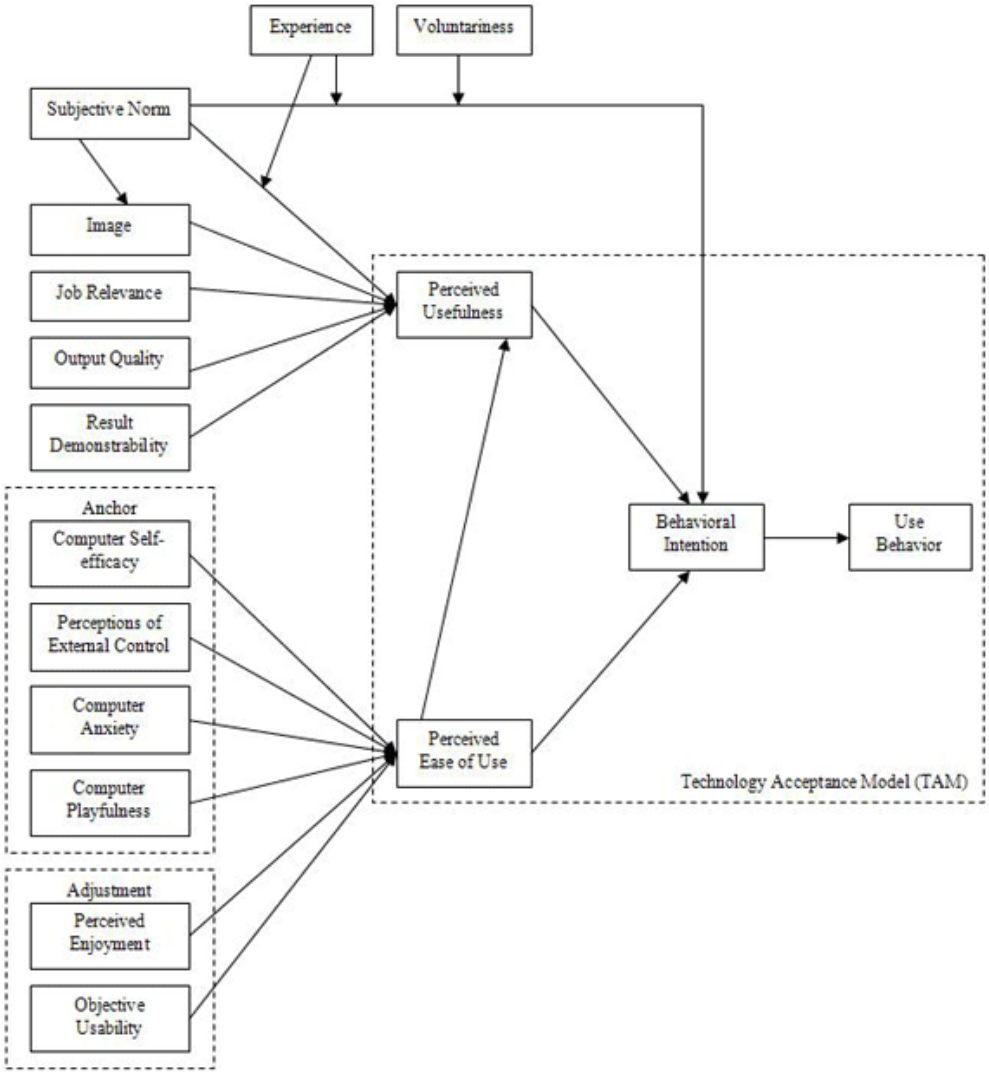


Figure 6: TAM 3 Model (Venkatesh & Bala, 2008)

Theory of Planned Behavior

TPB, similar to TAM, was based on Ajzen and Fishbein's (1972) TRA. The most influential factor common in TRA and TPB is "intention" which was defined as main factor for human behavior (Ajzen,1991). The diagram of TPB was given at Figure 7. It demonstrated the variables which were defined as influential factors for intention and their relations.

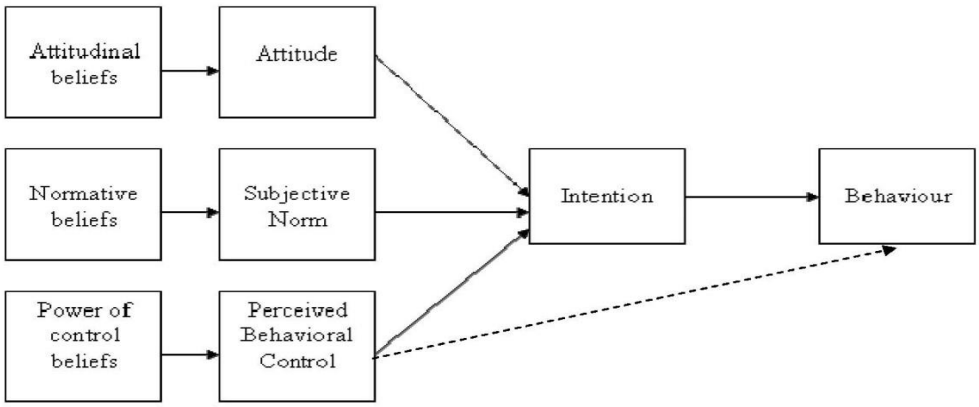


Figure 7: TPB Model (Ajzen,1991)

TPB proposed perceived behavioral control as a new variable regarding to TRA, which was defined as "an individual's perceived ease or difficulty of performing the particular behavior". In addition to that attitude and subjective norm were also proposed as interdependent variables which affect intention. Subjective norm was defined as "an individual's perception of social normative pressures, or relevant others' beliefs that he or she should or should not perform such behavior" and attitude was defined as "an individual's positive or negative evaluation of self-performance of the particular behavior". Thus, TPB investigates the relations of those 3 variables with intention to use.

Diffusion of Innovations Theory

The effect of innovation may show varieties in terms of success. It may resulted as failure, high success or need of incubation process (Rogers & Shoemaker, 1971). In this context, Rogers (1995) proposed Diffusion of innovation theory (IDT) in order to explain concept of innovation within the society (Figure 8). This theory aimed to identify acceptance constructs, to ground a mechanism and define the path of success for innovations. Mainly, the theory is all about transformation process of a new innovation or existing technology. It explained that phases of innovation as followings: (1) Knowledge (to be exposed to technology), (2) Persuasion (planting positive attitude), (3) Decision (affirmation of acceptance), (4) Confirmation (support by positive consequences). The most important features of innovation were defined as relative advantage, compatibility, complexity, trialibility and observability (Rogers, 1995). In IDT, different groups were defined considering acceptance process of innovation. These groups were early adapters, early majority, late majority and laggards. The theory outlines 3 main concepts which are features of success in innovations, the importance of communication and networking in society and determining needs of different users (Rogers & Shoemaker, 1971).

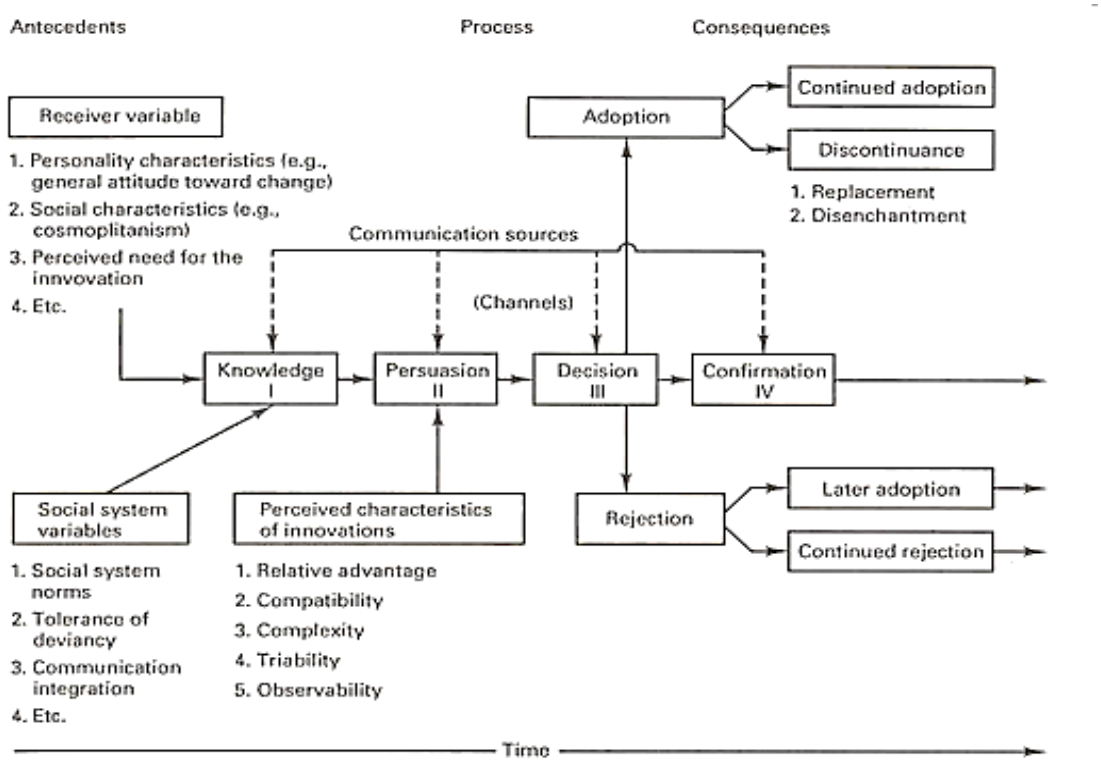


Figure 8: IDT Model (Rogers, 1995)

Unified Theory of Acceptance and Use of Technology

UTAUT was developed by Venkatesh (2003) as an alternative theory for assessing the factors influencing users' technology acceptance. The model was given in Figure 9. In the study of UTAUT, eight distinguished model of acceptance were reviewed, compared and utilized to establish a unified model. Those models were TRA, TAM, TPB, motivational model, a model combining TAM and TPB, model of PC utilization, IDT and social cognitive theory. The models were tested on four organizations, which explained up to 53% of variance in user intention to use IT. 8 models were tested within 4 different organizations about 4 different technologies (two of which were subject to mandatory use, the other were voluntary use) by employing a longitudinal survey study (questionnaire). Sample size was between 38 and 65 for each organization. PLS was employed to analyze reliability and validity. Results showed that eight models explained acceptance with 17% to 42% variance in intention. Considering the results and variables of the studies, UTAUT was formed, empirically tested by data from 4 organizations and cross validated by additional data from two other organizations. Preliminary test (215 sample size) presented acceptable internal consistency reliabilities and 70% of variance in usage intention.

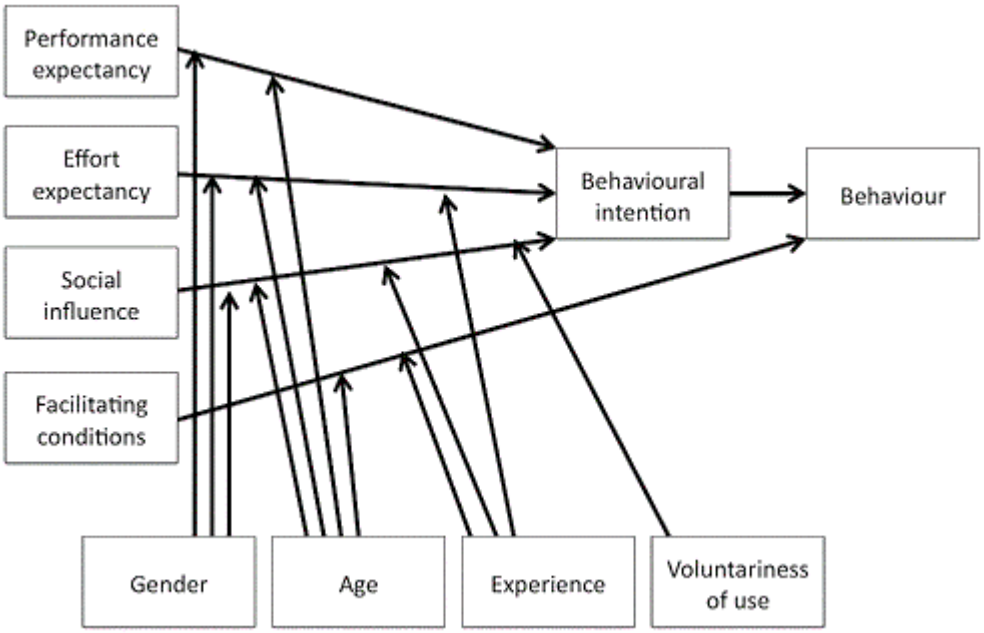


Figure 9: UTAUT model (Venkatesh et al., 2003)

The relation between the theories are obvious. Over the time they were evolved considering user needs and changes in technologies. In Figure 10, these changes were briefly demonstrated. Here, Sun et al.(2013) presented the relation of major theories (TAM, TRA, TPB and UTAUT) with changes in influencing factors (PU, PEOU, SN, PBC and Facilitating conditions). TAM was improved by social norms to TAM2, and eventually to UTAUT by including facilitating conditions. Similarly, TRA was utilized to develop TAM and TPB theories.

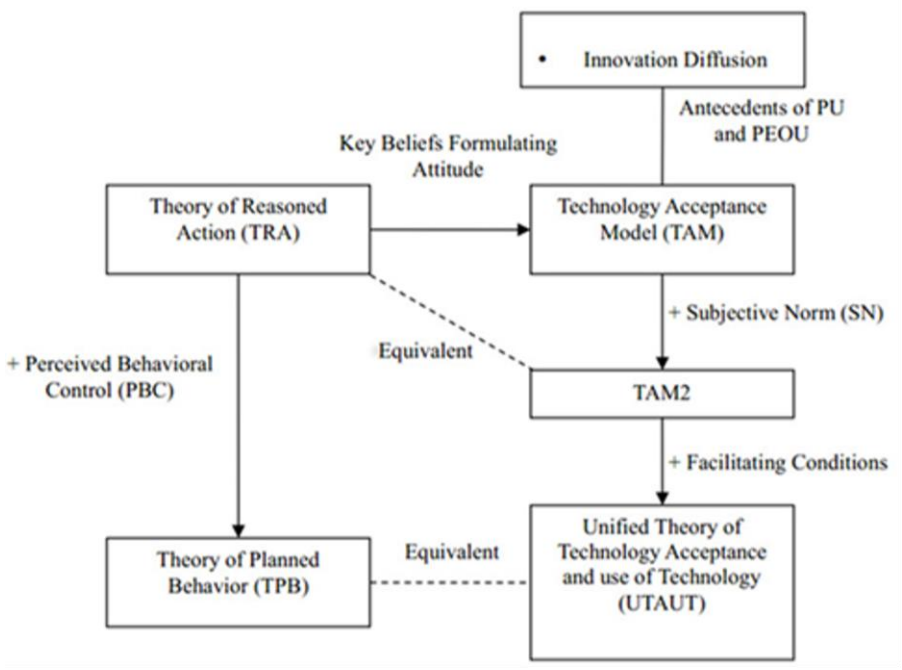


Figure 10: Technology acceptance theories and their relations (Y. Sun et al., 2013)

2.2.2. Review findings

Even though mHealth literature was relatively limited, they helped to reveal the trends of researches in mHealth domain. Table 2 presented the types of samples and the number of studies in HIS (excluding mHealth) and mHealth. The types were grouped in 4 including physicians, nurses, others and mixed. Their definitions were given below the table. According to the studies, physicians were found as the most popular target samples in the HIS acceptance studies, and it was followed by nurses. The popularity of physicians and nurses are found to be related to two major reasons. The main reason is that they constitute the majority of end users of HIS applications. They constitute a crucial part in diagnostic and decision making processes in healthcare services, thus, this condition increases their importance in use of HIS. Another reason can be argued as the reachability of target samples (convenience sampling). Because they, as the target sample, are employed by hospitals, which are the common reachable institutions, it leads the researchers to easily communicate with physicians and nurses, and to use substantial amount of data in the studies.

Table 2: List of samples participated to HIS and m-Health studies

Samples	**# of studies in HIS (Out of 37)**	**# of studies in m-Health (Out of 10)**
Physicians*	18	4
Nurses	7	-
Others**	7	2
Mixed***	5	4

* physicians, clinicians and pediatricians; ** physiotherapists, caregivers, healthcare workers, technicians, ER teams and therapists; *** a mixed set of participants consist of physicians and nurses.

Table 3 demonstrated the theories employed by the studies. Here, integrated models were the trending approaches which were developed by integrating TAM and other behavioral theories (such as UTAUT, IDT, IS success model and TPB) to propose a new model. It was found that TAM leads as the primary theory being employed by the studies for more than the last decade. It was followed by UTAUT, IDT and TPB. Here, TAM remained as the flagship theory of the HIS acceptance studies in model developments. The studies after 2000s were modified and integrated with other theories to form alternative models in explaining user attitudes towards technologies, and mostly TAM constituted the basis of the frameworks.

Table 3: List of theories employed in HIS and m-Health studies

Theories	**# of studies in HIS (Out of 37)**	**# of studies in m-Health (Out of 10)**
TAM*	14	2
UTAUT	5	-
IDT	1	1
TPB	2	-
IS Success Model	-	1
Integrated models**	15	6

* TAM includes TAM and TAM2; ** Integrated models including theories of UTAUT, IS success model, TRA Task-Technology fit and psychosocial model.

Table 4 presented the fundamental constructs of TAM and their relations with behavioral intention in order to explain user behaviors. The main reason to use constructs of TAM was its popularity and involvement in each study. Thus, constructs of TAM outlines main significant relations in the studies. It summarizes the fundamental factors of technology acceptance theories and their relations with behavioral intention in order to explain user behaviors. Here, it was found that the original factors in technology acceptance relations are still matter of HIS acceptance relations. In this context, PU-BI, PEOU-BI, Attitude-BI and PEOU-PU demonstrate major relations in explaining the healthcare professionals' attitudes in acceptance studies. However, the changes of significant factors over the time proposed that there is a trend in employing factors of Self-efficacy, Trust, Social norms, PU and PEOU in explaining user attitudes towards HIS. Due to increasing need in security and trust in technologies and highly socialized communities, trust and social norms have importance from a global standpoint. In addition to that, PU and PEOU maintain their explanatory power in defining user attitudes towards the new technologies. Table 4 provided statistically significant relations, number of these significant relations observed in HIS studies and mHealth studies.

Table 4: List of significant relations in HIS and m-Health studies

Significant relations*	**# of relations in HIS studies (37)**	**# of relations in m-Health studies (10)**
PU –BI**	25	7
PEOU –BI**	15	6
PEOU –PU	18	4
Attitude –BI**	9	2
PU –Attitude	8	4
PEOU –Attitude	5	2
Others –BI	19	17
Others –PEOU	8	8
Others –PU	5	9

* The main constructs of TAM and their statistically significant relations with each other were presented; ** BI may also represent actual use or intention to use, and PU and PEOU also represents PE and EE respectively

In the Table 4, other constructs of BI involve constructs of perceived behavioral control, social norms, self-efficacy, hospital type, self-identity, normative factors, perceived readiness, computer level, logical access, image, habit, compatibility, trust, reliability, net benefits, quality, perceived financial cost, value, control and perceived system performance. In addition to that, other constructs of PEOU are trust, compatibility, support, personal innovativeness, self-efficacy/ facilitating conditions, access, image, subjective norms, performance, service and system quality, knowledge, computer level, standardization, process orientation, enabling factors, competency, ownership, perceived system response, training, anxiety, habit, technical support, result demonstrability and perceived service availability. Other constructs of PU are compatibility, job relevance, self-efficacy, perceived service availability, trust/ personal innovativeness, subjective norms, facilitating conditions, threat, access, job

role, performance, security, documentation, ownership, quality, accessibility, image, technical support, result demonstrability and perceived service availability.

2.2.3. Findings about Health Information System Studies

HIS studies have been expanded by the development of health technologies. The term has been interchangeably used with e-health and health informatics even though they had slight differences in terminology. Haux (2006) defined HIS as interdisciplinary field of healthcare, computer science and information science. When at the time of early developments in health technologies in health and medicine, it was started with improvement in utilities and tools being used in health services. In this context, Reichertz (2006) explained technological developments in hospitals emphasizing the social side of technology. However, it was noticed that technology requires to be learned as Haux (2006) outlined. Haux (2006) elaborated Reichertz's study by increasing use and evaluation of health technologies and emphasized on the need of education and research on HIS. Furthermore, Berg (2001) argued the success in health information systems not limited to specific criteria but depended on implementation itself with inclusion of all parameters as systems and users. On the other side, altruism, individual commitment and motivation were identified as contributing attributes for technology acceptance of health technologies (L. Schaper & Pervan, 2007). The studies presented the need of involvement human side into the equation of technology use. With respect to that, there were number of studies conducted to assess health information system use by end users, who were mostly patients, physicians and healthcare professionals. Prominent behavioral theories, such as TAM, IDT, TPB and UTAUT constituted the majority of employed theories for acceptance studies.

Literature research of HIS studies, which employed TAM, TPB, UTAUT and extended models, demonstrated that they have succeeded to explain intention to health professionals' use of health technologies (Appendix A). In a study, as a new variable, habit was identified as effective factor in telemedicine adoption (Marie-Pierre Gagnon et al., 2003). However, in spoken dialog system acceptance study, perceived system response was argued as influential factor for PEOU (Barker, Schaik, Simpson, & Corbett, 2003). In most of the studies, the relations of PEOU-PU, PE-BI, EE-BI, Perceived Innovativeness and its relations with BI, SN and PEOU found significant, which meant as considerable factors to be evaluated in M-TAM (Yi, Jackson, Park, & Probst, 2006; Chang et al., 2007; L. K. Schaper & Pervan, 2007; Yu, Li, & Gagnon, 2009; Pai & Huang, 2011; Melas et al., 2011; Holden, Brown, Scanlon, & Karsh, 2012; S.-Y. Hung, Ku, & Chien, 2012; Dünnebeil et al., 2012; Pynoo et al., 2012). Exclusively, the impact of image (Yi, Jackson, Park, & Probst, 2006), facilitating conditions (L. K. Schaper & Pervan, 2007; Aggelidis & Chatzoglou, 2009), computer anxiety(L. K. Schaper & Pervan, 2007; Aggelidis & Chatzoglou, 2009), self-efficacy(L. K. Schaper & Pervan, 2007), compatibility (Tung, Chang, & Chou, 2008), training (Aggelidis & Chatzoglou, 2009), service quality (Pai & Huang, 2011), trust (Ortega Egea & Román González, 2011), Knowledge and ICT feature demands (Melas et al., 2011), Perceived risk and information integrity (Ortega Egea & Román González, 2011) and perceived threat to professional autonomy (Walter & Lopez, 2008) were found significantly related to influencing factors like PEOU and PU, which indirectly influence intention to use of health information systems.

2.2.4. Findings about Mobile Health Studies

As aforementioned in Introduction, mHealth has gained importance in the health industry. The recent studies underlined the impact of mobile health and systems in health services. Regarding to that, Istepanian et al (2010) outlined emerging mobile health technologies and systems, and emphasized on the power of mobility in health practice. From another point of view, Tachakra et al (2003) stated the importance of wireless communication tools in medicine, especially in telemedicine, in terms of flexibility and accessibility. Piette et al (2011)argued the feasibility of m-Health for non-communicable diseases by using informatics tools in different cultures and backgrounds for self-management. As the studies presented, mobile development has been adopted by different branches of health services. For instance, recent studies outlined the development in mobile health care services such as mobile echocardiograms and microscopes (Hampton, 2012). It was stated by Hampton (2012) that "nearly 90% of the world's population has wireless coverage and 65% of subscribers are in the developing world". Thus, the use of mobile health services has potential to constitute an inevitable part in human life, as well as health services. Hence, similarly to HIS acceptance studies, mHealth is an emerging field of health domain which needs to be investigated in terms of technology acceptance.

The literature research showed that, the factors influencing mobile system use in health services demonstrated similar factors as in the HIS studies. With this respect, PU, PEOU, compatibility, self-efficacy, training and support, personal innovativeness, SN were identified as prominent factors in adoption of mobile health services by health professionals (J.-H. Wu et al., 2007; Chen et al., 2010; I.-L. Wu, Li, & Fu, 2011). In addition to that, hospital type (I.-L. Wu et al., 2011) and age (Shengnan et al, 2006) were found as influencing mediating factors. From the another point of view, in a study of mobile healthcare service for patients, it was found that PU, PEOU, external cues to actions, and innovativeness influencing factors of behavioral intention (S. P. Lin, 2011). The study of Hung and Jen (2010) supported the major relations in acceptance studies about mobile health services. In addition to that, literature research provided that the recent studies had interest in IDT in order to extend the adoption models (Ducey & Coovert, 2016; Okazaki, Castañeda, Sanz, & Mukherji, 2016; Putzer & Park, 2012). Thus, it would be beneficial to consider extended studies in order to reach variety of influencing factors. In the same manner, the studies suggested further research about investigating influencing factors and identifying key variables in different branches of health services(Han et al., 2006; S. P. Lin, 2011; Melas et al., 2011; Tachakra et al., 2003).

2.3.Discussion and Implications

Considering the studies, it was found that extended TAM model and UTAUT was a powerful approach to explain intention to use in health technologies (Holden & Karsh, 2010). It also refers to that current acceptance models are better off with an integrated approach which merges more than two models, in order to understand more about user needs (J. Chen et al., 2010; Holden, Brown, Scanlon, & Karsh, 2012; Pynoo et al., 2012; J.-H. Wu et al., 2007). When the initial studies (cornerstones as TAM, TPB, IDT and UTAUT) considered, it was observed that there have been important improvements on the theories over the time (expanding with additional variables).

However, in the most of the studies, HIS and mobile systems to use for medical communication and health services were tested (J. Chen et al., 2010; Han et al., 2006; Holden & Karsh, 2010; I.-L. Wu, Li, & Fu, 2011; J.-H. Wu et al., 2007). Furthermore, variables in HIS and mobile system acceptance studies were also observed to be similar as well as the explained variances of relations. Thus, it can be concluded that studies on HIS and mobile health did not demonstrate highly differences in terms of explaining user intention towards a health service technology. It was also noted that in most of the studies perceived usefulness and ease of use found effective on behavioral intention.

On the other hand, new variables were emerging with regards to the changes in technologies in HIS acceptance studies (Marie-Pierre Gagnon et al., 2003; Ortega Egea & Román González, 2011; Yu, Li, & Gagnon, 2009). But they were mostly not comprehensive enough to explain intention to use. Even though new variables may fail to explain intentions, it is required to extend the scope in order to consider latent facts and to generate new variables with respect to the needs of technology users (Venkatesh et al., 2003). It was also observed that there was a particular increase in degree of variance to explain intention in recent studies. It may be the result of moderating effects of new variables, or increasing power of explanation by existing constructs. From broader point of view, it can be interpreted as there are positive changes in users' lifestyles (involving technology in their lives more than before), mindset, and so, attitudes towards new technologies.

Furthermore, some studies also underlined the impact of social conditions and developments in health services. Eysenbach and Diepgen (2001) argued that low health literacy leads poor health and underlined the contradiction in technology access and wealth (or level of literacy) in preventable health problems. Thus, even though new technologies have emerged, if accessibility by public remained low, the systems were not serving for their purposes. In addition to that, new technologies have always been questioned for effects on human health. Visvanatan et al (2011) argued that increasing use of mobile communication technologies may contain risks and cause pitfalls such as electromagnetic risks, patient security, confidentiality and data security and distraction. Thus, when the system view considered as a part of the big equation, other impacts of technologies and their indirect effects on human behavior should be investigated as future studies.

From the point of research design, the results showed that emerging studies should include more qualitative approaches and longitudinal studies in order to understand user needs effectively (Hadji, Martin, Dupuis, Campoy, & Degoulet, 2016; Kaplan, 2005). In addition to that, moderating factors should be considered as important inputs to seize variety of relations within the model. Most of the studies, in future research sections, emphasized on including moderating factors in proposed model, to extend current study with longitudinal studies and involving qualitative methods. But in action, they remained so few. However, this research did employ qualitative method within a mixed approach in order to increase reliability and integrity of results. Moderating factors were also investigated.

CHAPTER 3

CONCEPTUAL FRAMEWORK

Considering the findings of literature review, M-TAM is developed based on UTAUT model with integrating TAM, TPB and IDT theories and their implementations in the literature of e-health and mHealth.

3.1.Selection of behavioral theory and constructs

In this section, the model of M-TAM was proposed. M-TAM was developed in the light of literature, which helped to identify constructs in order to investigate acceptance of mHealth applications. In addition to that, experts' opinions were included in the study to reach a consensus about theory and constructs of the proposed model. For this purpose, card sorting methodology was employed in order to identify potential theories and constructs to be included in the study. The process was as the followings:

I. Three topics were determined that requires expert opinion:
    a. Theory of the model
    b. Construct of the model and relations
    c. Categorization of the constructs
II. Considering the literature review, the most influential behavioral theories were listed (TAM, TPB, TRA, UTAUT, IDT, IS success, Task-Technology Fit). In addition to that, constructs were listed with their definitions (Appendix D).
III. 4 experts in the field of acceptance were involved in sorting process. These experts were academic professionals who have been studying in the field of technology acceptance and behavioral theories at graduate level of knowledge. Theory and construct lists were given to experts, and the concept of the study was explained.
IV. The theories and constructs were sorted by experts considering its importance and potential in acceptance of mobile health applications. Relations among the constructs were discussed and their suggestions were collected. The suggestions were also checked for their consistency and applicability with the findings from the literature review. The major theories, TAM, TPB, UTAUT and IDT were determined to be used in model development. 12 of the constructs, which were found the most influential to assess user attitudes towards m-health applications, were selected and categorized under the framework.

Those constructs are as followings:

- Behavioral intention (BI): BI provides "the degree to which a person has formulated conscious plans to perform or not perform some specified future behavior"(Venkatesh et al., 2003). The concept of BI emerged as behavior predictor in TPB(Ajzen, 1991), and it was widely used and validated in many acceptance studies (Holden & Karsh, 2010; King & He, 2006; Venkatesh & Bala, 2008; Yousafzai, Foxall, & Pallister, 2007).
- Effort expectancy (EE): EE is defined as "the degree of ease associated with the use of the system. "(Venkatesh et al., 2003). It was used first in UTAUT, however it is successor of perceived ease of use of Davis (1989).This construct is used to explain relation between user attitudes and their perception about easiness towards a technology.
- Performance expectancy (PE): PE is "the degree to which an individual believes that using the system will help him or her to attain gains in job performance. "(Venkatesh et al., 2003). It is successor of perceived usefulness of Davis (1989) which is used in UTAUT. Here, users' attitudes were explained in relation with their job performance in using a technology. In many studies, PE and EE or PU and PEOU used as major factors to explain basic relations among behavioral constructs (King & He, 2006; Schepers & Wetzels, 2007).
- Social influence (SI): is defined as "the degree to which an individual perceives that important others believe he or she should use the new system"(Venkatesh et al., 2003). In many studies, it was reported that SI was employed for predicting influence of social environment of users(Legris et al., 2003). Yet, it may lack in explaining behavioral intention(Holden & Karsh, 2010; Lau, Kuziemsky, Price, & Gardner, 2010). However, its impact cannot be undermined. In addition to that, moderating factors can be effective to increase impact of SI.
- Habit (HB): HB "constitutes the level of routinization of behavior, i.e. the frequency of its occurrence" (Marie-Pierre Gagnon et al., 2003). Today, use of smart phones became inevitable part of human lives and mobile use became a habit. Wolters Kluwer Health report presented that 1 to 25% of a day, 46% of health professionals are using their smart phones, and mostly to access drug information and references (*Wolters Kluwer Health 2013 Physician Outlook Survey*, 2013). Thus, the current state of mobile use motivates to investigate habit in mobile health applications.
- Personal innovativeness in the domain of IT (PI): PI is defined as "the willingness of an individual to try out any new IT, plays an important role in determining the outcomes of user acceptance of technology" (S.-Y. Hung, Ku, & Chien, 2012; I.-L. Wu et al., 2011; Yi et al., 2006) . Considering rapidly developing technologies, including mobile health, it would be distinctive to identify personal eager of users towards trying new technologies.
- Result demonstrability (RD) refers to "the extent to which the tangible results of using an innovation can be observable and communicable"(Yi et al., 2006). RD is necessary as people have difficulty presenting the benefits in their job performance using the system(Venkatesh & Davis, 2000). RD helps to identify the degree of expressiveness of results in mobile health application use.
- Compatibility (CO) is defined as "the degree to which an innovation is perceived as being consistent with the existing practices, values, needs and experiences of the health care professional" (J. Chen et al., 2010; L. K. Schaper

& Pervan, 2007; Tung et al., 2008; J.-H. Wu et al., 2007) . Compatibility is employed in the studies of investigating effects of technological transformation (Moores, 2012). Here, mobile health domain initiated in the process of a similar transformation in healthcare services. Thus, its effects on existing values, needs and experiences are important.

- Computer Self efficacy is "the degree to which an individual beliefs that he or she has the ability to perform specific task/job using computer" (Aggelidis & Chatzoglou, 2009; L. K. Schaper & Pervan, 2007; J.-H. Wu et al., 2007). The term was rephrased as "Mobile Self efficacy (MS)" and the aim is to assess influence of personal abilities in using mobile health applications.
- Computer anxiety is" the degree of an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers" (Aggelidis & Chatzoglou, 2009; L. K. Schaper & Pervan, 2007). The term was rephrased as "Mobile anxiety (MA)" and the aim is to assess the degree of influence of personal anxiety in using mobile health applications.
- Technical support and training (TT) is referring to "the technical support and the amount of training provided by individuals of knowledge" (Aggelidis & Chatzoglou, 2009; J.-H. Wu et al., 2007). Commonly, new technologies require a basic training process in order to be competent in using these technologies. In mobile health, TT depicts a vital stance since the information gathered by mobile health applications will be used in human healthcare. Thus, it is important to assess the influence of TT in mobile health use.
- Perceived service availability (PS) refers to "the degree to which an innovation is perceived as being able to support pervasive and timely usage" (I.-L. Wu et al., 2011). Mobile health has been used in the process of vital decision. Thus, the perception of its availability can be influential in mobile health application use.

In the Figure 11, the proposed model was outlined. Computer anxiety and computer self-efficacy were re-defined to suit mobile platform as mobile anxiety and mobile self-efficacy, in which use of medium changed to "mobile". The relations were built up to consensus in card sorting group in addition to the literature.

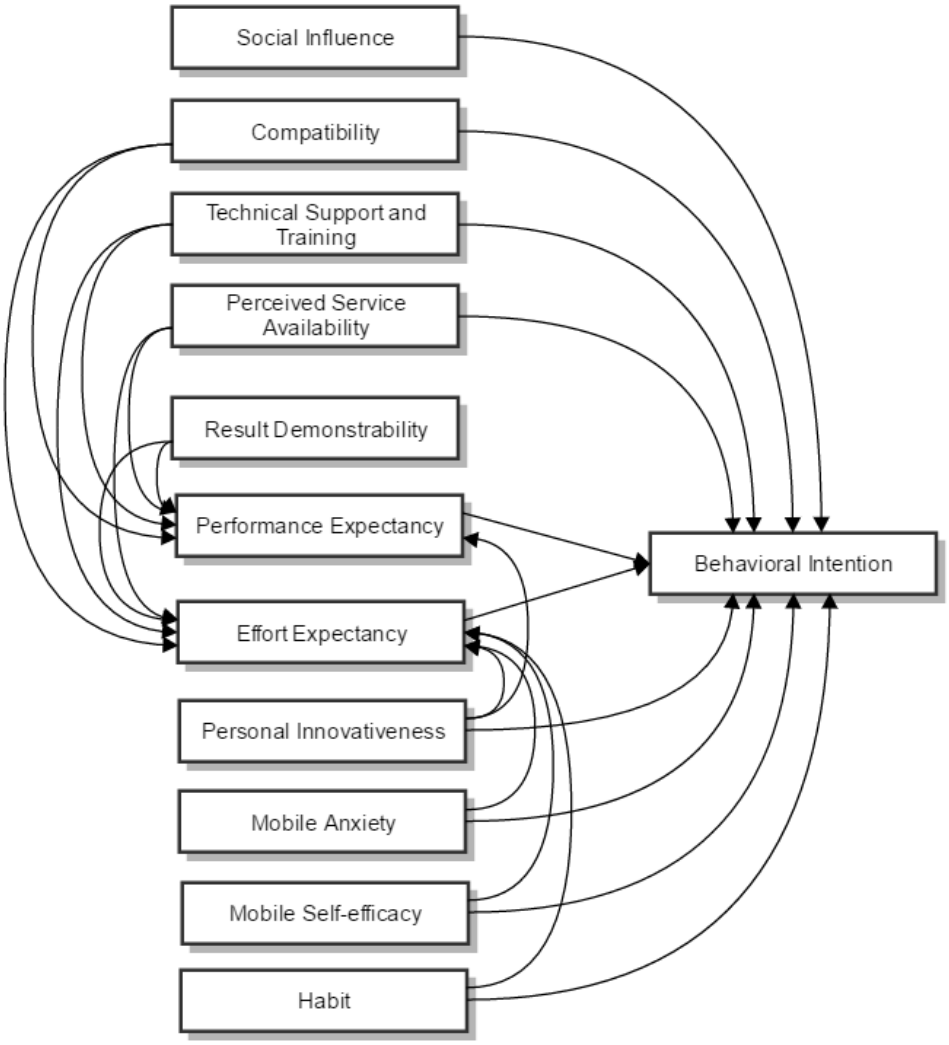


Figure 11: Mobile Health Technology Acceptance Model

CHAPTER 4

METHODOLOGY

The purpose of the study is to identify the intentions of physicians towards using mHealth applications and to figure if there is significant relationship among determinants. The study focuses on identifying factors influencing user intentions using a model (M-TAM). The main steps of the study is outlined in the Figure 12. A summary of the research also presents the overview of the research in Appendix F.

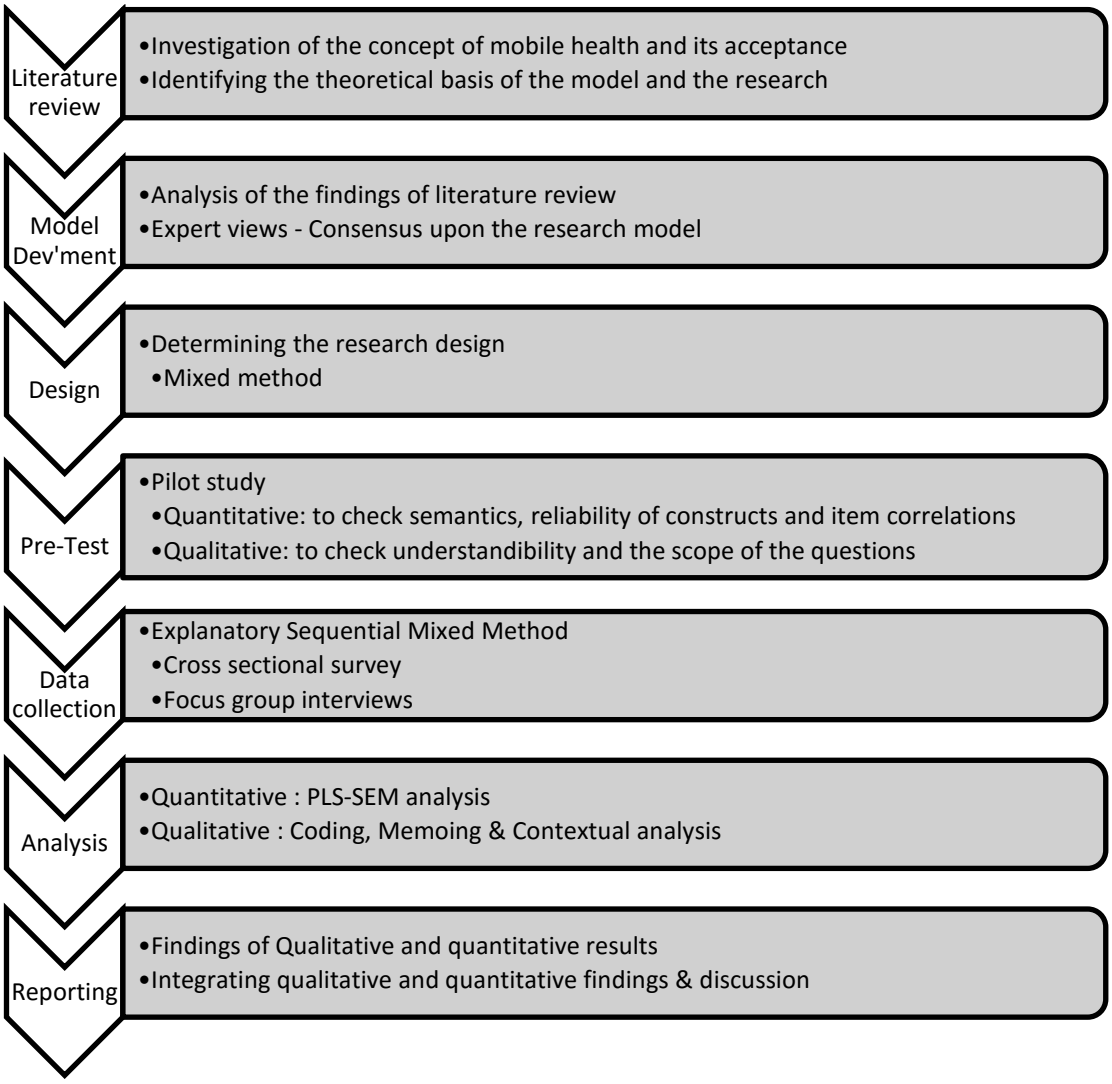


Figure 12: Stages of the research

The following sections provided research design, quantitative and qualitative approaches.

4.1.Research Design: Pragmatism & Mixed method

Scientific method or philosophy of this study embraced pragmatism, considering the quantitative approach and qualitative approach being used together to reach the facts and assumptions regarding to the research problem. In pragmatic view, the researcher employs the resources to seek answers for "how and "what" in the research, he/she is focusing on understanding the problem in terms of actions, situations and consequences (Creswell, pp. 10-11, 2003).

In the study, explanatory sequential mixed method was employed which fits to the concept and plan of the study. In a simple manner, the research design combines the power of quantitative and qualitative researches. However, sequential approach is used to support quantitative data with qualitative backup as well as to investigate unexpected outcomes. Creswell (2003) explains this method as following:

> "The explanatory sequential mixed methods approach is a design in mixed methods that appeals to individuals with a strong quantitative background or from fields relatively new to qualitative approaches. It involves a two-phase project in which the researcher collects quantitative data in the first phase, analyzes the results, and then uses the results to plan (or build on to) the second, qualitative phase. The quantitative results typically inform the types of participants to be purposefully selected for the qualitative phase and the types of questions that will be asked of the participants. The overall intent of this design is to have the qualitative data help explain in more detail the initial quantitative results. A typical procedure might involve collecting survey data in the first phase, analyzing the data, and then following up with qualitative interviews to help explain the survey responses."

Mixed method is employed in a research to enable the researcher gather the benefits of qualitative and quantitative research approaches. It would reflect to the procedure as in data collection and interpretation methods. However, it will add value to the study in terms of increasing the depth of understanding and collaboration (Creswell, 2003) In addition to that, the benefits of mixed method is essential to get in-depth understanding out of the study. The strengths and weaknesses of the mixed approach are presented in the Table 5. However, to overcome the weaknesses, expert opinions and group discussions were also utilized in decision making and training processes.

Table 5: Strengths and weaknesses of mixed method (Johnson & Onwuegbuzie, 2004)

Strengths	**Weaknesses**
* Words, pictures, and narrative can be used to add meaning to numbers. * Numbers can be used to add precision to words, pictures, and narrative. *Mixed method can provide quantitative and qualitative research strengths * Researcher can generate and test a grounded theory. * Mixed method can answer a broader and more complete range of research questions because the researcher is not confined to a single method or approach. * A researcher can use the strengths of an additional method to overcome the weaknesses in another method by using both in a research study. * Mixed method can provide stronger evidence for a conclusion through convergence and corroboration of findings. * Mixed method can add insights and understanding that might be missed when only a single method is used. * Mixed method can be used to increase the generalizability of the results.	* Mixed method can be difficult for a single researcher to carry out both qualitative and quantitative research, especially if two or more approaches are expected to be used concurrently; it may require a research team. * Researcher has to learn about multiple methods and approaches and understand how to mix them appropriately. * Methodological purists contend that one should always work within either a qualitative or a quantitative paradigm. * Mixed method research is typically more expensive than mono method research * Mixed method research is typically more time consuming than mono method research * Some of the details of mixed research remain to be worked out fully by research methodologists (e.g., problems of paradigm mixing, how to qualitatively analyze quantitative data, how to interpret conflicting results).

To use mixed method in investigating acceptance of mHealth application was a necessity, especially considering the major lean towards using emerging technologies in healthcare. Thus, Singular perspective (qualitative or quantitative research) would not provide sufficient information to solve or understand the scientific research problem. Thus, mixed method would provide a methodological integrity.

In **the mixed method data analysis**, the quantitative and the qualitative data were analyzed separately. To follow the sequential procedure, the quantitative results were used in development and implementation of the qualitative research. The questions of qualitative research were designed to be open-ended and to be deductive in order to collect information form the participants in a systematic manner. The independent and consecutive implementation of each method would provide a platform to compare the results and to conduct further investigation of quantitative results in the follow-up qualitative research.

After completion of quantitative and qualitative research analysis, the findings were used to interpreted in cohesion, to investigate quantitative results in the light of qualitative insights. Here, the primary concern is to focus on “how the qualitative findings help to explain the quantitative results”. In the literature, the common problem was identified as merging the results of two methods (Creswell, 2003). Since qualitative results were expected to provide more depth and insight for the quantitative results and to help narrowing down the scope of the quantitative findings, the question of “how the qualitative results help to expand or explain the quantitative results” was focused on discussion of findings in mixed method.

To establish **validity** of quantitative results and qualitative findings, different approaches were developed in each method. However, in the explanatory sequential mixed method, additional measures need to be taken to ensure validity. The common problems were outlined as narrow focusing (showing attention to only limited information and missing important explanations) and sample differentiation (involving different samples in each phase of the study) and inadequate sample size (Creswell, 2003; Recker, 2012). In this study, these problems were eliminated by practicing quantitative and qualitative data collection by pre-tests as well as utilizing from the literature.

4.2.Quantitative Stage

Quantitative design section composed of research questions and hypotheses, study population- design and procedure and study instruments.

4.2.1. Research Questions and Hypotheses

Hypotheses were developed by considering research questions, and grouped under each question. The proposed model and the relations of the constructs demonstrated the main structure of hypotheses.

Research Question 1: What are the factors influencing physicians' intention to use m-Health applications?

Here, it was aimed to seek the influencing factors for physicians to use mobile health application. It is important to identify those factors in order to comprehend the attitudes of users. In that regard, effects on the behavioral intentions were hypothesized to seek answer for this research question. The concept of BI emerged as behavior predictor in TPB (Ajzen, 1991), and it was widely used and validated in many acceptance studies (Holden & Karsh, 2010; King & He, 2006; Or & Karsh, 2012; Venkatesh & Bala, 2008; Yousafzai et al., 2007).

With the Performance Expectancy (PE), users' attitudes were investigated for the relations of their job performance with using a technology. Effort Expectancy was first used in UTAUT, as the successor of perceived ease of use of TAM (Davis, 1989). This construct was used to explain relation between user attitudes and their perception about easiness towards a technology (Venkatesh et al., 2003). In the literature, PE and EE were used as major factors to explain user behaviors (Holden & Karsh, 2010; King & He, 2006; Schepers & Wetzels, 2007).

H1. Performance expectancy will positively affect behavioral intention of health professionals.
H2. Effort expectancy will positively affect behavioral intention of health professionals.

On the other side, additional constructs were proposed in the literature to explain user behavior. In that regard, Social Influence (SI) was used for predicting influence of social environment of users and its impact on behavioral intention (Legris et al., 2003). Considering the trend in mobile healthcare, compatibility with the existing healthcare technologies could affect the intention to use. Thus, the Compatibility was used for investigating effects of technological transformation on behavioral intention (Moores,

2012). Similarly, training to be competent in technology use (Aggelidis & Chatzoglou, 2009) and availability of mobile services for timely use (I.-L. Wu et al., 2011) were influential factors in intention to use.

H3. Social influence will positively affect behavioral intention of health professionals.
H4. Compatibility will positively affect behavioral intention of health professionals.
H5. Technical support and Training will have a significant effect behavioral intention of health professionals.
H6. Perceived service availability will positively affect behavioral intention of health professionals.

In healthcare, routinization and high frequency of repetition in routine task could lead to habitual behaviors (Marie-Pierre Gagnon et al., 2003). Thus, the current state of mobile use motivates to investigate the relation of habit and behavioral intention in mobile health applications. On the other hand, healthcare providers' apprehension in using mobile technologies (mobile anxiety) (L. K. Schaper & Pervan, 2007), their perceived ability to perform specific tasks using mobile technologies (mobile self-efficacy) (Aggelidis & Chatzoglou, 2009), and their willingness to try new mobile technologies (Personal innovativeness) (S.-Y. Hung et al., 2012) would impact the behavioral intention.

H7. Habit will positively affect behavioral intention of health professionals.
H8. Mobile anxiety will not have a significant positive effect on behavioral intention of health professionals.
H9. Mobile self-efficacy will have a significant effect on behavioral intention of health professionals.
H10. Personal innovativeness will positively affect behavioral intention of health professionals.

Research Question 2: What are the relationships among the factors influencing the use of mHealth applications?

The second research question was for seeking inter-relations among the constructs. In addition to the direct effect of constructs to the behavioral intention, their impact on behavioral intention would also be observed via moderating effects over PE and EE (Moores, 2012). In that regard, literature suggested additional constructs to investigate physicians' intention to use healthcare technologies. Mobile anxiety (L. K. Schaper & Pervan, 2007), Self-efficacy (J.-H. Wu et al., 2007), Personal Innovativeness (Kummer, Schäfer, & Todorova, 2013; I.-L. Wu et al., 2011), Habit (Marie-Pierre Gagnon et al., 2003), Perceived Service Availability (Aggelidis & Chatzoglou, 2009; I.-L. Wu et al., 2011), Result Demonstrability (Marie-Pierre Gagnon et al., 2014; Yi et al., 2006), Technical Training and Support (Aggelidis & Chatzoglou, 2009; J.-H. Wu et al., 2007) and Compatibility (S.-Y. Hung, Tsai, & Chuang, 2014; J.-H. Wu et al., 2007) were the prior constructs included to the study. The hypotheses were formulated as the followings.

H11. Mobile anxiety will have a direct effect on effort expectancy.
H12. Mobile self-efficacy will have a direct effect on effort expectancy.

H13. Personal innovativeness will have a direct effect on effort expectancy.
H14. Habit will have a direct effect on effort expectancy.
H15. Personal innovativeness will have a direct effect on performance expectancy.
H16. Perceived service availability will have a direct effect on performance expectancy.
H17. Perceived service availability will have a direct effect on effort expectancy.
H18. Result Demonstrability will have a direct effect on effort expectancy.
H19. Result Demonstrability will have a direct effect on performance expectancy.
H20. Technical support and Training will have a direct effect on performance expectancy.
H21. Technical support and Training will have a direct effect on effort expectancy.
H22. Compatibility will have a direct effect on performance expectancy.
H23. Compatibility will have a direct effect on effort expectancy.

4.2.2. Population

The population consisted of physicians (as healthcare providers) who work actively in the field of health services at hospitals and other health institutions. The sample group was selected by convenient sampling approach. Inclusion criteria were (1) being a physician, (2) being aware of mobile applications and/or using them in practice and (3) being actively assigned to practice.

4.2.3. Design and Instrument

Research design is a non-experimental design in which researcher did not have any interference for manipulation of subjects. A cross-sectional survey was conducted to collect data from physicians.

The survey instrument was developed based on the model. Since the model was based on the theories of TAM, TPB, IDT and UTAUT, the technology acceptance literature of those theories were included during instrument development. The questionnaire consisted of demographic and survey questions. The questions were extracted from literature without any modifications. Responses were aimed to be acquired by 5 points Likert-type response scaling. M-TAM has 12 constructs and 36 items. Thus, 120 to 150 participants would be convenient with statistical analysis in acceptable level of errors (Blunch, 2008), and 3 questions for each item was found sufficient in the literature. Table *6* presented the constructs, questions and the references. The questionnaire was implemented in Turkish language. In translation, the questions were read by a researcher and a doctor in order to assess its understandability.

Table 6: Constructs, Items, Questions and Resources

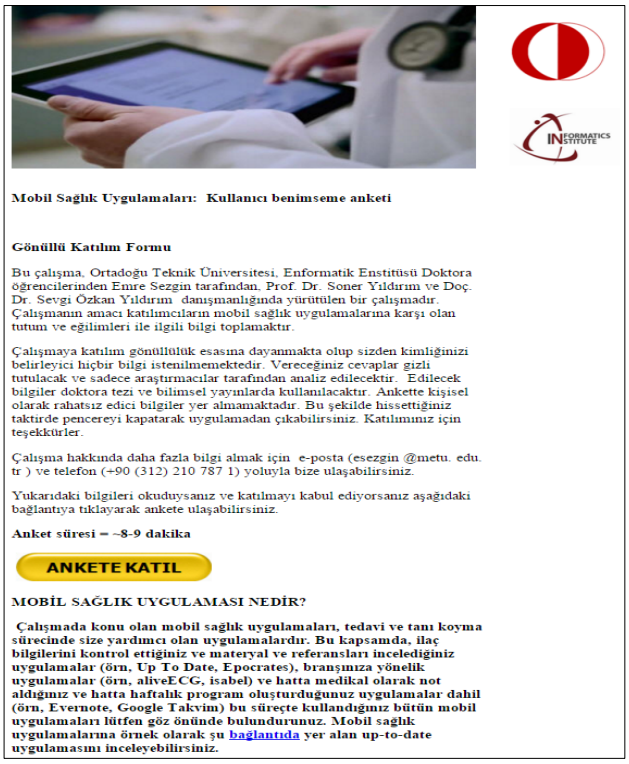
Constructs / Items / Questions			**Theory**	**Primary Source of the question**
BI	BI1	I intend to use the m-health.	UTAUT/TAM	(Davis, 1989; Venkatesh et al., 2003)
	BI2	I predict I will use m-health in the next 3 months		
	BI3	I plan to use m-health in the next 3 months		
EE	EE1	My interaction with m-health would be clear and understandable.	UTAUT/TAM	(Davis, 1989; Kijsanayotin et al., 2009; Kim, Lee, Hwang, & Yoo, 2016; Venkatesh et al., 2003)
	EE2	It would be easy for me to become skillful at using the m-health.		
	EE3	I would find the m-health easy to use.		
PE	PE1	I would find m-health useful in my job	UTAUT/TAM	(Davis, 1989; Kijsanayotin et al., 2009; Kim et al., 2016; Venkatesh et al., 2003)
	PE2	Using the m-health increases my productivity		
	PE3	Using the m-health enables me to accomplish tasks more quickly		
SI	SI1	People who influence my behavior think that I should use the m-health.	TPB	(Ajzen, 1991; Kijsanayotin et al., 2009; Kim et al., 2016; Venkatesh et al., 2003)
	SI2	People who are important to me think that I should use the m-health.		
	SI3	The senior health administration has been helpful in the use of the m-health.		
HB	HB1	I frequently use mobile systems during my life.	UTAUT2	(Marie-Pierre Gagnon et al., 2003; Venkatesh, Thong, & Xu, 2012)
	HB2	I feel like I must use m-health.		
	HB3	The use of m-health has become a habit for me.		
PI	PI1	If I heard about a new information technology, I would look for ways to experiment with it	IDT	(S.-Y. Hung et al., 2012; Rogers, 1995; Yi et al., 2006)
	PI2	Among my peers, I am usually the first to try out new information technologies		
	PI3	I like to experiment with new information technologies		
RD	RD1	I have no difficulty telling others about the results of using a m-health.	TAM2	

	RD2	The results of using m-health are apparent to me		(Venkatesh & Davis, 2000; Yi et al., 2006)
	RD3	I would have difficulty telling others about the results of using a m-health		
MS	MS1	I could complete the job using m-health if there was no one around to tell me what to do as I go	TAM3	(Aggelidis & Chatzoglou, 2009; Melas et al., 2011; L. K. Schaper & Pervan, 2007; Venkatesh & Bala, 2008)
	MS2	I could complete the job using m-health if I had never used a system like it before		
	MS3	I could complete the job using m-health if I had used similar system before this one to do the same job		
MA	MA1	The mobile system is somewhat intimidating the wrong to me	TAM3	(Aggelidis & Chatzoglou, 2009; L. K. Schaper & Pervan, 2007; Venkatesh & Bala, 2008)
	MA2	I hesitate to use the m-health for fear of making mistakes that I cannot correct		
	MA3	I feel apprehensive about using the system		
TT	TT1	Specialized instruction and education concerning use of m-health is available to me	UTAUT	(Aggelidis & Chatzoglou, 2009; Venkatesh et al., 2003; J.-H. Wu et al., 2007)
	TT2	A specific person (or group) is available for assistance with m-health difficulties		
	TT3	Specialized programs or consultant about training are available to me		
PS	PS1	I would be able to use m-health at any time, from anywhere.	UTAUT	(Hong & Tam, 2006; Venkatesh et al., 2003; I.-L. Wu et al., 2011)
	PS2	I would find m-health easily accessible and portable.		
	PS3	m-health would be available to use whenever I need it		
CO	CO1	Using m-health system is compatible with most aspects of my work	IDT	(J. Chen et al., 2010; Rogers, 1995; L. K. Schaper & Pervan, 2007; J.-H. Wu et al., 2007)
	CO2	Using m-health fits well with the way I like to work		
	CO3	Using m-health fits into my work style		

4.2.4. Target Sample and Data Collection

A **non-probabilistic (convenience) sampling** was employed as data collection design, which was conducted by employing online survey tools (qualtrics.com). The target sample was physicians (doctors, practitioners, specialists, etc.) who are actively

working in a health institution in Turkey. Following the approval by the ethical board of the university (i.e. METU), the survey was formed and linked to the METU webpage (www.metu.edu.tr/~esezgin) (Figure 13). The survey was announced online using (1) social network websites (Facebook, Twitter, Linkedin), (2) e-mails to mail groups of professions. In addition to the online announcement, formal notifications have been sent to the participants informing about the aim and context of the study and the agreement notice. The survey was accessible for six months (June 2015-November 2015). Considering the subscribers to the social network channels and mail groups, the survey was distributed to approximately 1031 participants.



Mobil Sağlık Uygulamaları: Kullanıcı benimseme anketi

Gönüllü Katılım Formu

Bu çalışma, Ortadoğu Teknik Üniversitesi, Enformatik Enstitüsü Doktora öğrencilerinden Emre Sezgin tarafından, Prof. Dr. Soner Yıldırım ve Doç. Dr. Sevgi Özkan Yıldırım danışmanlığında yürütülen bir çalışmadır. Çalışmanın amacı katılımcıların mobil sağlık uygulamalarına karşı olan tutum ve eğilimleri ile ilgili bilgi toplamaktır.

Çalışmaya katılım gönüllülük esasına dayanmakta olup sizden kimliğinizi belirleyici hiçbir bilgi istenilmemektedir. Vereceğiniz cevaplar gizli tutulacak ve sadece araştırmacılar tarafından analiz edilecektir. Edilecek bilgiler doktora tezi ve bilimsel yayınlarda kullanılacaktır. Ankette kişisel olarak rahatsız edici bilgiler yer almamaktadır. Bu şekilde hissettiğiniz taktirde pencereyi kapatarak uygulamadan çıkabilirsiniz. Katılımınız için teşekkürler.

Çalışma hakkında daha fazla bilgi almak için e-posta (esezgin @metu. edu. tr) ve telefon (+90 (312) 210 787 1) yoluyla bize ulaşabilirsiniz.

Yukarıdaki bilgileri okuduysanız ve katılmayı kabul ediyorsanız aşağıdaki bağlantıya tıklayarak ankete ulaşabilirsiniz.

Anket süresi = ~8-9 dakika

ANKETE KATIL

MOBİL SAĞLIK UYGULAMASI NEDİR?

Çalışmada konu olan mobil sağlık uygulamaları, tedavi ve tanı koyma sürecinde size yardımcı olan uygulamalardır. Bu kapsamda, ilaç bilgilerini kontrol ettiğiniz ve materyal ve referansları incelediğiniz uygulamalar (örn, Up To Date, Epocrates), branşınıza yönelik uygulamalar (örn, aliveECG, isabel) ve hatta medikal olarak not aldığınız ve hatta haftalık program oluşturduğunuz uygulamalar dahil (örn, Evernote, Google Takvim) bu süreçte kullandığınız bütün mobil uygulamaları lütfen göz önünde bulundurunuz. Mobil sağlık uygulamalarına örnek olarak şu bağlantıda yer alan up-to-date uygulamasını inceleyebilirsiniz.

Figure 13: Questionnaire web interface

Cross-sectional survey method was embraced as the data collection design. Survey was conducted as a structured questionnaire. Five points Likert-type scale was found as the optimal interval to make response levels easily identifiable and to reduce bias in responses (Allen & Seaman, 2007; Krosnick & Presser, 2010). The scale was identified as “1: Strongly disagree”, “2: Disagree”, “3: Neutral”, “4: Agree” and “5: Strongly agree”. Survey consisted of 3 parts. First part: the participants were informed about the purpose of study and confidentiality about their data, and they were asked to confirm that they understood the concept of the study in order to start the questionnaire. Second part: the demographic questions were asked including gender, city, age, education level, type of mobile device being used, experience in mobile device use, competency in mobile device use, frequency in mobile health application use, experience in mobile health application use, voluntariness, the health institution type, names of mobile health applications being used (13 Questions). Third part: 33 of close-ended survey questions.

4.2.5. Quantitative Data Analysis

The study results were tested by employing structural equation modeling (SEM). SEM model provided a path to estimate casual relations (Richard P Bagozzi & Yi, 2011).In addition to that, SEM provided various measures of validity for the study (i.e. predictive validity, internal validity, factorial validity and reliability). In the literature, the advantages of SEM was summarized as (1) appropriateness for theory-driven research, (2) its use for validation of more complex models then was possible with the first generation multivariate analysis tools, and (3) the inclusion of the measurement errors in calculations (Blunch, 2008). SEM was conducted with structural and measurement models. The measurement model provided the confirmatory factor analysis (CFA) and it helped to test factorial validity. The structural model was used for the path analysis of the study. Statistical analysis was conducted using SPSS software, and SmartPLS software was used for SEM analysis.

In detail, the research model was tested employing series of procedures. At the initial step descriptive analysis was completed to measure normality of the data. These analyses were completed using IBM SPSS 22 software. After depicting the characteristics of the data, Structural Equation Modeling (SEM) was employed to test linear and casual models. SEM is a multivariate data analysis approach that allow to discover latent relationships between constructs (Kline, 2010). In this context, measurement model and structural model were tested employing partial least squares (PLS) with SmartPLS software (C. Ringle, Wende, & Will, 2005). SmartPLS software was used as the tool for PLS analysis due to the following reasons: (1) it provides a variety of methods and widely used for PLS-SEM analysis, (2) it brings detailed reporting options for analysis, and (3) it is free-to-use and comes with a comprehensive graphical user interface. Here, PLS provided a component-based approach for applying SEM. PLS approach is a good suite considering the structure of the data, instead of covariance based SEM (CB-SEM), due to the fact that the sample size is small, and to have higher predictive power (F. Hair Jr, Sarstedt, Hopkins, & G. Kuppelwieser, 2014; C. M. Ringle, Sarstedt, & Straub, 2012). This method also helps to test the data that is not perfectly normally distributed (Chin, 1998; Goodhue et al., 2012). In this process of SEM, Measurement model test included convergent and divergent validity of the model, and the Structural Model was tested exploring construct path coefficients.

4.3.Qualitative Stage

As a part of explanatory sequential mixed method, a qualitative stage was designed. Patton (2005) stated that “The purpose of interviewing is to find out what is in and on someone else's mind” and continued “We interview people to find out from them the things we cannot directly observe”. Thus, qualitative data would contribute to the study for understanding physicians and their perception about the mHealth applications.

4.3.1. Design

The research employed focus group interviews to cross validate quantitative results as well as to reveal subtle facts about m-health application use by physicians. The questions were developed based on strongly significant, weakly significant and non-significant hypotheses affecting behavioral intention in quantitative phase.

4.3.2. Focus group interview

Focus group interview was defined as a form of data collection method. The researcher gathers a small group of participants who had similar "focus" (i.e. attributes, experiences), and he/she moderates the group in discussing about a topic without any directives or intervention (Yin, 2011). Focus groups are efficient methods in terms of data collection. In addition to that, group interviews are desirable in order to encourage individuals to participate to the conversation within a group (Creswell, 2003). However, focus group interviewing has several risks unlike individual interviewing. Yin (2011) summarized the risks in the following major topics. First of all, there is a risk of losing in-depth information by getting partial or less information from individuals in the group. Following that, there is a risk of dominant characteristics. In that case, one or two dominant individuals may take the major role in talking and interrupting others. And finally, there is a risk of misguidance the conversation and silence. Here, questions of group member may lead the conversation to an unintended path or the reluctance may lead to a complete silence. To eliminate the risks, the researchers need to effectively moderate the discussions. In that regard, a pilot study was held in this study in order to observe possible risks as well as to practice moderating capabilities of the researchers in the focus group interview. In addition to that a practical guideline were used during the focus group interviews. The practical guideline was provided by Yin (2011), outlining six topics in order to converse successfully. Table 7 provides the guideline.

Table 7: Practical guideline for qualitative interview (Yin, 2011)

Actions	**Suggestions & Explanations**
1. Speaking in modest amounts	• "to speak less than the other person" • "to avoid asking multiple questions that are embedded in the same sentence" • "to master the use of probes and follow-up questions"
2. Being nondirective	• "to set the boundaries for the conversation but nevertheless permit the participant to color it" • "grand tour" questions
3. Staying neutral	• As the researcher, "your body language and your expressions, as well as your words need to be carefully cast in a neutral manner"
4. Maintaining Rapport	• As the researcher, "you have created the particular research situation, you also have a special responsibility to avoid conversations that might do harm to the other person"
5. Using an interview protocol	• "The interview protocol contains a small subset of topic, those that are considered relevant to a given interview. Each topic might be followed by some brief probes and follow-up queries"
6. Analyzing when interviewing	• As the researcher, "you will be deciding when to probe for more detail, when to shift topics, and when to modify your original protocol or agenda to accommodate new revelations"

4.3.3. Interview protocol

An interview protocol was prepared in order to be used in the focus group interviews. The protocol provided a framework for "guided conversations" and helped to the researcher to control the process. First of all, an observational protocol was determined in order to record descriptive notes (observations about participants' portraits, characteristics, dialogue, environment) and reflective notes (personal thoughts, feelings and ideas about the interview)(Creswell, 2003). Following that, the interview protocol was prepared. The interview protocol included the components given in the Table 8.

Table 8: Interview protocol

DD/MM/YY
1. Interviewer Information
(Name/ Surname)
2. Interviewees' Information
(Name/ Surname, Age, Specialty, Job experience, experience in mobile device use)
3. Instructions for the interviewer
(Introduction speech: Welcoming, briefing about the study)
4. The questions
(Overall questions for general knowledge about the mHealth)
(Questions about the study)
(Probes about each questions)
5. Summary of the responses
6. Final speech
(Thank you statement)

4.3.4. Questions

Since the study employed explanatory sequential mixed method, the qualitative questions were mainly shaped and developed with regards to the results of quantitative stage. Direct effect of constructs to the behavioral intention was investigated developing the interview questions about significant and non-significant impacts on Behavioral Intention (Table 9). The questions were based on the quantitative questionnaire, yet focusing on in-depth investigation of the constructs to extract details about the relations. As given in the Table 9, overall questions were asked to assess participants' awareness and knowledge regarding to mobile health. Following that, based on the results of quantitative analysis, significant and non-significant relations were investigated.

Table 9. Interview questions

Content	Question	Sub-Question
Overall	What do you think of when you meet or hear the concept of mHealth?	What does mHealth application mean to you?
	What are the advantages and disadvantages of mHealth applications?	What are the problems you have while using mHealth applications?
		What is your motivation to use mHealth applications?
	What mHealth applications do you use?	Do you think there are enough number of mHealth applications in the market?
	For what purpose do you mostly use mHealth applications?	
	Do you think mHealth applications have a vital importance?	If not, do you think it will in the future?
	How do you find the interaction and use of mHealth applications by the new generation- physicians?	
	Do you think mHealth applications should be a part of medical education?	
PE and BI	To what degree could you accomplish your tasks without using mHealth applications?	Do you think it would be impossible or would it slow down the process?
	How your job performance would be effected if you do not use mHealth applications?	Even if it effects or not, could you provide an example for this case?
PS and BI	Do you have difficulties to access to mobile applications when you need to use it?	Do you have difficulties to access to mHealth applications?
MA and BI	Do you trust mHealth applications?	Do you do verification for the results you have from mHealth applications?
		Do you think to call a friend or to check from a computer would be appropriate for you? What is your motivation here?
	Do you have physicians in your circle who are anxious to use mHealth applications?	If yes, could you elaborate that what kind of behaviors do they exhibit?
PI and BI	What do you say about your interest in new technologies?	Would the new technologies, such as a new TV, smart phone or computer, attract you to buy and use them or do you show no interest on them?
		Do you think the same for mobile applications?
		Do you think the same for mHealth applications?
CO and BI	Do you think mobile applications are compatible with the current health systems and platform?	Can you do your jobs on mobile devices, as you do in personal computers?

		If yes, can you do your jobs using mHealth applications?
	Could you tell us about any recent technologies which affect your profession significantly?	Can you provide some examples about these technologies?
EE and BI	If we assume that there is a mHealth application which is useful for your job but it is complicated to learn. Are you willing to use this mHealth application?	
	Do you classify yourself as quick learner for mobile applications?	Do you use mobile applications easily?
HB and BI	Do you frequently use mobile applications?	Do you frequently use mHealth applications?
		What is the average hour for your daily use?
	Do you think use of mobile applications is a habit for you?	
MS and BI	Do you ask any help from your friends or colleagues in using mobile applications?	Do you ask any help from your friends or colleagues in using mHealth application?
	Do you consider yourself prone to use mHealth applications?	
SI and BI	Do you share mobile applications with your friends or chat about new applications that you are interested in?	Do you do the same for mHealth applications?
	Is there a procedure or motives to use mHealth applications provided by the management?	
TT and BI	Have you ever feel the need for help, training or assistance in using mobile applications?	Have you ever feel the need for help, training or assistance in using mHealth applications?
	If possible, do you attend to seminars or trainings for mHealth applications?	How do you feel about a helpdesk for mHealth applications?
	When you consider about having a training program, do you think mHealth applications would change your current routine?	

4.3.5. Interview procedure (data collection)

A pilot study was implemented to assess the focus group interview design and questions. 3 participants were invited to focus group pilot interview. The pilot study took one hour, and the interviews were recorded and transcribed. In the light of responses, the questions were revised in terms of semantics, understandability and the procedure was modified to be more precise.

In the focus group interviews, two researchers attended to the interviews as one moderator/researcher and one observer. Focus group 1 (FG1) consisted of 3 physicians and the focus group 2 (FG2) consisted of 4 physicians. The informants were physicians who were actively working in a health institution and using mHealth applications.

Each group was from different province of the city. The informants were selected based on demographic characteristics (their gender, age, specialties and experience in professions) in order to create variance in each group. Snowball approach was used in recruitment. The details about each group is given in the Table 28. In addition to that, Turkish interview questions and introduction is in Appendix C. FG1 and FG2 interviews took approximately one hour. The responses were recorded. The responses were transcribed and transferred to QDA Miner software. In addition to that, the researcher took observational notes during the interviews. During the interviews, the procedures outlined in the Section 4.3 were followed. An interview protocol was implemented and the questions, which were rooted to the quantitative survey (Table 9), were directed to the groups.

4.3.6. Qualitative Analysis

Qualitative analysis of the study focused on the reliability and validity of the data, in other words "coherence" and "order" (Kaplan, 2005). Since qualitative approach investigates "what", "how" and "why", it is important to ensure acquiring reliable and to-the-point responses from the participants. Thus, in addition to the practical guidelines and interview protocol (which are important for the validity), qualitative reliability was investigated by methods of memoing, coding (Glaser & Strauss, 1967; Recker, 2012) and contextual analysis (Mishler, 1991). Multiple methods help for cross checking the responses. As the definition, a code is a phrase which is used to identify the context of a sentence or paragraph. Following that, codes were categorized under the themes to refine the results and to reveal patterns. Memoing is about recording thoughts and reflective notes about what the researcher has learned from the interview records. Furthermore, contextual analysis include the conditions, such as "social, institutional, and environmental conditions within which people's lives take place" (Yin, 2011).

In addition to that, these methods constitute a methodological triangulation (memos, responses and contextual inputs) to ensure reliability of the responses. Figure 14 provided the process of qualitative analysis. The steps outlined that the raw data, audio recordings and notes, were transcribed at the first step. Following that, the data was read to ensure accuracy of the information. Then, the codes and themes were created, and the meaning of these themes were interpreted. The process of reading and interpretation continued until all relevant information were grouped with codes and themes.

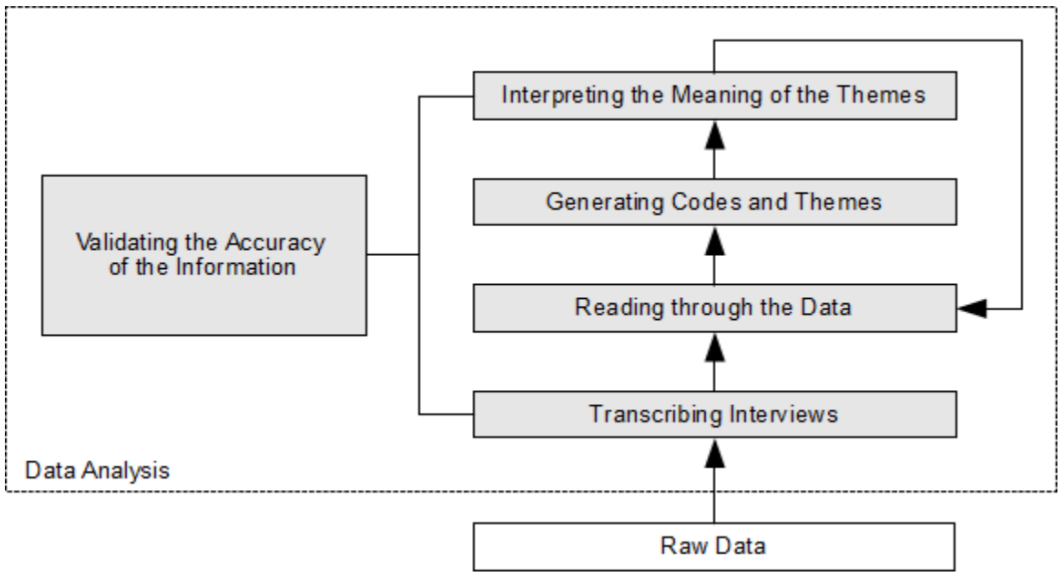


Figure 14: Qualitative Analysis steps (Creswell, 2003)

During the procedure of transcription, a colleague assisted in order to reduce the risk of researcher's bias and misunderstandings. During the analysis, peer debriefing (Spall, 1998) was utilized, in which the researcher was assisted by a colleague who has impartial opinions about the study. The key elements being considered in the process of qualitative data evaluation is given in the Table 10. QDA Miner software was used in transcribing and coding.

Table 10: Key elements in qualitative data evaluation (Recker, 2012)

Key elements	**Descriptions**
Dependability	"Dependability concerns whether individuals other than the researchers, upon considering the same observations or data, would reach the same or similar conclusions. If dependability can be demonstrated, it is similar to reliability in that it is demonstrated that measures provide consistently similar results."
Credibility	"Credibility of findings concerns whether the researcher has been able to provide sufficient substantiated evidence for the interpretations offered in qualitative data analysis (this relates to the internal validity of the research results). Credibility can be achieved through triangulation, maintaining a chain of evidence, and keeping clear notes regarding any decision made throughout the research process"
Confirmability	"Confirmability is a principle that postulates that qualitative research findings can be independently verified by outsiders in a position to confirm the findings (typically participants). This is usually done by reviewing interview summaries, conclusions, or other inferences drawn from qualitative data."
Transferability	"Transferability concerns whether and how much the findings from a study can be generalized to other settings, domains, or cases. Very detailed and rich descriptions of the research context should be provided such that others can assess the extent to which the context characteristics match those of other fields of research."

Dependability element is about the unity in the interpretation of findings, thus other individuals were expected to reach similar conclusions from the same data. It represents the reliability of the data. In that regard, codes and themes were overviewed and checked by a researcher independent from the study. **Credibility** of findings concerns about the evidence being sufficient for interpretations during the analysis. Here, triangulation method was used in order to maintain chain of evidence, including observational notes, memos and insights from contextual analysis. **Confirmability** is about confirming or verifying the findings by an independent individual. In that regard, transcription of the interviews and findings were sent to two of the participants from each group, and they were asked to provide feedback. **Transferability** is about generalizing the findings for other study settings or cases. Here, rich description of the context was expected in order to provide a comprehendible sum of context of the study. In that regard, observational notes including environment, participants' characteristics and contextual information was shared during the report of findings. Actions for each element were given in the results (Table 30).

CHAPTER 5

FINDINGS

5.1.Pilot Study – Pretest

A pilot study was conducted in order to analyze for correlations among items, reliability and understandability of the survey. It was conducted in smaller scale than main study. Hence, not all the reliability and validity measures would be applicable. Cronbach's alpha was employed to ensure reliability. In terms of reliability analysis, Cronbach's alpha loadings would be above .60 (Gliem & Gliem, 2003).

Before the test, expert reviews were used to identify understandability of questionnaire, semantics and to remove possible language related misunderstandings. 4 experts, who have academic professions with acceptance studies and health professions were invited to overview, compare and analyze the questions. The experts assisted to make wording corrections and to identify semantic errors. Final version of the questionnaire (Appendix B) was distributed to the participants via e-mail. The participants were randomly selected doctors from Kocaeli University Hospital, Osmangazi University Hospital and Ege University Hospital. In total, 71 questionnaires were distributed, 58 of the responses has returned. After removal of outliers, 56 responses remained for validity and correlation analyses. SPSS v18 software was used for the analysis.

Demographic results are given in Table 11. It was presented that most of the participants were female (71,5%) and ages were between 27 and 55. The participants were mostly practitioners (61%) and professions showed varieties (including cardiology, ER, otorhinolaryngology, psychiatry, surgery, pulmonary, orthopedics, pediatrics, plastic surgeon, gynecology and urology). The participants were mostly experienced in mobile device use (67,8%), especially smart phones (99,1%) and laptops (95,5%). They mostly categorized themselves as moderately competent in mobile device use (43,6%). The majority is familiar with mobile health applications (94,8%) and uses mobile health application 2-3 times a week (36,2%). Participants have been using m-health voluntarily mostly for 1 to 2 years. They are mainly working in a medical center and using mobile health applications for "reference and information gathering" and "communication and consulting". Items were added and removed considering the responses: a question was added to learn the city of participants that they are currently working on into the final version of questionnaire. The responses for health institutions were updated considering the variety of institutions. The response "laptop" was removed from "What mobile device do you use", in order to remove any biases regarding to the concept of mobile device.

Table 11: Results of demographic questions –Pilot study

	Responses
1. Gender	
Female	71,5%
Male	28,5%
2. Age	27-55
3. Education Level	
Bachelors	64,9%
Specialist	29%
PhD	6,1%
4. Experience in mobile device use	
None	0,0%
Less than 1 year	4,1%
1-3 years	6,7%
4-6 years	7,3%
7-9 years	14,1%
10 years and more	67,8%
5. What mobile devices do you use?	(multiple)
Smart Phone	99,1%
Tablet PC	70,3%
Laptop	95,5%
Others	3,6%
6. Skill Level in Mobile device use?	
Excellent	10,4%
Good	36,7%
Moderate	43,6%
Bad	9,3%
7. Have you ever used mobile health application before?	
Yes	94.8%
No	5.2%
8. What is your mobile health application use frequency?	
None	5,3%
Once in a Month	6,3%
2-3 times in a Month	9,9%
Once in a Week	13,7%
2-3 times in a Week	36,2%
Everyday	28,6%
9. Do you use the mobile applications on voluntary basis?	
Yes	98.3%
No	1.7%
10. How long have you been using the mobile health applications?	
None	5,9%
Less than one year	23,9%
1-2 years	31,6%
3-4 years	10,5%

5 years and above	8,1%
11. How can you define the type of your health institution?	
Medical center	89,8%
Regional hospital	10,2%
Local hospital	0,0%
12. Which mobile health applications do you use?	(multiple)
Information Management	29,1%
Time Management	11,2%
Health Record Maintenance and Access	21,2%
Communications and consulting	41,4%
Reference and Information Gathering	38,3%
Clinical Decision Making	10,1%
Patient Monitoring	5.2%
Medical Education and Training	12.7%

The applications being used by the doctors were grouped considering Ventola's (2014) m-health application use category (Table 12) as given in 12th demographic question. Reportedly, the most frequently used applications were related to "reference and information gathering", which indicates the doctors are mostly need medical references in decision making processes and communicate about medical diagnoses.

Table 12: Categorized mobile health applications used by the health professionals –Pilot study

Category	**Application Name(s)**
Information Management	Evernote, Keep
Time Management	Google calendar
Health Record Maintenance and Access	Monthly Prescribing Reference, NEJM
Communications and consulting	Whatsapp, Doximity, Messenger
Reference and Information Gathering	Medscape, Epocrates, MedPage Today, Dynamed, Ready by QxMD
Clinical Decision Making	AliveECG, Isabel
Patient Monitoring	AirStrip
Medical Education and Training	Skyscape, Virtual practice

Cronbach's alpha test was conducted to measure internal consistency of the constructs. Total reliability was found 0.89. Construct base reliability values are given in Table 13. The results presented that the reliability values of constructs are ranged between 0.71 and 0.89.

Table 13: Cronbach's Alpha values of constructs –Pilot study

Constructs	Cronbach's Alpha	Number of Items
BI	0.825	3
EE	0.723	3
PE	0.790	3
SI	0.816	3
HB	0.772	2
PI	0.768	3
RD	0.887	2
MS	0.715	3
MA	0.889	2
TT	0.890	3
PS	0.712	3
CO	0.855	3

Correlation analysis was conducted to measure the correlation among the items within each construct. The correlated items that presented significant relation with other construct items were eliminated. Thus, items of mobile anxiety (MA2), result demonstrability (RD3) and habit (HB2) were removed from the instrument due to their irrelevant relations with other items given in Table 14.

Table 14: Item correlations –Pilot study

Item	MA2
BI1	0.411*
EE2	0.553**
PE3	0.567**
SI1	0.394**
TT1	0.627**
PS1	0.511**
CO1	0.453**
CO2	0.414**

Item	RD3
BI2	0.152
EE1	0.482*
PE1	0.283
SI2	0.491**
HB1	0.724**
PS1	0.611**
CO1	0.330*
CO2	0.616**
MA1	0.328**
MA2	0.388*
MS1	0.211

Item	HB2
EE1	0.351*
PE1	0.383*
PE3	0.283
SI1	0.369**
PS2	0.811**
MS1	0.621**
RD1	0.241
CO2	0.326**
CO3	0.383**

5.2. Findings of Quantitative Study

Findings of the quantitative study were presented in the following sections, including respondents' information, demographics, descriptives, measurement model and structural model.

5.2.1. Respondents

The questionnaire was completed by 271 participants. The response rate was 26%. After the data collection, data was cleaned from manipulative responses including null, incomplete and repetitive data (4% of the responses). Consequently, 259 of the responses remained for analysis (137 users and 122 non-users). The response rate was

found sufficient in order to conduct analysis (Tabachnick & Fidell, 2012; Ullman & Bentler, 2003).

The results provided data of two types of participants: the users of mobile health applications and the participants who has not used mobile health applications before. Thus, the results and discussion of the model will be reported considering these two major groups.

5.2.2. Demographics

The demographic characteristics of participants were given in Table 15. The results presented that gender distribution for each group almost equally divided. The majority of participants from the large cities of Turkey. Most of the mHealth users were young or mid-aged, however non- mHealth users were mostly mid-aged and elders. Majority of the participants were specialists in specific medical professions (210). Rest were practitioners (59) who do not hold a specialist degree. A small part of participants had PhD degrees (18) (Table 16). For both groups, smart phones were the essential mobile device preferences, followed by Tablet PCs. The experience in mobile device use was higher in mHealth users, however there was not a significant difference between 2 groups. MHealth users perceived themselves "good" in terms of competency in mobile devices use, whereas non-users reported mostly good and moderate level of competency. Most of the mHealth users reported that they were using mHealth applications more than once in a week and using on voluntarily. The mHealth users are relatively new in using the applications: their experience in use mHealth apps were mostly one to two years. Public hospitals and Training and Research hospitals were the majority of health institutions that participants were working.

Table 15: Demographic characteristics

	MHealth users	**Non-users**
1. Gender		
Female	44%	43%
Male	56%	57%
2. City	Ankara (27%)	
	İstanbul (15%)	
	İzmir(12%)	
	Eskişehir (6%)	
	Kocaeli (4%)	
	Others (36%)	
3. Age	25-35 (53%)	25-35 (22%)
	36-45 (36%)	36-45 (44%)
	46-66 (11%)	46-65 (34%)
4. Education Level		
Practitioners	26%	21%
Specialists	74%	79%
Specialists with a PhD degree	8%	10%
5. Mobile device preferences	Smart Phone 98%	Smart Phone 97%
	Tablet PC 61%	Tablet PC 60%

6. Experience in mobile device use		
None	-	1%
Less than 1 year	2%	9%
1-5 years	69%	73%
6-10 years	19%	8%
More than 10 years	10%	9%
7. Perceived competency in Mobile device use		
Excellent	18%	14%
Good	63%	47%
Moderate	19%	33%
Bad	-	6%
8. What is your mobile health application use frequency?		
None	1%	100%
More than once in a Month	28%	-
More than once in a Week	54%	-
Everyday	17%	-
9. Do you use the mobile applications on voluntary basis?		
Yes	98%	-
No	2%	-
10. How long have you been using the mobile health applications?		
None	1%	100%
Less than one year	20%	-
1-2 years	53%	-
3-4 years	22%	-
5 years and above	4%	-
11. How can you define the type of your health institution?		
Public hospital	43%	37%
Training and research hospital	33%	34%
Health research center	7%	8%
Community clinic	5%	5%
Private hospital	12%	15%
On-site medical services	-	1%

Table 16: Profession of participants

Field of Profession	**Number of participants**	**Percentages**
Specialty	**210**	**81,08**
Emergency medical service	7	2,70
Primary care	11	4,25
immunology and allergy	3	1,16
Anesthesia	11	4,25
Surgery	12	4,63
Pulmonology	27	10,42
Pediatrics	13	5,02
Dermatology	4	1,54
Internal medicine	11	4,25
Dentist	10	3,86
Dietician	1	0,39
Physical medicine and rehabilitation	4	1,54
Genetics	2	0,77
Ophthalmology	11	4,25
Aviation medicine	5	1,93
Hematology	1	0,39
Gynecology	10	3,86
Cardiology	12	4,63
Otorhinolaryngology	8	3,09
Neurology	7	2,70
Oncology	8	3,09
Orthopedics	7	2,70
Pathology	6	2,32
Psychiatry	9	3,47
Radiology	1	0,39
Urology	6	2,32
Pharmacology	1	0,39
Medical biochemistry	2	0,77
General practitioner	**59**	**18,92**
Doctoral degree	18	6,95

5.2.3. MHealth Use Statistics

The participants of the survey reported names of the mobile health applications they have been using in healthcare services. These applications were categorized by their field of use regarding the categorization of Ventola (2014). The results presented that most of the applications were used from the category of communication and consulting. It was followed by clinical decision making, reference and information gathering, information management, medical education and training, time management and health record, maintenance and access. The least used apps were in

the category of patient monitoring (Figure 15). In total, 764 mobile health applications were reported, and they were grouped under one of each eight categories. The use rates in Figure 15 were calculated with the ratio of aggregated number in each category to total reported apps.

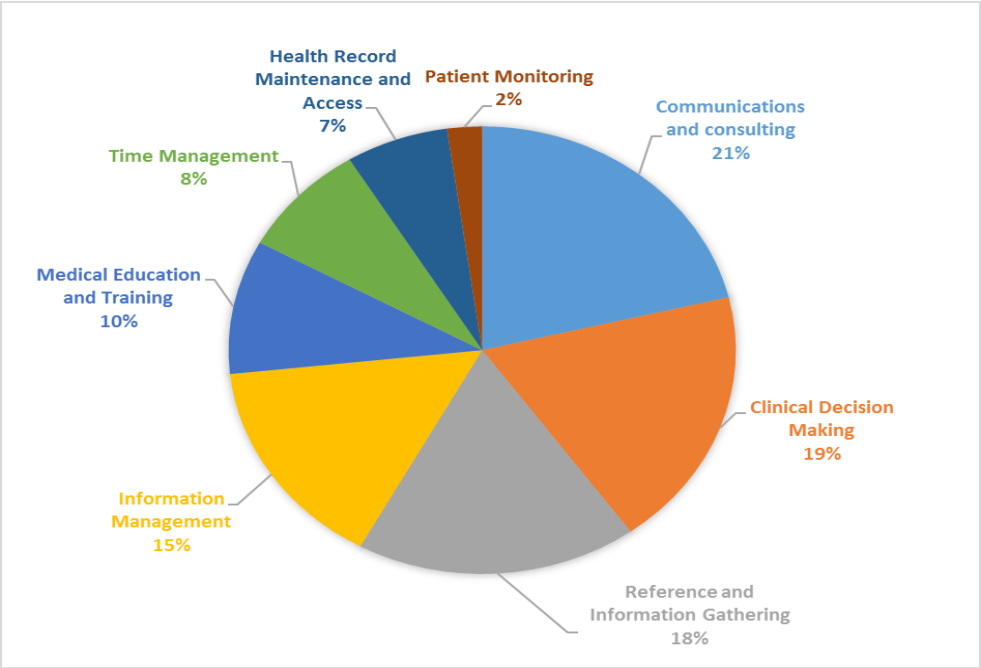


Figure 15: M-health application categories with use rates

Table 17 provided the names of mobile health applications in each category. The numbers given with category names are the total number of responses peculiar to that category. In addition to that, Appendix E provided the application categories for each specialties. The results presented that text and multimedia messaging apps (Whatsapp, Google Hangout) are the leading applications in "communications and consulting" category. In "clinical decision making", medical calculators (Medcalc, Das28) and diagnostic assistance tools (Prognosis, Dxsaurus) were mostly used applications. Drug referencing applications (cepilaç, nature, uptodate) are the mostly used "reference and information gathering" applications. It was followed by applications of scholar publications, cases and guidelines. In "information management", basic mobile applications were used to read and keep notes (Google notes, e-book reader, evernote). Visual training and educative applications (Medscape, Vcell) were commonly used applications in "Medical training and education" category. For "Time management", Google calendar was mostly used application. In addition to that, some participants reported using MHRS, an appointment application developed by the Health Ministry, for time management application. For "health record maintenance and access", Enlil, a hospital management information system, was reported as the most used application. It followed by other medical health recording systems as Meddata and E-nabız. "Patient monitoring" category had the least number of applications reported by the participants. Here, distance tracker (pedometer), calorie tracker (calorie counter) and heart rate tracker (cardiograph, Apple health) are mostly used applications.

Table 17: Mobile health application categories with application names and frequency rates

Groups	Name	Explanation	Frequency of use in the group (%)
	Communications and consulting (# of apps reported: 162)		
Audio, video and text based communications	Whatsapp	Text and multimedia messaging	50
	Google hangout	Text and multimedia messaging	43
	QuantiaMD	Text and multimedia messaging	7
	AOL	Text and multimedia messaging	1
	Clinical Decision Making (# of apps reported: 144)		
	Name	**Explanation**	**Frequency of use in the group (%)**
Medical calculators	Medcalc	Medical calculator for common use	44
	Das28	Medical calculator for common use	
	QTc ECG Calculator	Medical calculator for ECG analysis	
	QxCalculate	Medical calculator for common use	
	ASCVD Risk Calculator	Cardiac risk calculator	
	eGRF calculator	Calculator for Kidney functions analysis	
	ABG	Medical calculator for blood analysis	
	Anesthesiologist	Medical calculator for anesthesists	
	Keratoconus Nomogram	Medical calculator for Ophthalmology	
	Balthazard	Medical calculator for forensic medicine	
Diagnostic assitance	Prognosis	Diagnostic assitance with Cases and guidelines	43
	Dxsaurus	Diagnostics assitance	
	Eye handbook	Diagnostic and treatment assistance	
	ThoraxCT	Guideline for chest scans	
	InternetMedicin	Diganostic assitance	
Tests	Eye exam	Tools for eye examiantion	13
	Color Blindness Test	For application of color blindness test	
	iSnellen	Eye chart	
	PESi index	Pulmonary embolism outcome prediction tool	
	Sight selector	Assistance in eye disease diagnosis	
	Reference and Information Gathering (# of apps reported: 137)		
	Name	**Explanation**	**Frequency of use in the group (%)**
Drug referencing	CepİlaÇ	Drug referencing	62
	Ecza Plus	Drug referencing	
	İlacabak	Drug referencing	
	Epocrates	Drug referencing	
	Rx Mobile	Drug referencing	
	Tarascon Pharmacopoeia	Drug referencing	
	DrugDoses	Drug referencing and guidelines	
Journal and common references	EACTS Journals	Academic Journal about Cardio-Thoracic Surgery	14
	Chest	Academic journal about pulmonary	
	The Annals of Thoracic Surgery	Academic journal about Thoracic Surgery	
	ACS - Annals of Cardiothoracic Surgery	Academic Journal about Cardiothoracic Surgery	

	JTD - Journal of Thoracic Disease	Academic Journal about Thoracic Disease	
	Nature	Academic Journal in science	
	Immuno-Oncology @Point of Care	Immuno-Oncology database	
	PubMed Mobile	Medical academic database	
	TUBİTAK	National Science association database	
	PulmCCM	pulmonary and critical care medicine referencing	
	Radiology assistant	References for radiology scans	
	UpToDate	Medical cases and guidelines	
	AO surgery reference	References and guidelines for surgery	
	XploreRNA	Database for transcriptome analysis	
Cases and guidelines	ESMO Cancer Guidelines	Guideline and practices in cancer treatment	14
Dictionary and terms definition	Medical Dictionary	Dictionary for medical terms and use	
	Eponyms	Medical eponyms database	10
	Information Management (# of apps reported:117)		
	Name	**Explanation**	**Frequency of use in the group (%)**
	E-book reader	Read medical books and references	31
	Google notes	Keep audio and text notes	28
	Evernote	Keep audio and text notes	21
	Photo App	Taking images for historical data notes	20
	Medical Education and Training (# of apps reported: 74)		
	Name	**Explanation**	**Frequency of use in the group (%)**
Common purpose medical education	Medscape	medical database covering daily medical news, major conference coverage, and drug information	62
	OrthoApp	Orthopeatic surgeon training	
	Vcell	Virtual cell animations	
	Anatronica	Anatomy training with 3D animations	
	CataractMobile	Cataract surgery simulation	
Visual training	Eyetube	Online surgical video archive	27
Public health training	Toraks	Public health training	
	MLP-CARE	Public health training	11
	Time Management (# of apps reported: 63)		
	Name	**Explanation**	**Frequency of use in the group (%)**
	Google Calendar	Managing appointments	68
	MHRS Mobil	Managing appointments	16
	Mobile Calendar	Default app for Managing appointments	16
	Health Record Maintenance and Access (# of apps reported: 50)		
	Name	**Explanation**	**Frequency of use in the group (%)**
	Enlil	Hospital Information Management Systems	52
	Meddata	Medical record database	16
	E-Nabız	Patient health record access and management	16

	PACS app	Monitoring radiology scans and diagnosis	8
	Acıbadem	Patient health record access and management	8
	Patient Monitoring (# of apps reported: 17)		
	Name	**Explanation**	**Frequency of use in the group (%)**
	Pedometer	Tracking steps and walking distance	24
	Calorie Counter	Tracking calories taken and burnt	24
	Cardiograph	Tracking heart rates	18
	Apple Health	Recording and tracking personal health information	18
	Instant Heart Rate	Tracking heart rates	12
	Fitwell	Recording and tracking personal health information	6

5.2.4. Descriptives

Normality of the data was tested by analyzing Shapiro-Wilk, Mean, Skewness and Kurtosis and standard deviation values. The normality analysis was tested in order to observe if the data is normally distributed and to decide the model testing method (Tabachnick & Fidell, 2012).

The mean values of constructs for m-health users were mostly around 3 with low standard deviation (between 0.4 and 0.9). For non- users, the mean values were lower but they also had low standard deviation (between 0.4 and 0.7). Negative Skewness and positive Kurtosis were mainly observed in the distribution of the mHealth users' data, and positive Skewness and positive Kurtosis were mainly observed in the distribution of the non-users' data. However, in both cases, the Skewness and kurtosis values of the constructs were within the acceptable level of +1.5 and -1.5 (Tabachnick & Fidell, 2012). In addition to that, due to small sample size, Shapiro-Wilk test was completed to test normality (Ghasemi & Zahediasl, 2012). It was observed that the data is not perfectly normally distributed for both cases ($p<0.05$) (Table 18, Table 19).

In addition to that, missing data analysis was completed in order to investigate the relationships among the missing values. No significant relationship was found, and list-wise deletion approach was used for handling missing data. Reliability analysis was completed to assess the internal consistency of the constructs. Cronbach's Alpha values of constructs were analyzed (Table 20, Table 21). For both groups, the constructs were found reliable with Alpha values greater than 0.70 (Steel, Torrie, & Dickey, 1997). In addition to that, the overall reliability of the constructs was found significantly reliable at 0.796 (mHealth users) and 0.825 (non-users).

As a result, descriptive statistics provided that data was moderately normally distributed, yet it was in acceptable limits. Thus, it was found eligible to test the data with further analysis in order to identify construct and item relations.

Table 18: mHealth users- Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis	Shapiro-Wilk
BI	137	2,33	5,00	4,2600	,51613	-,605	,910	0,000
EE	137	2,67	5,00	3,9416	,45696	-,026	,467	0,000
PE	137	3,00	5,00	4,1191	,40583	-,068	,695	0,000
MA	137	1,00	4,00	1,7591	,59440	,689	,841	0,000
MS	137	2,67	5,00	3,9295	,47900	-,073	-,045	0,000
PI	137	2,00	5,00	3,6349	,59647	-,073	-,170	0,000
HB	137	1,00	5,00	3,1752	,95408	,034	-1,068	0,000
SI	137	1,00	4,33	3,3186	,67873	-,752	,238	0,000
CO	137	2,67	5,00	3,7104	,52783	-,263	-,472	0,000
TT	137	1,00	4,33	2,6884	,66311	,509	-,012	0,000
RD	137	2,50	5,00	3,9635	,38651	-,455	1,229	0,000
PS	137	2,33	5,00	3,9126	,48688	-,796	1,137	0,000

Table 19: Non-users - Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis	Shapiro-Wilk
BI	122	1,33	5,00	2,9118	,72353	,632	,326	0,000
EE	122	2,00	5,00	2,9620	,45328	1,471	1,103	0,000
PE	122	1,33	5,00	3,5744	,56091	-,550	1,443	0,000
MA	122	1,00	5,00	2,3975	,71564	1,021	1,293	0,000
MS	122	2,33	5,00	3,1425	,50085	1,096	1,326	0,000
PI	122	1,33	5,00	3,0334	,78119	,265	-,552	0,001
HB	122	1,00	5,00	1,8730	,54379	1,003	1,277	0,000
SI	122	1,33	5,00	3,3612	,73587	-,784	,223	0,000
CO	122	1,00	5,00	3,0705	,56935	,258	,867	0,000
TT	122	1,00	5,00	2,5743	,66879	1,182	,669	0,000
RD	122	2,00	5,00	3,0533	,50127	,684	1,143	0,000
PS	122	1,67	5,00	3,1422	,56705	,610	1,125	0,000

Table 20: Item-Total Statistics of mHealth users

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
BI	38,1528	12,574	,585	,769
EE	38,4712	12,699	,636	,767
PE	38,2937	12,883	,664	,768
MA	40,6536	16,703	-,427	,856
MS	38,4833	12,346	,715	,759
PI	38,7779	12,209	,580	,767
HB	39,2376	10,131	,649	,759
SI	39,0942	12,478	,426	,783
CO	38,7024	12,211	,675	,760
TT	39,7244	13,092	,302	,796
RD	38,4493	13,396	,507	,779
PS	38,5002	13,141	,454	,780

Reliability Statistics	
Cronbach's Alpha	N of Items
,796	12

Table 21: Item-Total Statistics of non- users

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
BI	32,1844	15,529	,494	,811
EE	32,1342	15,971	,744	,797
PE	31,5218	16,479	,456	,814
MA	32,6987	18,622	-,043	,859
MS	31,9537	15,696	,737	,795
PI	32,0629	15,737	,407	,821
HB	33,2233	15,969	,600	,804
SI	31,7350	16,672	,276	,832
CO	32,0257	15,131	,771	,789
TT	32,5219	15,431	,570	,804
RD	32,0430	16,136	,617	,804
PS	31,9540	15,939	,577	,805

Reliability Statistics	
Cronbach's Alpha	N of Items
,825	12

5.2.5. Measurement Model

In this section, construct validity was tested by convergent validity and discriminant validity in order to provide evidence that expected relations were met and no unexpected relations have occurred. In that regard, the convergent validity was tested by following the procedure proposed by Fornell and Larcker (Fornell & Larcker, 1981). The procedure includes three analyses, which were item reliability, composite reliability and average variance extracted (AVE). At the first step, factor-loading values for each valid item were extracted in order to check item reliability. The item reliability (square of item-loading) values resulted above **0.4** meeting minimum requirements for the reliability provided in the literature (Hair, Black, Babib, Anderson, & Tatham, 2009). Following that, due to the conservative measurement of Cronbach's alpha for reliability testing in PLS, composite reliability is proposed as a replacement in the literature(Richard P Bagozzi & Yi, 2011; F. Hair Jr et al., 2014). According to Nunnally & Bernstein (1994), composite reliability values were expected to be above **0.60**, and all constructs met the requirement of composite reliability with the values above 0.730. At the third analysis for convergent validity, AVE values were extracted, and AVE was expected to be equal to or more than **0.50** for each construct (Segars, 1997). The test results demonstrated that AVE values of constructs met the requirements with above 0.535 and 0.529 for each case. The model met the requirements for convergent validity for both groups as given in Table 22 and Table 24. In this part, SI3 and TT2 were removed from m-health users due to low item loadings (SI3=0.210, TT2=0.231).

On the other side, discriminant validity provides evidence of relations by indicating divergence within constructs (Tabachnick & Fidell, 2012). It is extracted by comparing square roots of AVE values and correlation degrees of all constructs. According to the literature, the square root of AVE value is expected to be greater than all correlation values of constructs in order to meet the discriminant validity (Hair et al., 2009). In other words, if the correlation value is greater than the square root of AVE value for

the corresponding construct, it is highly correlated with another construct(s) rather than the relevant items. In the study, the correlation matrix table was created using square roots of AVE values in the diagonal path. The table presents that square root of AVE values of constructs are greater than correlation values, which means the discriminant validity met for the both dataset (Table 23 and Table 25).

Table 22: Item reliability, composite reliability and AVE values of mHealth users

mHealth users- Constructs	**Items**	**Item loadings**	**Item reliability**	**Composite reliability**	**AVE**
BI	BI1	0,743	0,552	0,858	0,670
	BI2	0,838	0,701		
	BI3	0,869	0,755		
CO	CO1	0,775	0,601	0,823	0,609
	CO2	0,702	0,493		
	CO3	0,856	0,733		
EE	EE1	0,834	0,696	0,811	0,590
	EE2	0,739	0,546		
	EE3	0,726	0,527		
HB	HB1	0,929	0,862	0,919	0,850
	HB3	0,915	0,838		
MA	MA1	0,679	0,462	0,730	0,578
	MA3	0,833	0,693		
MS	MS1	0,808	0,654	0,810	0,587
	MS2	0,733	0,538		
	MS3	0,755	0,571		
PE	PE1	0,738	0,544	0,775	0,535
	PE2	0,677	0,458		
	PE3	0,776	0,602		
PI	PI1	0,802	0,643	0,860	0,673
	PI2	0,808	0,652		
	PI3	0,851	0,724		
PS	PS1	0,820	0,672	0,820	0,607
	PS2	0,637	0,405		
	PS3	0,862	0,743		
RD	RD1	0,786	0,617	0,810	0,681
	RD2	0,864	0,746		
SI	SI1	0,923	0,852	0,903	0,824
	SI2	0,892	0,796		
TT	TT1	0,725	0,526	0,830	0,713
	TT3	0,949	0,900		

Table 23: Discriminant validity of mHealth users

	BI	CO	EE	HB	MA	MS	PE	PI	PS	RD	SI	TT
BI	**0,818**											
CO	0,447	**0,780**										
EE	0,563	0,528	**0,768**									
HB	0,543	0,621	0,535	**0,922**								
MA	-0,538	-0,256	-0,349	-0,422	**0,760**							
MS	0,566	0,600	0,653	0,546	-0,375	**0,766**						
PE	0,667	0,622	0,577	0,602	-0,483	0,562	**0,731**					
PI	0,529	0,478	0,504	0,596	-0,367	0,588	0,540	**0,820**				
PS	0,441	0,349	0,459	0,339	-0,335	0,463	0,354	0,229	**0,779**			
RD	0,450	0,453	0,405	0,333	-0,254	0,470	0,494	0,337	0,516	**0,825**		
SI	0,221	0,227	0,205	0,248	-0,172	0,223	0,160	0,020	0,365	0,214	**0,908**	
TT	0,027	0,166	0,129	0,207	0,260	0,231	0,093	0,167	0,126	0,054	0,277	**0,844**

Table 24: Item reliability, composite reliability and AVE values of non- users

Non-mHealth users- Constructs	**Items**	**Item loadings**	**Item reliability**	**Composite reliability**	AVE
BI	**BI1**	0,705	0,498	0,876	0,705
	BI2	0,908	0,824		
	BI3	0,890	0,793		
CO	**CO1**	0,828	0,686	0,893	0,736
	CO2	0,871	0,759		
	CO3	0,874	0,764		
EE	**EE1**	0,677	0,458	0,770	0,529
	EE2	0,806	0,650		
	EE3	0,693	0,480		
HB	**HB1**	0,897	0,805	0,859	0,753
	HB3	0,837	0,700		
MA	**MA1**	0,911	0,831	0,854	0,746
	MA3	0,814	0,662		
MS	**MS1**	0,763	0,582	0,806	0,584
	MS2	0,857	0,735		
	MS3	0,659	0,434		
PE	**PE1**	0,825	0,680	0,836	0,630
	PE2	0,807	0,652		
	PE3	0,747	0,558		
PI	**PI1**	0,849	0,720	0,858	0,669

	PI2	0,769	0,592		
	PI3	0,833	0,694		
PS	**PS1**	0,779	0,606	0,781	0,543
	PS2	0,681	0,464		
	PS3	0,748	0,560		
RD	**RD1**	0,806	0,649	0,776	0,634
	RD2	0,787	0,619		
SI	**SI1**	0,908	0,825	0,842	0,643
	SI2	0,783	0,613		
	SI3	0,700	0,490		
TT	**TT1**	0,818	0,670	0,868	0,686
	TT2	0,824	0,679		
	TT3	0,842	0,708		

Table 25: Discriminant validity of non-users

	BI	**CO**	**EE**	**HB**	**MA**	**MS**	**PE**	**PI**	**PS**	**RD**	**SI**	**TT**
BI	**0,840**											
CO	0,493	**0,858**										
EE	0,528	0,666	**0,728**									
HB	0,284	0,568	0,522	**0,868**								
MA	-0,187	0,009	-0,060	0,217	**0,864**							
MS	0,562	0,636	0,689	0,387	-0,101	**0,764**						
PE	0,347	0,512	0,472	0,306	-0,202	0,425	**0,794**					
PI	0,280	0,365	0,451	0,297	0,037	0,570	0,117	**0,818**				
PS	0,616	0,474	0,475	0,284	-0,119	0,636	0,311	0,397	**0,737**			
RD	0,367	0,554	0,635	0,394	0,117	0,596	0,283	0,277	0,403	**0,796**		
SI	0,095	0,345	0,170	0,206	0,025	0,145	0,435	-0,056	0,213	0,051	**0,802**	
TT	0,188	0,546	0,509	0,569	0,070	0,440	0,260	0,349	0,288	0,480	0,235	**0,828**

Here, it should be noted that a goodness-of-fit measure for PLS-SEM commonly omitted due to its measure is unsuitable for identifying latent impact of the models, and measures of the model's predictive capabilities are found more profound to assess model quality (F. Hair Jr et al., 2014)

5.2.6. Structural Model

In this study, reflective measurement scale (arrows pointing away) was employed during the PLS testing of the model due to having highly correlated and interchangeable items for each variable.(Hair et al., 2009; Petter, Straub, & Rai, 2007). After model definition, PLS algorithm was run with maximum iteration set to 300. For a stable estimation, we expect algorithm to converge before reaching the maximum number of iterations. In our study, the converged iterations are under the maximum value 300 by 9 and 8 respectively. Thus, our estimations remained in good scale

(Wong, 2013). In addition to that, bootstrapping was applied with 5000 resampling. Bootstrap provides an approximate estimation for the normality of the data. The bootstrapping method was "bias corrected and accelerated" and "complete bootstrapping" with "individual changes" and two tailed test type was at "0.05" significance level. The results of PLS test (path coefficients) and bootstrapping (t statistics) were given in the table with significance levels. Here, path coefficients were expected to be larger than 0.1, and t values were expected to be larger than 1.96 at $p<0.05$ (F. Hair Jr et al., 2014; Wong, 2013). In addition to that, the table presents multicollinearity results (exogenous variables were checked in the inner model), and multicollinearity was found within the acceptable interval with variance inflation factor (VIF) under 5.0 (Grewal, Cote, & Baumgartner, 2004). As a result, as given in the status column of the Table 26 and Table 27, 9 hypotheses were approved for m-health and 10 hypotheses were approved for non-m-health model.

According to test results, for mobile health application users, mobile anxiety ($\beta= -0.160$, $p < 0.05$, $f^2= 0.03$), performance expectancy ($\beta=0.359$, $p < 0.001$, $f^2=0.13$), personal innovativeness ($\beta=0.139$, $p < 0.05$, $f^2=0.02$) and perceived service availability ($\beta=0.120$, $p < 0.05$, $f^2=0.02$) had a significant influence on behavioral intention. In addition to that, compatibility ($\beta=0.383$, $p < 0.001$), personal innovativeness ($\beta=0.284$, $p < 0.001$) and result demonstrability ($\beta=0.196$, $p < 0.05$) had significant influence on performance expectancy. Mobile self-efficacy and perceived service availability had influence on effort expectancy ($\beta=0.365$, $p < 0.001$ and $\beta=0.175$, $p < 0.05$). However, compatibility, effort expectancy, habit, mobile self-efficacy, social influence and technical support and training were found to have no influence behavioral intention. In addition to that, the remaining hypotheses were not supported due to insignificant relations. In the bottom line, the determinants of behavioral intention (MA, PE, PI and PS) accounted for 59% of total variance explained for intention to use mobile health applications. In addition to that, determinants of effort expectancy explained 51% of variance, and the determinants of performance expectancy explained 51% of variance (Table 26 and Figure 16).

For non-users, effort expectancy ($\beta=0.215$, $p < 0.05$, $f^2=0.04$), mobile anxiety ($\beta= -0.105$, $p < 0.05$, $f^2=0.02$), perceived service availability ($\beta=0.409$, $p < 0.001$, $f^2=0.2$) and technical support and training ($\beta=-0.182$, $p < 0.05$, $f^2=0.04$) had a significant influence on behavioral intention. In addition to that, compatibility had influence on effort expectancy ($\beta=0.204$, $p < 0.05$) and performance expectancy ($\beta=0.504$, $p < 0.001$). Moreover, habit ($\beta=0.183$, $p < 0.05$), mobile anxiety ($\beta=-0.115$, $p < 0.05$), mobile self-efficacy ($\beta=0.242$, $p < 0.05$), and result demonstrability ($\beta=0.280$, $p < 0.05$) had significant influence on effort expectancy. However, compatibility, habit, mobile self-efficacy, performance expectancy, perceived innovativeness and social influence were found to have no influence behavioral intention. In addition to that, the remaining hypotheses were not supported due to insignificant relations. In the bottom line, the determinants of behavioral intention (EE, MA, PS and TT) accounted for 51% of total variance explained for intention to use mobile health applications. In addition

to that, determinants of effort expectancy explained 61% of variance, and the determinants of performance expectancy explained 28% of variance (Table 27 and Figure 17**)**. Moderating effects were also investigated by observing total effects in bootstrapping, and no significant effect was found.

Table 26: mHealth users- Hypotheses testing

Hypotheses	**Path Coefficients**	**T Statistics**	***p*-Values**	**VIF**	**Status**
PE -> BI	0,359**	4,072	0,000	2,334	Supported
PS->BI	0,120*	1,997	0,045	1,531	
MA -> BI	-0,160*	2,001	0,046	1,872	
PI->BI	0,139*	1,996	0,047	2,051	
CO -> PE	0,383**	4,536	0,000	1,521	
PI->PE	0,284**	3,548	0,000	1,344	
RD->PE	0,196*	2,457	0,014	1,585	
MS -> EE	0,365**	3,348	0,001	2,301	
PS->EE	0,175*	2,007	0,041	1,613	
CO -> BI	-0,105	1,267	0,205	2,253	Not supported
CO -> EE	0,103	1,347	0,178	2,061	
EE -> BI	0,106	1,475	0,140	2,139	
HB -> BI	0,077	0,905	0,366	2,360	
HB -> EE	0,146	1,505	0,132	2,278	
MA -> EE	-0,011	0,202	0,840	1,678	
MS -> BI	0,118	1,411	0,159	2,547	
PI->EE	0,112	1,481	0,139	1,912	
PS->PE	0,059	1,076	0,282	1,412	
RD->EE	0,009	0,176	0,860	1,611	
SI -> BI	0,063	1,432	0,153	1,357	
TT->BI	-0,06	1,204	0,229	1,463	
TT->EE	-0,041	0,643	0,520	1,340	
TT->PE	-0,036	0,741	0,459	1,050	

**p < 0.05, **p< 0.001*

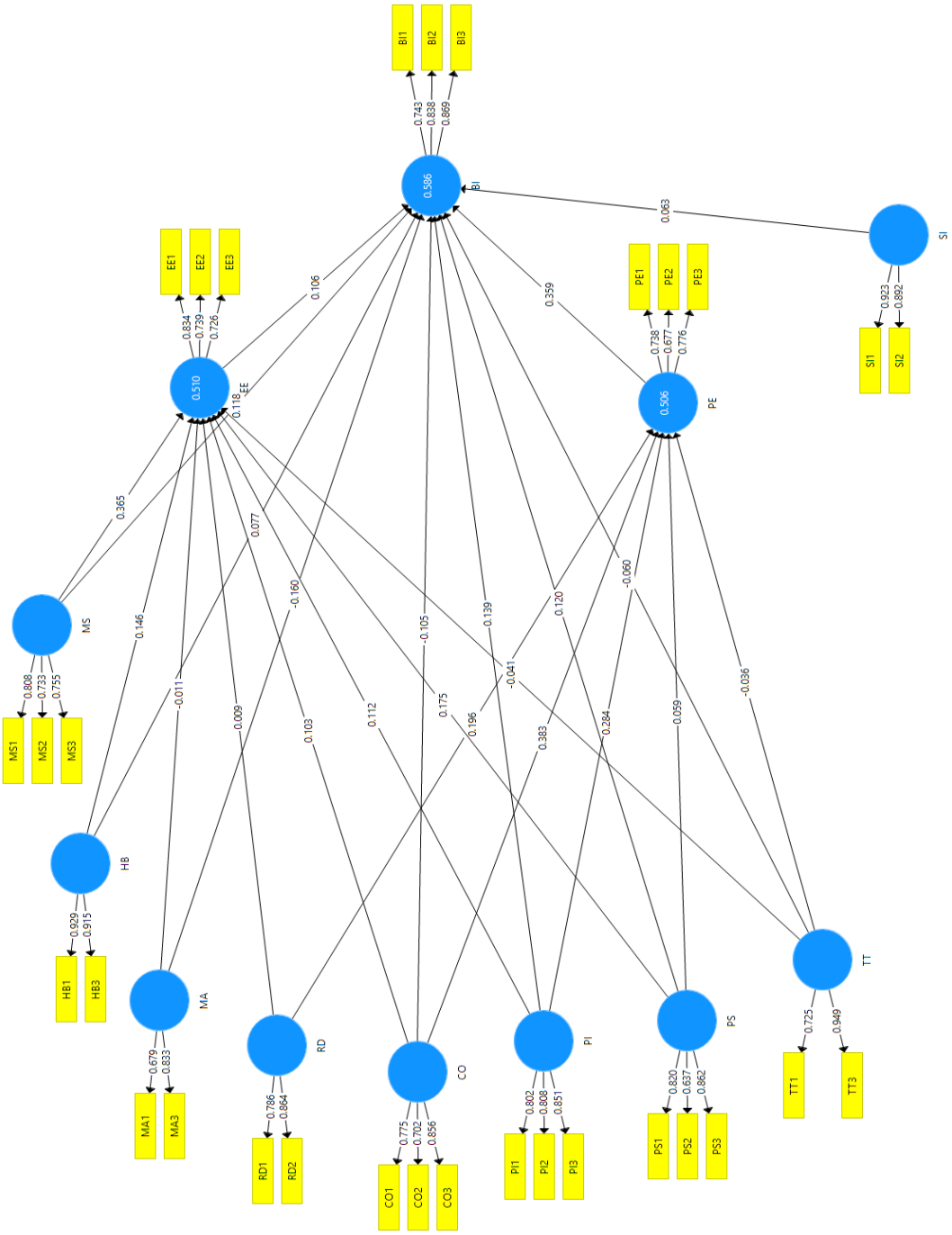


Figure 16: mHealth users – Path analysis

Table 27: Non- users- Hypotheses testing

Hypotheses	Path Coefficients	t-Statistics	p values	VIF	Status
PS->BI	0,409**	4,058	0,000	1,769	Supported
EE -> BI	0,215*	2,191	0,048	2,591	
MA -> BI	-0,105*	1,973	0,049	1,195	
TT->BI	-0,182*	1,993	0,049	1,775	
CO -> PE	0,504**	3,775	0,000	1,891	
RD->EE	0,280*	2,556	0,011	1,886	
MS -> EE	0,242*	2,197	0,028	3,113	
CO -> EE	0,204*	2,18	0,029	2,316	
HB -> EE	0,183*	2,114	0,035	1,836	
MA -> EE	-0,115*	1,99	0,044	1,164	
CO -> BI	0,189	1,445	0,148	2,666	Not Supported
HB -> BI	0,061	0,864	0,388	1,927	
MS -> BI	0,129	1,257	0,209	3,108	
PE -> BI	0,025	0,39	0,697	1,776	
PI->BI	-0,081	1,123	0,261	1,635	
SI -> BI	-0,095	1,097	0,273	1,404	
PI->EE	0,104	1,343	0,179	1,58	
PI->PE	-0,11	1,368	0,171	1,292	
PS->EE	-0,002	0,046	0,963	1,729	
PS->PE	0,123	1,412	0,158	1,442	
RD->PE	-0,013	0,146	0,884	1,599	
TT->EE	0,026	0,425	0,671	1,800	
TT->PE	-0,007	0,097	0,923	1,577	

**p < 0.05, **p< 0.001*

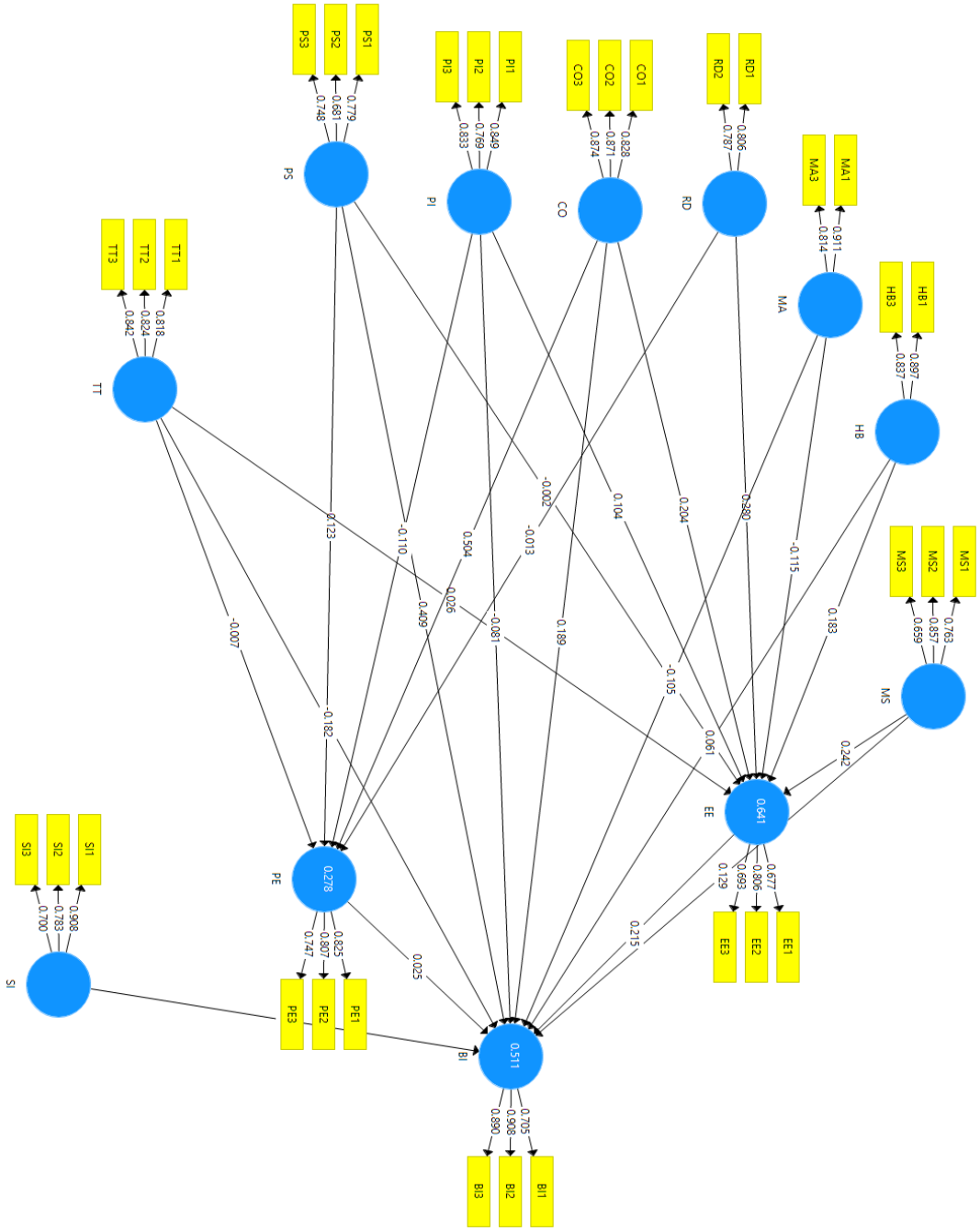


Figure 17: Non- users – Path analysis

5.3.Findings of Qualitative Study

Findings of the qualitative study were presented in the following sections, including characteristics of focus groups and results.

5.3.1. Characteristics of focus group informants

Table 28 presented the characteristics of focus groups. The informants were from 2 different hospitals in Kocaeli, Turkey. They have different characteristics in terms of gender, age, specialty, experience in mobile device use and experience in their jobs.

Table 28: Focus groups' characteristics

	Focus Group 1			**Focus Group 2**			
Identifier	FG1.a	FG1.b	FG1.c	FG2.a	FG2.b	FG2.c	FG2.d
Gender	Male	Male	Female	Female	Female	Female	Male
Age	39	29	33	28	31	35	40
Specialty	Cardiology		Pulmonology	Gynecology		Anesthesiology	Urology
Experience in mobile device use (years)	10	7	3	5	4	8	2
Experience in job (years)	15	4	7	4	8	12	18
Institution	Kocaeli State Hospital			Kocaeli University Research and Application Hospital			
Interview duration	57 minutes			52 minutes			

5.3.2. Results

After two focus group interviews, rich data was obtained and researchers agreed that the saturation of data was reached based on similarity and repetitiveness in information. During the analysis of the interviews, coding was completed and the codes were categorized under themes of the study (Table 29). Themes were classified as enablers, barriers and enablers and barriers. Codes were grouped as personal and organizational in order to differentiate external categories and personal categories. Codes covered sub-codes, which are identified items influencing actual use of mobile health applications. In addition to that, memos were added to each sub-codes. Furthermore, Contextual analysis was used to investigate external or environmental input.

Table 29: Themes and codes of focus group interviews

Themes	Codes	Sub-codes	Count	% Codes
Enablers	Personal enablers	Leisure time	4	3,1%
		Education	6	4,6%
		Information gathering	17	13%
		Communication	2	1,5%
		Social sharing	5	3,8%
		Ease of use	4	3,1%
		Interest in new technologies	6	4,6%
		Accessibility	8	6,2%
		Urgency	16	12,3%
		Expectations	9	6,9%
	Organizational enablers	Compatibility	2	1,6%
		Assistance	2	1,5%
		Performance	11	8,5%
Barriers	Personal barriers	Software problems	5	3,9%
		Lack of knowledge and interest	7	5,4%
		Anxiety	4	3,1%
	Organizational barriers	Lack of investment	11	8,5%
		Lack of control	6	4,6%
Enablers and barriers		Habits	5	3,8%

Key elements for qualitative evaluation were checked during the analysis. Table 30 provided the details about the actions to fulfill validation of key elements.

Table 30: Key elements in qualitative data evaluation and actions

Key elements	Actions
Dependability	The codes and themes were overviewed by an independent researcher
Credibility	Triangulation was used including observational notes, memos and contextual analysis.
Confirmability	The transcription and the findings were shared with two of the participants (from FG1 and FG2) and feedback requested.
Transferability	Observations about environmental settings, characteristics and findings were used

Observations

Based on observational notes, the working environment of both hospitals (FG1 and FG2) was busy for the most of the time of a day. Number of daily visiting patients, returning patients and on-site patients were high. Thus, the physicians had to fulfil their duties in a limited time, and the hospital management expect them to work at their maximum while providing healthcare services. Both hospitals were located close to the city center. The technical infrastructure of hospitals was sufficient to maintain healthcare services for number of branches. The technology was based on mostly non-mobile equipment, such as desktop PCs, X-ray devices and operational technologies. There are limited number of mobile equipment, such as mobile ECG and ultrasound devices, but they are available for particular healthcare services. Internet was actively used for communication among Ministry of Health, hospital management, nurses and

physicians. The health records were sent to Ministry of Health, and e-mail and SMS were used as the main communication medium. There is a social connection among physicians and nurses within the clinics. They have an open communication channel since their services are vitally important as healthcare delivery. However, mental and physical exhaustion of physicians was observed during the interviews. Since patient number per physician is high, their work conditions can be considered as heavy that requires full concentration.

During the interviews, the researcher act as the moderator, and he tried to maintain the interviews ensuring highly participation from each physician, following the guidelines (Table 7) In the focus groups, there have been dominant characteristics as well as suppressed or recessive. Their participation into the conversations were encouraged during the interviews.

Enablers

Regarding to personal enablers, "information gathering", "Urgency", "accessibility" and "expectations" stand out as the most influential personal enablers in the study. For information gathering, the participants' interest was focused on reaching to the information time and location independent, mostly during the patient visiting hours. In that regard, they mostly use medical calculators to assess patients' critical health values.

> ***"… because the clinic is busy, you can quickly enter values…it returns the numbers. I save much time…" - FG1.b***
>
> *"...poliklinik yoğun olduğundan, mesela hemen giriyorsun değerleri, sonuç rakam veriyor. Zamandan kazandırıyor sana..."*
>
> ***"… I enter the weight of the patient, age, gender and the creatine value which I retrieve from blood analysis. After that the app quickly brings the results about light or medium level renal failure… thus, we keep away from certain medicines or reduce the dosage…" –FG1.c***
>
> *"...Kilo giriyorsun, kreatinini giriyosun, onu kandan bakıyorsun. Bir de bayan olup olmadığını giriyorsun ve de yaşı. Bunları giriyorsun hemen önüne işte hafif , orta böbrek yetmezliği gibi sonuç getiriyor... bazı ilaçları vermiyoruz yada düşük doz veriyoruz..."*

Urgency stand for the practical needs of physicians based on the necessity of duties. In that regard, behaviors of physicians' bypass application dependency but the fulfilment of needs. The mobile applications were practical mediums which help to physicians to reach necessary information. In the current state, they are informally used and based on personal initiatives. However, when there is no appropriate application for the necessary information or if there is no time to search for an application, physicians prefer to use web browser and web search tools to reach information.

> ***"… there is the website kardiyolit.com, it is very useful… it is providing abstracts in 8-9 pages, providing a summary… I can reach the studies quickly in a condense form…" –FG2.b***

"…kardiyolit.com var mesela o site çok güzel bir site… mesela sekiz dokuz sayfa … abstract'larını veriyor. özet geçiyor… orada çok daha kısa çok daha öz çalışmalara hızlıca erişiyorsun…"

"There is Medscape… Pubmed is the mostly used website… there is up-to-date…journal of medicine… American journal JAMA, Lancet…JAC cardiology journal. England Journal of medicine as medical journal…" - FG1.c

"Medscape… Pubmed zaten en temel en çok kullanılan … uptodate var …journal of medicine var, amerikan şeyi var, JAMA, Lancet var … JAC kardiyoloji dergisi. England journal of medicine tıp dergisi…"

Accessibility is an important category in reaching information via mobile platform. In that regard, websites close the gap of mobile application in fulfilling information needs. It also effects the job performance. Thus, if the information is accessible, it is valuable during the working hours. In that case, either a specific application or a shortcut to a specific website were useful for the physicians.

"Our patient examination notes and information are on the computers. There is this software, UV, they are stored in it. I think we should be able to access this information via our smart phones or tablet PCs…"-FG2.d

"Bizim mesela hasta tetkiklerimiz, herşey bilgisayar ortamında. İşte UV diye bir yazılım var onda. Cep telefonlarımız yada tabletlerden, biz bilgilere hasta başında vizit yaparken ulaşabilmeliyiz…"

"…I put some shortcuts of couple of medicines about renal failure on the mobile desktop. I downloaded it in the recent times… in the chaos environment during the work it is hard to reach the appropriate prospectus of medicine…but there is this shortcut, I tap and reach it. I do not use it frequently but I did download for fast reach…" –FG1.c

"…bir iki ilacın böyle böbrek yetersizliğine nasıl verilir diye aplikasyon gibi internet sayfasını masaüstünde duruyor mesela… Bir dönem indirmişim. Çünkü o karmaşa içinde ilacın uygun prospektüsünü bulacağım falan zor, ama orda kısayol var basıyorsun geliyor. Çok sık kullandığım yok ama öyle bir kısayol oluşturumuştum biraz hızlı göreyim diye…"

"Some is hard to find in the books. I mean you have to open the book and spend time to find it, pick out of many. Instead, I type on Google, it already says 'did you mean that' if I even type wrong. Thus, it is more accessible…" –FG2.c

"… kitapta bulmak çok daha zor yani kitabı alacaksın bulacaksın içinden ondan seçeceksin. Google'a yazıyorsun 'bunu mu demek istediniz'e kadar sonuçları döndürüyor. O yüzden daha rahat oluyor…"

The needs would also lead to seek for personal solutions in mobile platform. One of the physicians (FG2.d) reported that, for the current need in practicing patient visiting,

she attempted to build a personal mobile application to be used for her specific requirements.

> ***"Once I tried to create my own application. I searched on the web to learn how to do it and subscribed to a website. But I had no time to work on it in late night… I was going to do a form-like interface…it was about keeping records" – FG2.d***
>
> *"İşte ben bir tane uygulamayı kendim yapabilirmiyim diye baktım, internette uygulama nasıl yapılır diye böyle şeyler vardı ve üye oldum. Ama böyle çok geç saatlerde uğraşacak vaktim olmadı… Form şeklinde bir şey mi yapacaktım…kayıt tutma üzerine birşeydi"*

Expectations were the visions of physicians about the future of mobile health applications and their opinions toward the current state of mobile health application use. First of all, there is a common opinion about the need of mobile health applications in specific healthcare branches. The expectation is the increase in mobile health applications which would assist in diagnostic processes.

> ***"I believe if there are more options in mobile health applications, more would dare to use them. Applications are so practical. Instead of searching websites and picking among most of search results, using application would be practical. It would be nice to have more"- FG2.b***
>
> *"Bence olsa yani daha çok olsa herkes kullanır. Uygulama çok pratik bir şey. İnternet sitesindense bir sürü şey arasından bulmaktansa uygulama kullanmak çok pratik bir şey. Olsa çok güzel olurdu."*

Some physicians have conceptualized their expectations from a mHealth application. They expect the current applications to be more branch-specific.

> ***"… maybe an application could be designed for cardiology. Uploading patient's ECG and scanning the image and sending with better resolutions. Probably it would be good for cardiologists and internal disease doctors, but it would work. Maybe it includes some other functionalities that I cannot think of right now…"-FG1.b***
>
> *"... için bir kardiyoloji sistemi programı yapılabilir mesela. Hastanın EKG'sini çekip o program ile EKG'yi scan edip daha güzel bir görüntü kalitesiyle gönderebilecek bir şey sunsa. ama sadece kardiyologların veya dahiliyecilerin işine yarayacak birşey olurdu. ama öyle bir program olabilir. Belki farklı özellikler de yüklenir o programa. Onu bilemeyeceğim tabi..."*

Furthermore, their expectations were based on their trust on the current applications. All the participants stated that they are trusting these informally distributed applications available in application stores on their mobile phone. Since the applications provide "refreshing" knowledge as well as simple mathematical solutions, physicians trust the information and validate the results by self-calculating or based on consensus.

"…I re-calculated some of the results that I received from mobile application and I see that they are the same. After that, I use the application my routine…"- FG1.a

"…uygulama sonuçlarının birkaç tanesi mesela elinle hesaplıyorsun, diyelim bakıyorsun applikasyonla aynı. Ondan sonra rutinde applikasyonu kullanabiliyorsun…"

"The guidelines of applications are from the international workbooks, scorings and exist in our medical guidelines... there are some testing institutions which checks the validity…" –FG1.c

"Onlar uluslararası klavuzlara bizim tedavi klavuzlarına girmiş şeyler, skorlamalar… bazı test kuruluşları var onların testlerinden geçiyor tabi…"

However, there were also an expectation for government auditing over the applications.

"…I suppose it would be better if the government could audit the information or application being used. But of-course it is only expectation… there are lots of information in the web but auditing is missing…"

"...şöyle olabilir hani kullanılan bilginin yada o aplikasyonun devlet tarafından denetlenmesi. Ama tabi bu bizde çok şey olmaz belki de... Internette artık herşey olduğu için hani herşey var ama denetlenmiyor"

In gynecology, physicians stated that mobile platform will gain vital importance in practicing.

"Sometimes I think if the case is problematic or cases can be unclear. At that time, for instance, if I had an application to capture the case and share with other physicians. At that time, I can have help in vital diagnostic process. At least, we have a consensus upon a case…" -FG2.a

"Bazen böyle ya bu sıkıntılı mı değil mi, bundan bir şey olur mu olmaz mı durumuna geliyorsun. Atıyorum bir aplikasyon olsa fotoğrafını çeksen ve karşı taraf değerlendirse, ona göre hayati önem taşıyacak kararlar verirsin yani. En azından ortak bir konsensus olur onun üzerinden gidilir…"

In addition to that, as personal enabler, mHealth applications attract physicians less for leisure times. Physicians reported that they spend less than half an hour daily using mHealth applications. In that regard, games with medical content does not attract physicians either. However, when they use mobile health applications for leisure time, physicians prefer to check literature or read the latest medical developments.

"… for instance, application of a journal or a guideline is a different subject. They are useful to read at my spare time, or to reach to the information when I wonder about…" -FG1.a

"...mesela bir derginin, bir klavuzun uygulaması ayrı birşey. Onun olması senin boş zamanında açıp bakman veya birşeyi merak ettiğinde kolay ulaşabilmen için faydalı..."

"… when I rest a while I open up an article. I spend some time reading it. Mostly I read and browse if I find an interesting topic. If I wonder about a subject, I spare some time for it. It is practical from my smart phone…" – FG2.b

"...iki dakika oturduğumda makale bir şey açarım. Baya vakit geçiririm öyle. Okuyorum bakıyorum güzel bir konu olduğunda. Neydi bu bir bakayım beş dakika diyorum mesela. Telefonumdan çok pratik geliyor..."

Education content was observed to be effective for the new generation physicians. There was a consensus about that new physicians are more compatible in using applications and there is a higher rate of use mHealth applications amongst them, especially in education, such as simulations.

"…previously in our times, there was picture handouts from the machines. Then, CDs came out, we all used them. We use CDs to work on cases from computers. Now things get better, there is no CD, people are using smartphones and internet to reach to the content easily…" – FG1.c

"… biz ilk başta fotoğraf veriliyordu, makina fotoğrafı. Sonra CD ler çıktı, ben de dahil CD leri alıyorduk. CDyi koyuyorduk çalışıyorduk bilgisayar başında. Şimdi artık iyice kolaylaştı işler. CD yok telefondan, internetten çok rahat elde ediyorlar…"

Participants have been only using educational content for spare time activities, such as learning about cases and diagnosis. For educational purpose, there are sources like Medscape and Figure1, but Pubmed is widely used.

"There is this website, Figure1. I downloaded it as application. It has the cases. They put photos and short clinic information about each case. Then it asks about pre-diagnosis. There are contents about dermatology, ECGs for brain surgery, and different cases for cardiology and gynecology." – FG1.d

"Figure1 diye bir site var. İşte onu aplikasyon olarak indiriyorsun. Olgular var mesela. Fotoğraf koymuş altına da klinik değerleri vermiş iki üç kelimelik. İşte ön tanınız nedir diye sormuş. Onda mesela işte dermatoloji için var, beyin cerrahisi için EKG ler var. Kardiyoloji için kadın doğum için ayrı vakalar var."

Communication may have resulted as one of the less coded category in the coding stage, however it is one of the most influential category in using mobile health. However, the application being used for healthcare purposes was not an application created for mobile health. It is a common messaging tool (Whatsapp), and it is frequently used among the physicians for informal, but vital, communications. Physicians asks each other about their current cases, or to contact with the authorized physicians. They share image and videos about the cases and try to reach a consensus.

The graphical resolution does not create any problem, especially for charts like ECG reports.

> ***"…we use whatsapp, the image quality is quite good. The images give you the feeling of looking at the real paper report…" –FG1.d***

> *"...whatsapp'tan gönderiyoruz, yani görüntü kalitesi falan çok iyi. Normal kağıda bakar kalitesinde görüntüler gönderilebiliyor..."*

> ***"…we also record and share videos. They return their opinions about the case but the symptoms might not be followed from ECG visuals. Thus, in monitoring arrhythmia can be identified…" –FG1.b***

> *"Görüntüde video da kullanılabiliyor, videoya çekip gönderiyoruz, evet böylemiş diyorlar ama onu EKG görüntüsünde yakalayamıyorlar. Monitör takibinde ama arada ritim bozukluğu gözlenebiliyor..."*

> ***"… for instance, it is a simple example but, arrhythmia occurred and ended. Let's say at that moment I do not have paper to insert to the machine in order to receive output. At that moment I can use my smartphone to capture video, at least to catch the core frames…" –FG1.d***

> *"...mesela basit birşey ama monitörde diyelim ki ritim bozukluğu oldu bitti. Sen o sırada mesela kağıt yok kağıdı bulayım makineye takayım diyene kadar zaten bulamıyorsun kağıdı örneğin. hemen telefonu çıkarıp videosunu çeksen en azından o temel görüntüyü yakalamış oluyorsun..."*

> ***"I have used it in emergency a lot. I have been sending visual message for apoplexy, because the surgeon will respond to the case accordingly. If I use visual content it would help them to decide on their hospital visits because brain surgeons were reluctant to visit …" –FG2.b***

> *"… ben acilde çok kullanıyordum işte… beyin kanaması için yolluyordum. Ona göre gelecek doktor evden çünkü. Fotoğraf çekip ıspatlarsan adam rahat çıkıp geliyordu yani. Beyin cerrahı kolay gelmiyor…"*

Social impact of mobile health applications was at the individual level. Thus social sharing is low. Physicians seek for mHealth applications online, from application stores. They rarely contact to a friend to talk about applications.

> ***"…I mostly check from the web…personally search from app stores. That applies for not only mHealth applications but all applications I search for…" –FG1.a***

> *"…Ben internetten bakarım hani… kendim araştırırım app store'dan. Yani sadece onunla ilgili değil, başka birşey de eğer araştırıyorsam kendim bakarım önce ne var ne yok diyerek…"*

> ***"…before I install an application, I check the comments and rates. I prefer the highest rated and free applications..." –FG2.c***

"…onları yüklerken hani yorumlara bir bakıyorum. En çok yüklenenler hangileri onlara bakıyorum. Ücretsiz olup olmaması önemli …En çok yıldız alanlar bir de…"

However, if they cannot find a particular application, they demonstrate their willingness to ask for help from their colleagues.

"…in such circumstances, if we are having a conversation and one of us tell that 'there is an A application did you hear that?', then we may talk about it… but I personally search for very specific applications…" –FG1.a

"…E tabi şöyle olabilir, sohbet ortamında biri atıyorum der ki bak ya A programı varmış hiç duydun mu diye bak işte öyle olur…. Böyle çok spesifik bir şeyi zaten kendin araştırırsın"

But in visiting hours, desktop PC or mobile devices were reported to be more suitable for searching.

"… when I am with a patient in my desk, I am able to check from the computer since it is turned to me…at that moment I cannot say to the patient 'please wait I need to ask to a friend about an app', it would be inappropriate… "–FG2.b

"… hastaya bakarken de bilgisayar başında olduğun için, ekran sana dönük, hasta görmediği için istediğine bakma şansın var. Dur bir dakika ben bir kalkayım sorayım dediğin zaman hasta huylanıyor yani..."

Ease of use of an application is important during completing routine tasks. It is important for work performance while physicians have tight schedule, they need simple applications as well as communication tools (exp. Whatsapp). For challenging applications, physicians have tendency to prefer substitute applications which is relatively easy.

"…Our work based on-call services. Our superiors are standby doctors, and we keep night watch. Under uncertain conditions, we can ask for their help…sometimes I do not understand what I saw from an ultrasound result. In order to resolve this issue, I record two or three short videos and send them to the standby doctor for their help. It is so convenient for me, and by this way, standby doctor can understand the condition better…" –FG2.a

"…bizde icap sistemi var. Uzmanlarımız icapçı, biz nöbet tutuyoruz. Hani sıkıştığımız anda onlara danışıyoruz…bazen kendim ne gördüğümü anlamıyorum ultrasonda. Yani onu ona belirtmem için en güzel yöntem iki -üç video çekip yollamak oluyor. Benim için daha rahat oluyor. Karşı taraf ise ne ile karşılaştığımı alnlıyor..."

The physicians' interest in new technologies was observed as the trigger in using mHealth applications. No resistance towards mHealth as well as new technologies was observed. Almost every physician has a smart phone, and they have interest in new technologies as well.

"…more or less everyone is using smart phones around us… of-course when people have smart phone they use applications too…everyone has applications on their phone being used …" –FG1.a

"…etrafımızda az çok herkes kullanıyor akıllı telefon…tabi akıllı telefonu olan aplikasyon özelliğini de kullanır…herkezin ufak tefek birşeyleri (applikasyonları) var telefonunda illaki …"

Aside from personal enablers, organizational enablers were the categories that involves health institutions inclusion in the process of mHealth application use. These categories were identified as compatibility, assistance and performance. Compatibility is about mHealth being consistent with the existing practices and systems. However, the interviews revealed that there is a lack of compatibility among the mHealth applications and the existing hospital system, which indirectly effect the performance of healthcare providers. Even though, mHealth applications assist in physicians' current practice, physicians reported the need for compatible mHealth applications.

"We make NST (No-Stress Test) tests. Like ECG, we have NST to check heartrate of babies…I wish we have access to these kind of controls from tablet PCs… like remote connecting to the test results…" –FG2.b

"Biz mesela NST (No-Stress Test) çekiyoruz, EKG gibi bizim de NST'miz var bebeğin kalp hızını değerlendirdiğimiz…Keşke bu uygulama şöyle tablette olsa ne güzel olur… mesela uzaktan bağlanabilse…"

"…during visiting, I should reach to the latest examination results. Still we write on piece of paper in order to report to our superiors... there is that kind of incompatibility among the systems…" –FG2.c

"…hasta başında hastanın son tetkiklerine ulaşabilmeliyim. Hala çünkü kağıda yazarak söylüyoruz hocalara mesela… Öyle bir uyumluluk eksikliği var sistemler arasında…"

Physicians reported that they do not need for an assistance during mHealth application use, including technical support and trainings. No organizational culture was observed in terms of mHealth application use, thus the idea of assistance (i.e. training and support) did not make sense for the physicians. They expressed that if they do not feel the urge, they were not willing to have trainings, instead they prefer online resources.

"I search for these kind of things from the blogs, I check from them. For instance, I search for applications in mobile health and application samples, bloggers discuss about the applications if they are useful or not. I use this method but I am not sure that I would want training for it…" –FG2.a

"Ben yani böyle şeyleri bloglardan aratıyorum, blog üzerinden öğreniyorum. İşte şöyle bir aratıyorum mobil sağlık ile ilgili uygulamalar ve örnek uygulamalar mesela, blogger yazıyor şu şu uygulamalar güzel gibi. Böyle şeylere bakıyorum ama böyle eğitim olayını bilemedim yani..."

Performance represents organizational performance which would affect the effectiveness of the hospital in healthcare delivery. In that regard, the benefits of

mHealth in routine use was observed to be beneficial for physicians as well as patients. mHealth applications were reported to be "time saving" and "assistive".

> ***"… there is an application I heard of, it is about a rare disease… it has a calculation method, you enter the values to the application, and it brings the result in a blink of an eye. I mean it make your job easier for you…" –FG1.c***
>
> *"…bir uygulama var, kullanmadım ama var diye biliyorum, seyrek görülen bir hastalık ile ilgili… bir hesaplaması var, uygulamaya giriliyor, yazıyorsun 'tak' diye çıkarıyor. yani senin işini kolaylaştırıyor."*
>
> ***"I use these application for general purposes, because it makes your job easer or it helps to do better and more accurate…" –FG1.a***
>
> *"Bunları genel olarak kullanırsın, işin kolaylaştığı için kullanırısın yada daha iyisini yapmak için, daha doğrusunu yapabilmek için kullanırsın… "*
>
> ***"In the clinic environment, if you want to reach to information, you have to do it quick. You have to complete your tasks in seconds. I mean you have no time to spare…" –FG1.c***
>
> *"Poliklinik koşullarında birşeye bakmak istiyorsan hemen çok hızlı bilmen lazım. Saniyeler içinde yetiştirmek zorundasın. Yani öyle hani ben vakit ayırayım yok…"*

The performance is so important for an organization; it may override the need of ease of use in practice. Physicians opinions regarding to an application which helps their performance but has low usability were positive to use in any case.

> ***"I prefer simple apps…but if it is a sure thing to reach to a result with this application, even though it is not easily used, I can prefer to use it." –FG2.d***
>
> *"Basit uygulamayı tercih ederim…ama bana garanti veriyorsa mesela sonuca ulaşıcağım ama sıkıntılıysa da kullanırım."*

Barriers

Barriers were the categories limiting or disabling physicians to use mHealth applications. These barriers can be physical or psychological. In either case, barriers are the negative influences affecting the users at individual or organizational level. As personal barriers, software problems are one of the leading barriers. These are information security perceptions and software malfunctions. Even though there was a certain level of trust in application due to expectations and perceived standards, in information security, sharing confidential information would limit some physicians to communicate via internet using applications. Moreover, software problems include lacks in language support and branch-specific advancements. In that regard, physicians have problems to find mHealth applications with Turkish interface. In some health branches, unlike ECG, resolution of images would create problems, such as surgical cases. Thus, these limitations would create barriers for physicians to use mHealth applications in practice.

"…when I capture and send surgery videos, their quality is not good enough. From medical view, they are not so useful…I mean the resolution may change while sending…However, since ECG is graphical image, quality is not a big issue for it but for others…" –FG1.a

"…ben kendim ameliyat görüntülerini gönderdiğimde baktım mesela görüntü hakkaten iyi değil. Hani tıbbi açıdan karşılaştırınca çok iyi olmuyor görüntüler…Yani çözünürlük değişebiliyor... EKG grafiksel onda etkili olmuyor ama diğerleri için öyle ..."

"…most of the applications do not have Turkish interface…some are Latin or Greek, and I try to guess their meaning while using the application…" – FG2.b

"…Türkçe yazıları yok mesela çoğunun… Bazısı Latince mesela bazısı Yunanca oluyor ordan onu tahmin etmeye çalışarak bunları yapıyorum..."

In addition to that, lack of knowledge and interest in mHealth applications and mHealth utilities would reduce awareness of mHealth applications and the benefits of mHealth. Even though there is a level of use of mHealth applications in different specialties, the consensus is that mHealth applications does not have vital impact at the current state. However, the communication applications were stated to have vital importance by the physicians. Informal use of mHealth applications is another indicator of lack in knowledge. It was stated that government or managerial incentives would affect to outcome in terms of awareness.

"…if I think about my own department, I believe there is not an excessive need for mHealth applications in cardiology. Maybe there are different use in other specialties that I am not aware of…however, Whatsapp is not like that, it has a vital importance for us" - FG1.a

"…kendi bölümüme göre düşünürsem mesela kardiyolojide mobil sağlık uygulamaları çok aşırı gerekli değil, bekli başka bölümlerde başka kullanımıları vardır, onu bilemem …ancak Whatsapp öyle değil, hayati önemi var bence…"

"…Do I need a lot…I mean it do not add to much value to our service…we already use messaging for this…" –FG1.c

"…Çok gerek var mı… yani, şöyle söyleyim bize çok değer katmaz... biz zaten işimizi görüyoruz mesajlar üzerinden... "

Even though anxiety was expected as a major barrier in use of mHealth applications, the participants had shown less anxiety issues toward using applications. They express no significant concerns regarding to trust, security, or any cause for resistance to technology use. However, in terms of validity of results, they expressed their concerns if they are not using an application in routine.

"…sometimes I doubt about it (the results) … let's say I enter values to calculate something. I feel anxious about the results, if there correct or not. But after regular usage I get used to it…" –FG1.c

"… insan sorguluyor bazen. Yazıyorsun diyelim, hani birşey hesaplıyorsun diyelim. Bir tedirginlik oluyor mesela. acaba doğru mudur diye mesela. ama devamlı kullandığın zaman geçiyor…"

Organizational barriers consisted of categories which are mainly the result of acts by the health institutions, ministry or government. Their actions were also required in order to remove the barriers. Here, lack of investment is observed to be one of the main barrier which significantly influence mHealth application use. Physicians reported that there are relatively few applications for their specialty (i.e. gynecology, urology). They also stated that there are more applications for patients, which was believed to be more profitable for developers, and less applications for physicians. Thus, these are results of lack in investments in mHealth application research and developments.

"…there are applications for pregnancy monitoring since the mothers wonder about the progress. For patients, there are lots of applications for patients but less for physicians…" –FG2.a

"…yani bir gebelik ile ilgili hani anneler merak ettiği için gebelik haftasının ilerlemesinin nasıl olacağına dair uygulamalar var. Hastalara yönelik çok, hekime az uygulama var..."

"I wish there were more applications for our specialties, that is a missing…" –FG1.c

"Daha çok uygulama olsa alana yönelik, o bir eksik…"

In addition to that, lack of control reduces the incentive and motivation to use mHealth applications. Since it is informal and not mandatory, mHealth applications were used when needed, but without control of data traffic, reliability and security of the sources. Since the health data is classified and confidential, physicians stated that a standardization is needed in the domain. In addition to that, medical education was also pointed out to be controlled for their content.

"…Since everything is reachable via internet, it is easy but uncontrolled… such as in the future, on tablet PCs, simulations could be used in lectures and it can be audited…however it should get a formal state, like a committee can be gathered for standardization and control…" – FG2.a

"… Internette artık herşey olduğu için, yani herşey var ama denetlenmiyor… örneğin ileride simulasyonlar üzerinden ders işlenebilir ve öğrencilerin tabletinde içerik denetlenebilir…bu formalize edilmeli, bir kurul toplarsın mesela, karar alırsın, şunları kullabilirsiniz gibi belirtirsin…"

"…It would be good if have standardization…sometimes when I make calculations, results may vary depending on the application…" –FG1.a

"… Standardizasyon olsa daha güzel olur mesela. Bir hafta hesaplıyorsun mesela, uygulamaların birine göre bir eksik birine göre bir fazla olabiliyor…"

"Standardization is a global problem. It is in the literature too. In U.S, Ministry of Health works on standardization of health applications…" – FG1.c

"Bu standardizasyon zaten global bir sorun. Literatürde de var. Amerika'da da sağlık bakanlığının çalıştığı noktalardan biri o..."

Enablers and barriers

As enabler and barrier, habits play an effective role. In general, mobile phones infused into physicians' lifestyle, and they were reported to be the "part of physicians' life". However, physicians did not perceive mHealth application use as habit. They perceived as information resources for the physicians which can be reachable, accessible and reliable. Thus, the habits of physicians are heavily based on communications. In that regard, their habits may be a barrier (habit of computer use) or enabler (habit of mobile application use) in terms of mHealth application use.

"…we used to chat via personal computers, now it is on mobile phones. There are some still using personal computers but it is hard. There are already lots of applications on the phone, thus chatting via mobile phone is more convenient…" –FG2.b

"…eskiden bilgisayar başında chat üzerinden iletişim kurmak alışkanlıktı, şimdi telefona taşındı bu. Halen bilgisayardan devam edenler var ama zor oluyor. Zaten telefonda bir sürü applikasyon kullandığımız için telefon üzerinden yazışmalar daha elverişli…"

On the other hand, a habit of use may start as enabler and then turns into a disabler. Repetitive use of an mHealth application may result as increasing the anticipation ability of physicians about the results of the process, thus it may reduce to use of application and increase the use of personal anticipation.

"… after a couple of use, I understand the limits, objectives and cut-off values in the application. While I am speaking to a patient, I start to guess that there are three risk factors possible considering patient's age and blood pressure…when you use the application frequently, after a while, I start to guess the results that I can get from the application… there were no need to use application at that time." –FG1.c

"…iki üç kullanımdan sonrasını senin de sınırların, hedeflerin, cut off değerlerin oluşuyor. Sen hastayla konuşurken yaşı buymuş, tansiyonu buymuş, üç tane risk faktörü var diyorsun… Sürekli uygulamayı kullana kullana bazı şeyler tahmin edilebilir oluyor... artık bakma ihtiyacı duymuyorsun."

"For instance, we used to use application before surgical procedure for risk scoring, but do we now? Not really. We check the indicators like the age, blood pressure and previous heart attack cases…Considering these, we guess the risk factor. But before that we used to use the guidelines/ best practices… not anymore for frequent use…" – FG1.b

"Mesela ameliyata gidecek hasta için zamanında açıyorduk. risk skorlamasını, ama artık açıyor muyuz? (diğerlerine sordu). Hiç açmıyoruz. Diyoruz bak yaşı varmış, tansiyonu da varmış, daha önceden kalp krizi de geçirmiş... Ona göre risk faktörünü yazıyorsun. Ama daha öncesinde klavuza bakıyorduk… kullana kullana artık bakmıyoruz …"

In sum, the findings outlined that physicians have a tight schedule in their daily works. They have limited time to provide healthcare services to the patients. Thus, they need to reach to the information quickly when needed. The observations demonstrated that physicians commonly use medical calculators and reference materials. Since they need to reach information at any time and place, web browser and search engines are mostly used for medical searches. The accessibility to information is a priority for their job performance. In that regard, they stated the need of branch-specific applications as well as standards and regulations by the authorities. The physicians spend less time with mHealth applications in their leisure time, and if they do, mostly use for educational purposes. Socially, mHealth applications are not a common conversation topic, but communication applications are very useful for medical communication among doctors. The ease in using the application is expected during their job, and mostly challenging applications are changed by substitute applications. Physicians are highly interested in new technologies including mobile phones and applications, and no resistance towards mHealth or mobile technologies was observed during the interview. At the organizational level, compatible mHealth applications with hospital information system were expected. Since the use of mHealth was informal and voluntary basis, technical assistance and support were not found to be necessary. Performance was identified crucial at organizational level. On the other side, lack of branch specific applications or software support (e.g. language support) would become barrier in mHealth use. In addition to that, lack of interest and knowledge by the physicians create barriers to further use. Here, at organizational level, investments and control are needed. More applications for specialties needed to be developed, as well as quality standards and incentives needed to be provided by the authorities. Since physicians showed trust in current applications, and they accustom to mobile phones and applications, no resistance towards the mHealth applications were observed. Thus, there were low level of anxiety. As the final category, habit constitute barrier and enabler for physicians. Physicians demonstrated that communication applications are habit for them but other mHealth applications. This is a positive reinforcement to use other mHealth applications if available. However, it was reported that repetitive use of mHealth applications, such as calculators, may result as learning the mechanism and anticipating the outcomes. Thus, it may create a barrier to use specific applications any further.

CHAPTER 6

DISCUSSION AND CONCLUSION

6.1. Discussion: Non-user physicians

The study results outlined that different factors might be effective in the perception of physicians toward mHealth applications in comparison to the actual users. Lu et al. (2005) has already been demonstrated the influence of Effort Expectancy (EE), Performance Expectancy (PE), Social Influence (SI) and personal Innovativeness (PI) on perception using mobile technologies. However, M-TAM was able to contribute to the literature providing alternative outcomes and additional factors influencing the perception of use.

The results presented that the factors influencing non-user physicians' perception to use mHealth applications (RQ1) were explained by the constructs of EE, Perceived Service Ability (PS), Mobile Anxiety (MA) and Technical Support and Training (TT). In that context, EE stood out as one of the major indicator in explaining user intentions towards technology use. Since its first formulation by Venkatesh et al. (2003), the impact of EE on Behavioral Intention (BI) has been proved in many studies(Holden & Karsh, 2010; Hsiao, Tang, & Liu, 2015; Sezgin & Özkan-Yildirim, 2014). The expected findings regarding to EE and BI relation were supported, and EE significantly influenced perception of behavioral intention to use mHealth applications (H2). However, this study unveiled that EE was not only influential on the actual users, but also non-users would perceive that their intentions could be influenced by the ease of use. Thus, for the non-users, the benefits of mobile health applications can be regarded as perceivable and substantial (Chang et al., 2007; Kijsanayotin et al., 2009), and there was a certain level of awareness of the technology. In addition to that, PS was another factor significantly influencing BI (H6). Here, the study investigated if the intention to use would be affected by perception of mobile health applications supporting pervasive and timely use. Findings provided that the time and location constraints were no further considered as a limitation to fulfil physicians' tasks. This result was consistent with previous arguments in UTAUT about the effect of perceived service availability (facilitating conditions in UTAUT) while explaining the use of technology (Venkatesh et al., 2003). Due to the fact that dissemination of mHealth technologies were higher in patient healthcare, the importance of mobility in patients would have been effective in perception of physicians towards significance of service availability (Hong & Tam, 2006; I.-L. Wu et al., 2011). On the other side, BI was negatively influenced by mobile anxiety (H8). Thus, it was underlined that, unlike Venkatesh's findings (Venkatesh et al., 2003), the apprehension, intimidation and hesitation towards using mHealth applications would be influential in perception of actual use. The expectation was that anxiety would be a predictive factor in perception of use,

since the participants were non-users, and a certain level of reluctance was acceptable. However, it can be claimed that mobile anxiety would be a result of lack in fulfilment of other factors in the model, such as self-efficacy or service availability (Aggelidis & Chatzoglou, 2009; L. K. Schaper & Pervan, 2007). Similar to MA, TT had significantly negative effect on BI. This was an unexpected result considering that the physicians would need technical support during the stage. However, the common perception about the ease of mobile application use would be the effective input in the reverse impact of TT (J.-H. Wu et al., 2007). In addition to that, the concept of technical support and training in mobile application use have not been widely practiced in the field of healthcare training in Turkey. Thus, conceptualization of TT would be relatively hard for the participants. As a result, negative impact was understandable towards using mHealth applications.

On the other hand, the relationships among the factors influencing the perception to use of mHealth applications (RQ2) were tried to explained by the remaining hypotheses in the study. One of the significant relations was identified between Compatibility and PE (H22). In other words, the perception of physicians about the consistency of mHealth application with the healthcare practices, needs and experiences were found significant to affect beliefs towards the mHealth's benefits at job performance (J. Chen et al., 2010; J.-H. Wu et al., 2007). It was argued that higher compatibility results in higher success rate in mobile health acceptance (J.-H. Wu et al., 2007). Similarly, the perception of compatibility was observed to have a similar effect on physicians in the study. That indicates that there exists knowledge and concept regarding to mHealth applications and their practical use. On the other side, the MA (H11), MS (H12), HB (H14), RD (H18) and CO (H23) were found to have significant relationship with EE, which also indirectly affect BI. Mobile anxiety demonstrated that the perception about the ease of use of mHealth applications would be influenced by anxiety towards the technology. In the literature, there have been studies that anxiety affected use of technology significantly (L. K. Schaper & Pervan, 2007) and did not affected at all (Aggelidis & Chatzoglou, 2009). However, the study revealed that anxiety in use of mobile health technologies has an undeniable influence in physicians' perception. Regarding to significant direct and indirect relation of MA and BI, it can be argued that physicians' apprehension and intimidation in mHealth application use is critical in their perceived ease to use, and eventually, intention to use. Following that, H12 provided another finding regarding to MS. Physicians demonstrated that their individual beliefs about their abilities to use mHealth applications were related to ease of use of the technology. As Chen et al. (J. Chen et al., 2010) stated, healthcare providers may have high level of intention to use the technology if they think positive about their mobile technology skills. Thus, the indirect impact of MS on BI over EE may indicate that physicians' perceptions about their skills to use the technology has effect on their perception of actual use. On the other side, habit provided a new perspective. Gagnon et al. (2003) argued that habit was not an effective predictor of use considering relations among frequency of health technology use in the past and future. Unlikely, the findings unveiled the influence of habit on ease of use. It indicates that physicians' beliefs would be significantly influenced by their habits of using mobile applications in terms of their perception of ease of use mHealth applications. RD was another significant factor influencing EE. Yi et al. (2006) stated that if a technology helps users to reach job relevant results that

contributes to their tasks, perceptions of ease of use are significantly affected. Similarly, physicians' perceptions about ease of use affected by their degree of beliefs about communicable and observable results of using mHealth applications. Similar to CO and PE relation, CO demonstrated that perception of ease of use of mHealth is significantly affected by the perception about consistency of mHealth application with the healthcare practices, needs and experiences.

On the other side, there have been thirteen hypotheses remaining which were not supported in the study. Even though the literature and expert opinions were used in identifying and testing the factor relations, it was the fact that majority of hypotheses were rejected. However, they contributed to the literature by supporting or not supporting the current evidence regarding to healthcare technology use. Unlike significant relations in the literature regarding to CO- BI (J. Chen et al., 2010), PI-BI (Lu et al., 2005), PI-EE(Yi et al., 2006), PI-PE (Kummer et al., 2013), PS-PE (I.-L. Wu et al., 2011), RD- PE(Yi et al., 2006), MS-BI (J. Chen et al., 2010) and PE-BI (Venkatesh et al., 2003), the study findings did not support these hypotheses. However, the relations of HB-BI (Marie-Pierre Gagnon et al., 2003), PS-EE (I.-L. Wu et al., 2011), SI-BI (Yu et al., 2009), TT-EE and TT-PE (J.-H. Wu et al., 2007) were resulted insignificant consistent with the literature. The overall picture of the insignificant relations revealed that the lack of conceptualization of the mHealth technology and its use, lack of knowledge and awareness, and thus, low level of understanding about the factors being questioned would be effective for incompatibility assessing the perceptions of non-users.

Practical implications

From the practical point of view, lack of using current technologies can be argued as a loss in resources. Even though there is an increase in investment of healthcare technologies(Manyika et al., 2013) and mHealth developments (Aitken & Gauntlett, 2013), international reports provided that the use of mobile services in healthcare has not reach at the effective state (Deloitte, 2013; OECD, 2015; PwC Health Research Institute, 2014). Thus, encouraging the potential users (i.e. physicians) to benefit from the technology would enhance health services. In that regard, the study proposes several implications.

The study findings revealed that there are number of issues needed to be identified in order to increase the use of mHealth applications by the physicians. First of all, it was observed that there is an awareness of mHealth applications, however there are also lacks in incentives and assistance for physicians. The literature suggested that awareness of technology is an important step in technology use (Chang et al., 2007), and technical support and training are important as a driver of mHealth use (J. Wu, Wang, & Lin, 2005). Here, these would be considered as key indicators while developing and disseminating use of the mHealth applications (Kijsanayotin et al., 2009). In addition to that, anxiety was another key indicator which was observed to influence the perception of use. However, the lack in use of mHealth applications can be resulted from anxiety as well as other subtle reasons. Hale et al (Hale, Capra, & Bauer, 2015) suggested that healthcare providers have trust issues towards mobile applications. Furthermore, Rehman and Ramzy (ur Rehman & Ramzy, 2004) argued that time constraints, lack of skills and lack of awareness would be important indicators

to be considered in technology use. In that regard, increasing ease of use in applications and providing mobile service availability in order to reduce time spending with the applications would be encouraging for non-user physicians.

In addition to that, the beliefs about weakened patient-doctor relations, increase of workloads, threat of dangerous applications and challenges to use technology were reported as obstacles in healthcare technology use (C. Lin, Lin, & Roan, 2012). In that regard, the managers and developers should consider personal abstains and beliefs towards the mHealth application use. On the other side, age and experience in using mobile device, personal competency and type of institution would be other key mediating elements in physicians' perceptions to use (Venkatesh et al., 2003). Thus, personalized or profession-specific applications and government/ institution incentives to use mHealth would be beneficial to disseminate the technology.

In the bottom line, one of the suggestions may be to promote collaborations among patients and physicians. The policy makers should focus on providing standards in mHealth applications (Becker et al., 2014). For developing countries, infrastructure and regulations are suggested to be developed (Varshney, 2014) as well as taking action to reduce technological and sociocultural barriers (O' Connor, O' Connor, Heavin, Gallagher, & O' Donoghue, 2016). Furthermore, interventions to education and communications among physicians, management support and clinical diagnosis assistance would be useful for developing countries (Free et al., 2013). Regarding to benefits of mHealth use, such as increase in personal time, communication and monitoring enhancements (Steven & Steinhubl, 2013), it is evident that enabling physicians to use mHealth applications would contribute to the healthcare practice as well as quality of services. In that regard, potential problems should be identified focusing on sociological perspective and needs in healthcare delivery (Chib et al., 2015)

6.2.Discussion: mHealth application user physicians

Literature provided that there is an awareness and belief in benefits of mHealth among healthcare providers in terms of clinical communication use (Embi et al., 2004; R. Wu et al., 2011) and providing healthcare services (M.-P. Gagnon et al., 2015; Vital Wave Consulting, 2009). This study supports this argument outlining variety of evidence regarding to physicians' attitudes towards mHealth applications.

M-TAM was able to explain behavioral intention (BI) to use mobile health applications with 51% of total variance. In that regard, Performance expectancy (PE) was one of the factors significantly influencing BI. In the study, it was observed that PE was more effective in explaining BI than effort expectancy (EE). The significant effect of PE indicated that physicians had beliefs about mHealth applications that would be helpful in their job routines. The literature has already provided that performance expectancy is one of the important indicators in adoption of health information systems (M.-P. Gagnon et al., 2015; Holden & Karsh, 2010; Sezgin & Özkan-Yildirim, 2014), thus, the findings supported the impact of PE. On the other hand, influence of PE on BI was an expected outcome from the developing countries' perspective (M.-P. Gagnon et al., 2015). In that regard, one of the primary concerns of physicians can be stated as the practical benefit of the mHealth applications, especially while practicing with a tight schedule (Chau & Hu, 2002; Kim et al., 2016). Focus group interviews supported this

argument, stating that they have to be quick to fulfil their tasks in seconds. The access to information in timely manner is crucial during the physicians' routine (Duhm, Fleischmann, Schmidt, Hupperts, & Brandt, 2016).

In addition to that, PE was influenced by compatibility (CO), personal innovativeness (PI) and result demonstrability (RD). In other words, the consistency and integrity of mHealth applications, the degree of willingness to use new technologies and availability of demonstrable results had influences on perceptions of physicians related to their job performances (Ducey & Coovert, 2016; S.-Y. Hung et al., 2012; Yi et al., 2006).

Perceived service availability (PS) was found as another significant influencing intention to use. Thus, one of the expectations of physicians from mHealth applications was underlined as the ability for pervasive and timely use. Venkatesh (Venkatesh et al., 2003) also supported that the facilitating conditions, such as service availability, were influential in explaining the use of technology. In that regard, service availability in terms of branch-specific mHealth applications was a challenge, yet regarding to UI, the language support was expected by the physicians. The physicians reported that use of mHealth applications were not vitally important at the current level, however, when they need to use it, they expect to have Turkish language interface for convenient access.

Similarly, personal innovativeness (PI) was another factor that had significant influence on BI. In that regard, physicians were found to have a certain level of willingness to use new technologies which eventually positively affect their attitudes towards using mHealth applications (S.-Y. Hung et al., 2012). In that regard, the physicians were observed to have no barriers to new technologies, especially to smart phones and mobile applications. They also stated that there are no physicians around them who do not own a smart phone and do not use mobile applications.

On the other side, Mobile anxiety (MA) was identified to have negative influence on BI. Here, the findings revealed that perceived intimidation, hesitation or apprehension would negatively affect physicians' intention to use. Regarding to Venkatesh's arguments about anxiety (Venkatesh et al., 2003), it was not expected to have significant influence on intention. However, the literature suggests that lacks in initiatives and perceived ability may increase physicians' anxiety as well as reducing intention to use mHealth applications (M.-P. Gagnon et al., 2015; L. K. Schaper & Pervan, 2007). According to the findings of interviews, as a disabler, anxiety resulted to have less impact on physicians. The reason can be connected to couple of factors, such as existing trust in informally used applications, lack of organizational support or incentives, and low level of importance in common practice. However, validity may create hesitation in terms of estimating calculation results, but they are overcome by regular usage. One of the informants stated that when he starts using a new mHealth applications, he becomes anxious and precautious for the validity of the results. However, after using a period of time with self-validating, he gains trust.

On the other hand, physicians' perceptions towards the consistency of mHealth applications with their tasks and practices (HP4: Compatibility to BI) and their perceived abilities in performing daily task with mHealth applications (HP9: Mobile self-efficacy to BI) were found not to have significant relations with BI. Even though

the literature states otherwise (J. Chen et al., 2010; J. Wu et al., 2005), lacks in routine practices with mHealth and the job conditions (as in a developing country) would be effective drivers in that regard (M.-P. Gagnon et al., 2015). In addition to that, focus group interviews revealed that there is a certain level of compatibility issue among mHealth applications and hospital information systems. However, since there is no active implementation of mHealth or use of mHealth applications under the authorization, there may not be a perception about compatibility in behavioral intention. Similar to the literature, lack in work practices were one of the main concerns (Embi et al., 2004; Georgiou, Ampt, Creswick, Westbrook, & Braithwaite, 2009). In that regard, some informants reported that they have been making no-stress test for babies, yet they wish to be able to access these tests via tablet PCs.

On the other hand, mobile self-efficacy was observed to exist, however, the conceptualization of mHealth use in practice would be ambiguous due to lack in applications for each specialty. The physicians reported the need for applications for their own specialty. Participants from gynecology stated that there are popular and many applications for pregnancy monitoring for mothers and many other applications for patients, however there are less applications for physician use. In that regard, self-efficacy may not be assessed due to lack in use of mHealth applications for physicians' specialties which require further developments (Duhm et al., 2016).

For the similar reasons, the insignificant relations of technical support and training (TT) on BI can be explained. Since there is no formal use or regulations for mHealth applications, voluntary use resulted low incentive and motivation toward the needs of technical support and training (Venkatesh et al., 2012). Interview findings supported the argument. The physicians reported to have busy schedule and low willingness to participate to a training program or to have support in use. Instead, they prefer to use internet for support and training. One of the physicians reported that she uses web blogs to search for new mHealth applications and also for their usefulness. In this case, technical support and training could be perceived insignificant for the physicians.

On the other side, Habit (HB) and social influence (SI) were not found influential on BI, consistent with the literature (Marie-Pierre Gagnon et al., 2003; Yu et al., 2009). Here, the argument is that the perception of mHealth application use was not reached to a level of regular use to be considered as a habit. Considering the interview findings, there is a certain level of use of mobile applications which can be considered as habit (e.g. Communication applications), yet it is not applicable for the use of mHealth applications. Thus, it was found that physicians do not consider mHealth applications as a habit even though they frequently use communication applications for health related communications among physicians.

However, insignificant result of social influence could be the result of time constraints, lack in interest and awareness of using mobile health applications (ur Rehman & Ramzy, 2004). Physicians reported that they prefer individually to search for applications, and they do not engage in conversations regarding to mHealth applications often. In case they were not able to find a particular application, they may ask colleagues. In that regard, the insignificance effect of social influence is expected. One of the participants reported that he always uses web sources for all applications he downloaded.

Unexpectedly, effort expectancy (EE) had no influence on BI. The influence of EE had been repeated in many studies (Holden & Karsh, 2010; Hsiao et al., 2015; Sezgin & Özkan-Yildirim, 2014). However, the findings suggest that physicians may demonstrated a certain level of competence and adaptability towards mHealth applications (Y. Sun et al., 2013). Interview findings provided that ease of use of an mHealth application is important for job performance. If there is substitute applications, physicians prefer to use simpler applications in their routines. The rationale was based on simplicity and accessing the information easily. But here, the insignificant impact can be the result of low frequency of application use and lack in perception of capability in using mHealth applications. Indirectly, it would be the result of lack in investments and control in mHealth domain.

In addition to that, even though the moderating and direct effect of EE was not significant in the study, mobile self-efficacy (MS) and perceived service availability (PS) had significant effect on EE. Here, it can be argued that ease of use of mHealth applications would be influenced by physicians' ability and availability of the technology (Aggelidis & Chatzoglou, 2009; Embi et al., 2004; I.-L. Wu et al., 2011). On the other hand, effort expectancy of physicians was found to have no influence by their habits (HB), technology compatibility (CO), anxiety (MA), innovativeness (PI), need for observing and sharing results (RD) and need for support and training (TT). Since the influence of EE on BI was not significant, its moderating effect for aforementioned factors remained redundant. Similarly, the need for service availability (PS) and technical support and training (TT) had no influence on performance expectancy. Unlike Wu et al. (2011)'s suggestion, PS showed no encouraging indication to use mHealth by physicians. On the contrary, its impact was disregarded due to the lack of conceptualization of the construct in real life. In the similar manner, perception of TT may not be identified by physicians due to lack of practice in mHealth support. Thus, the direct effect of TT on performance expectancy remained insignificant (J.-H. Wu et al., 2007).

Practical implications

Regarding to self-reported responses of physicians, communication, decision making and information gathering are the primary aims of physicians to use mHealth application in healthcare services. This finding was supported by Franko and Tirrell's study (Franko & Tirrell, 2012), which outlined that commonly used applications among physicians were drug guides and medical calculators, and requested applications were about reference materials treatment guides and general medical knowledge. Thus, information gathering and communication needs were the primary application choices by the physicians.

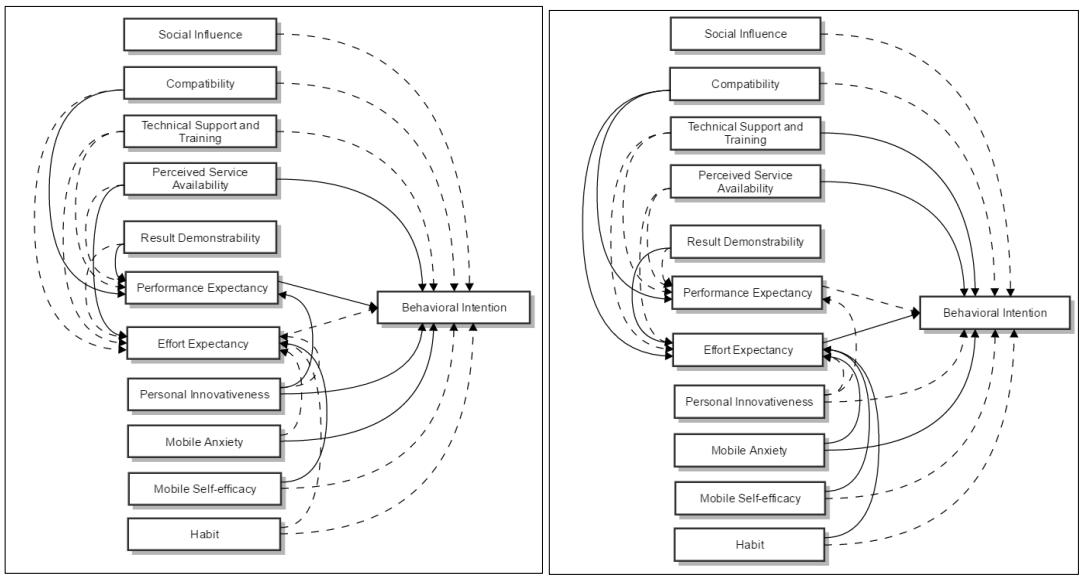
Blending these empirical results with the factors influencing behavioral intention to use the technology, the evidences demonstrated that practical benefits are the key elements in actual use of mHealth applications. In that regard, developers of mHealth applications should primarily focus on practicality of applications more than focusing on the contents (C. Liu, Zhu, Holroyd, & Seng, 2011; Sama, Eapen, Weinfurt, Shah, & Schulman, 2014). In addition to that, the availability for timely use is another important element. Even though the applications were available in mobile platform, time is an important constraint, especially for tightly scheduled physicians (ur Rehman

& Ramzy, 2004). Thus, their responsiveness and providing effective to-the-point results would be important benefits. Here, the optimization of mHealth applications specific to medical branches would enhance usability. Physicians' willingness towards new technology provided that physicians should be nurtured towards using mHealth applications. However, the reluctance in using mHealth should be also investigated to reduce behavioral resistance in using the technology. Especially in developing countries, underlying reasons could be the result of cost issues, increasing workloads and unscheduled tasks (M.-P. Gagnon et al., 2015). In addition to that, trust, security (Hale et al., 2015), privacy (Kumar et al., 2013), lack of standards and regulations (Barton, 2012; Becker et al., 2014) were other possible reasons which should be considered as key elements in development processes. On the other side, non-significant relations and interview reports regarding to these relations suggested that the active and formal use of mHealth should be promoted among the physicians, with providing trainings and offering system-compatible and branch-specific applications. Social environment and habitual behaviors can be investigated for further actions in promotion. Even though these were non-significant relations, after dissemination of mHealth use, as the literature suggests, the organizational and individual behaviors may change with increasing awareness, use and knowledge.

The policy-makers and managers need to consider aforementioned implications in procedure and policy development in order to promote effective healthcare services for the communities. In that regard, it should be noted that there is a need for alignment between mHealth applications healthcare services for creating an interoperable and controllable working environment for physicians (OECD, 2015). On the other side, it is important to note that mHealth applications need control for reliability and consistency to maintain healthcare quality (Barton, 2012). In addition to that, on-the-job training and operational support were suggested in use of mHealth applications in order to enhance physicians' ability to perform daily tasks, as well as effectiveness in healthcare services. For organizational decisions, Cooper and Zmud's six stages of IT implementation would be helpful in decision making (Cooper, Randolph B & Zmud, 1990). In that regard, the findings suggest that physicians using mHealth applications could be categorized in the adoption stages due to the awareness of the benefits and use of mHealth applications and the state of institutions. Thus, political and managerial incentives would be helpful to motivate actual use of mHealth applications. In addition to that, investors should consider the current state of individual and organizational awareness as well as the organizational culture since it could be significant in technology acceptance (Ward, 2013).

6.3.Discussion: Comparison of user and non-user physicians

The study investigated the attitudes and perceptions of physicians towards mHealth applications regarding to two different perspectives of physicians: users of mHealth applications and non-users. Figure 18 presented M-TAM model for each groups outlining significant (continuous line) and non-significant (dashed line) relations. As given in the previous sections, M-TAM model testing resulted different for each group regarding to significant relations as well as implications. In this section, a comparison of factors influencing these different groups was given.



(a) mHealth user physicians (b) non-user physician

Figure 18: M-TAM model for mHealth user physicians and non-user physician

Significant and non-significant relations for both groups is given in Table 31. BI was influenced by PE and PI for users, and EE and TT for non-users. This finding revealed that mHealth application user physicians would perceive their job performance and their willingness to try new technologies influential for their intention to use mHealth applications (Chau & Hu, 2002). On the other side, perception of non-users depends on ease of using mHealth, and the support they are receiving would affect their intention to use mHealth applications (Chang et al., 2007).

Behavioral intention was influenced by perceived service availability and mobile anxiety in both groups. Thus, there was a common perception regarding to reachable and accessible mHealth applications in practice (Becker et al., 2014), and apprehension towards the new technology. Furthermore, compatibility influences performance expectancy and mobile self-efficacy influences effort expectancy for both groups. Here, as aforementioned in interviews, job performance was perceived to be related to compatible systems by non-users similar to users, such as mHealth with hospital systems. In addition to that, ease of mHealth use was perceived to related with personal competency for the both groups. However, their indirect influence on behavioral intention can be observed differently in each group due to significant impact of PE and EE. Thus, compatibility is rather influential on BI over PE for user physicians, and mobile self-efficacy is on BI over EE for non-users. That impact would be related to perceived job performance of user physicians since they observe the relation of compatibility and job performance. For non-users, the expected ease of using mHealth applications could be perceived to related to personal competency (L. Schaper & Pervan, 2007).

On the other side, direct effect of CO, HB, MS and SI was not influential on BI for both group. Here, there is consensus of physicians about direct impact on BI. Even though, CO and MS had indirect effect, they were not perceived to have significant

influence on BI as well as HB and SI. As explained in the previous section, these factors might have been seen rather less relevant or non-applicable by the physicians considering the current state of mHealth application use in health institutions (M.-P. Gagnon et al., 2015).

Table 31: Significant and non-significant relations for mHealth user and non-user physicians

Hypotheses	**User Physicians**		**Non-user Physicians**	
	Sig.	*Non-sig.*	*Sig.*	*Non-sig.*
PS->BI	X		X	
MA->BI	X		X	
CO->PE	X		X	
MS->EE	X		X	
CO->BI		X		X
HB->BI		X		X
MS->BI		X		X
SI->BI		X		X
PI->EE		X		X
PS->EE		X		X
TT->EE		X		X
TT->PE		X		X
PE->BI	X			X
PI->BI	X			X
PI->PE	X			X
RD->PE	X			X
PS->EE	X			X
EE->BI		X	X	
TT->BI		X	X	
HB->EE		X	X	
RD->EE		X	X	
CO->EE		X	X	
MA->EE		X	X	

6.4.Suggestions

In the research, qualitative and quantitative knowledge about physicians were gathered following technology acceptance theories and research procedures. The previous section outlined the findings in intention and perception to use mHealth applications and implications. Considering the both groups, in this section, number of elements were outlined in order to be considered in application development and managerial processes in the common ground. Becker et al. (2014) provided psychological, clinical, technological and regulatory viewpoints to outline the state of the mHealth. In the following sections, these viewpoints were used to categorize the elements in suggestions.

1. Psychological perspective

Today, more than 75% of world population are able to access mobile communication services (Becker et al., 2014). In the largest countries, such as U.S. and China, more than 27 thousand medical applications were available in Android and IOS market (Xu & Liu, 2015). However, literature provided that mHealth applications were underutilized in practice, and it have created no dramatic change in neither organizational culture of health institutions nor health behavior (Becker et al., 2014).

In that regard, collaboration has been a need amongst application developers, physicians and researchers who have expertise on behavior and attitudes. In this study, significance of perception in job performance, ease of mHealth use, personal perspectives in new technologies and potential of anxiety were revealed for both groups. Thus, the following elements should be considered for mHealth applications.

- **Focusing on the job performance and providing simple applications**. Since the workload is high and quick access to the information is a need, physicians rather prefer less exhausting assistive services in practice. Thus, they expect an effort-free and useful, to-the-point applications in healthcare services. Thus, simplicity of the application as well as providing quick and relevant information are valuable features in use. (M.-P. Gagnon et al., 2015)
- **Incentives for new mHealth applications.** There is a potential interest of physicians toward new technologies. Utilizing from this feature, mHealth applications could be promoted among physicians for encouraging active use and creating positive perception in healthcare services. Thus, instead of basic trainings or seminars at the initial stage, the promotional activities, such as meetings or activities including social interactions would attract both users and potential users toward using mHealth applications in practice. Alternatively, key characters in the organizations, such as "opinion leaders", would be assistive to disseminate the use of mHealth applications, which would also impact the organizational culture and mHealth use 'etiquette' in long term (Hao, Padman, & Telang, 2013).
- **The next level: Trainings.** Following the promotional activities, trainings would help physicians to use mHealth in completing daily tasks. It could be provided as on the job trainings and in-action implementations. It is especially beneficial for new users in order to eliminate the risk of resistance and reduce potential anxiety in use by familiarizing the new users to the mHealth applications. In addition to that, it would reduce the possible risks as errors in multitasking (Varshney, 2014; J. Wu et al., 2005). In that regard, Electronic Performance Support System (EPSS) would be helpful for organizations to maintain trainings as well as assessing learning performances. EPSS provides computer based tools having knowledge and learning experiences as input in order to improve individual or organizational performance (Yakin & Yildirim, 2015).

2. Clinical perspective

In the current state, literature and the study demonstrated that simple features of mobile technologies work effectively in clinical practice, especially in developing countries, such as communication applications and SMS (Becker et al., 2014; Free et al., 2013; Källander et al., 2013).

- **Collaboration is the core.** The study provided that there is a social bond among healthcare providers (i.e. physicians, nurses, technicians). Thus, collaboration among healthcare providers has been a must, and the applications should be developed regarding collaboration the core of the operations. In that regard, easy sharing methods and collaborative working tools would be beneficial in mHealth applications.

- **Providing continuous services**. The service availability was perceived to be important factor by the physicians. In that regard, one of the major benefit of communication applications were their service availability and providing access to the service time and location independent. Here, the benefits of communication applications could be embraced in a broader extend to include healthcare-specific services providing significant functions available.

3. Technological perspective

The study provided that the technological infrastructure of healthcare institutions included internet and local area computer network within the institutions. Each hospital uses a medical health record system to keep the track and to report the operations. In that regard, couple of issues should be considered for mHealth application use.

- **Compatibility and interoperability of applications.** Compatibility of mHealth applications with the healthcare systems would influence physicians' working routines and the job performance as well. Current state of mHealth showed that the technology is still evolving and incompatible mHealth applications exist (Becker et al., 2014). Thus, development of a mobile-compatible healthcare service platform for institutions is as important as developing mHealth application itself. In addition to that, the communication among the systems is also crucial for services. Thus, interoperable systems would also boost the development and use of mHealth applications in healthcare services.
- **Providing demonstrable results.** The ability to demonstrate the medical results, calculations, problems or processes were perceived important by the physicians. Thus, the mHealth technology being provided should grant the ability to display and share high quality visual medical contents. In that regard, increasing visual quality as well processing speed in medical contents would be valuable in healthcare delivery.
- **Focusing on infrastructure.** Technological infrastructure, especially the communication network, is important for timely delivery of healthcare services (Sezgin & Özkan-Yildirim, 2016). However, the reliability could be an issue, and uninterrupted service could not be provided for the developing countries (Varshney, 2014). Thus, developing an interoperable and compatible platform does also rely on a solid infrastructure. It is suggested to develop contingency plan and ad-hoc solution maps for unexpected infrastructural issues (such as, electricity cuts, network loss, hardware and software malfunctions).

4. Regulatory perspective

Laws and regulations regarding to mHealth technologies and applications are at the initial stage (Barton, 2012; Becker et al., 2014).In developing countries, it was estimated to be regulated in a long term. In that regard, the following points would be considered in mHealth application development.

- **Acting in compliance with the laws and regulations about mHealth.** Even though the current state of regulations is at the development phase, the need

for laws and regulations were apparent considering number of available mHealth applications in the market. These applications were commercially available and enable users to share confidential information with the third parties. Thus, for security and privacy of information, regulatory acts were required by the authorities. In that regard, in the study, physicians were also stated their expectations on regulations about mHealth applications.

- **Standards for applications.** In the study, it was reported that some mHealth applications were following international standards in medical practice while providing content in healthcare. However, the market crowded with many other unregulated and unstandardized applications being available for end users. Considering the current trajectory, mHealth applications obeying the standards were found more reliable by the physicians. Thus, considering international standards in the development would increase the reliability and credibility of the mHealth applications. In addition to that, providing the procedures of implementing international standards at national level application development would also be recommended to the authorities.

Considering the 4 perspectives, the current stage of mHealth would be an opportunity for developers to anticipate the trajectory of the transformation in healthcare services, and to provide expected applications in the market on time. In that regard, the potential of change in organizational culture and its evolution around mHealth applications and technologies should be considered in long term strategic plans.

6.5. Conclusion

This study focused on understanding the perception and intention to use mobile health application use by physicians in practice. In that regard, a Mobile Technology Acceptance Model (M-TAM) was proposed to assess physicians' perception and intention to use mobile health applications.

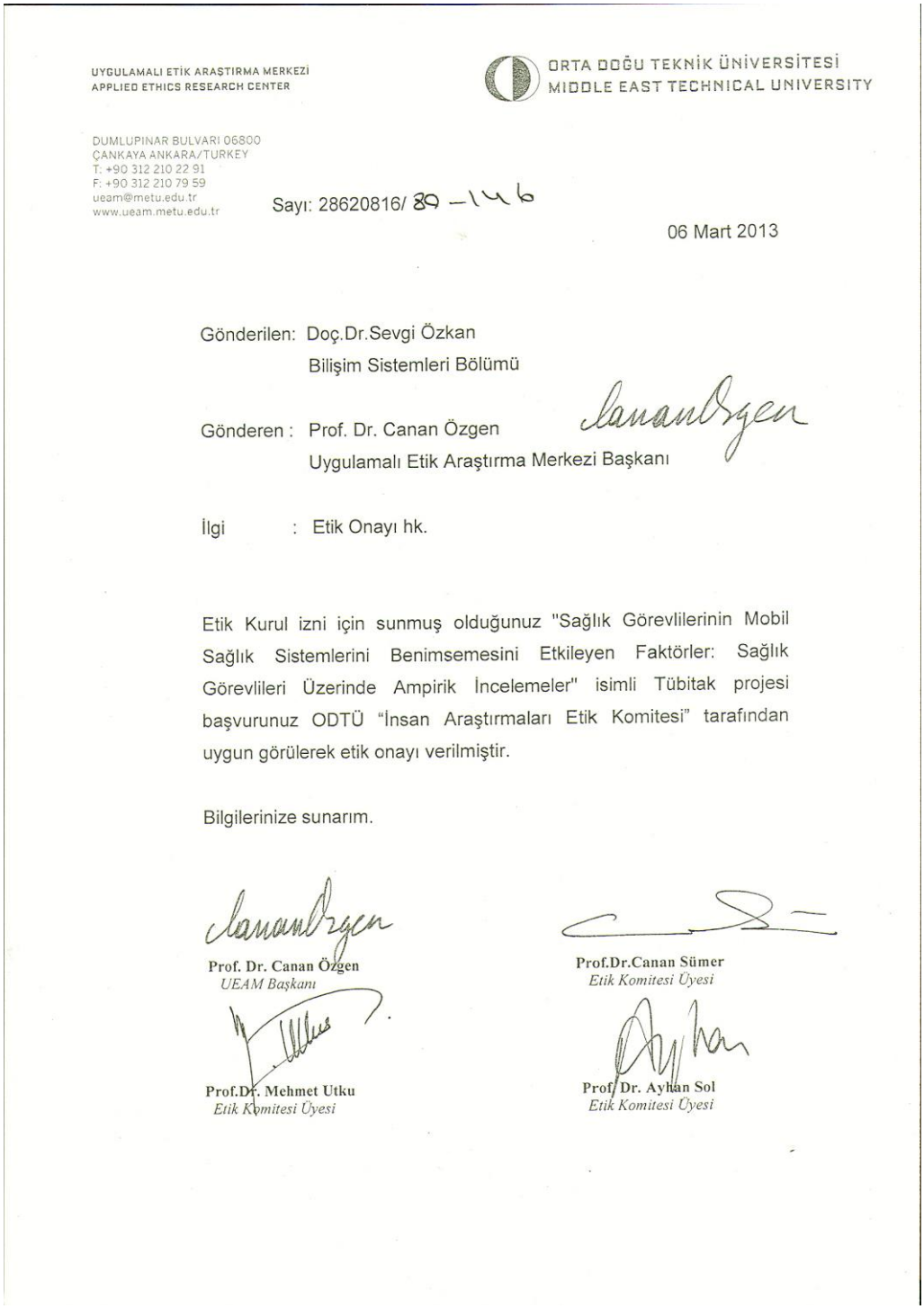
Data was collected from two different groups of physicians (users and non-users of mHealth applications). In that regard, two different methodologies were employed. For non-user physicians, a cross-sectional survey was conducted, and mixed method (including cross-sectional survey and focus group interviews) was employed for the mHealth application users. The data was analyzed employing confirmatory factor analysis (CFA) and structural equation modeling (SEM). Significant relations were identified, which depicted implications for mHealth application use. The model was able to explain intention to use with 59% of total variance for mHealth application users and 51% for non-user physicians.

This approach brought an alternative perspective to enlighten the literature in terms of revealing the potential intentions to use mHealth applications, as well as in-depth investigation of factors for actual users. In that regard, the study brought not only non-user physicians' perspective, but also it is the only study, to our knowledge, investigating perception of mHealth applications acceptance by non-user physicians and investigating intention to use mHealth applications with a mixed method. In addition to that, this study reported one of the first researches conducted in Turkey towards assessing physicians' intention to use mobile health applications.

The study contributed to the literature in the following aspects: (1) a new model was proposed to explain physicians' perceptions, (2) a new sample of the population was provided, and (3) a unique model (M-TAM) has been proposed. M-TAM proved its potential as a model to be employed for acceptance of mHealth applications in healthcare. Further studies on acceptance of mHealth applications by healthcare providers are required to provide insight about factors influencing the use of mHealth by different healthcare professions. In that regard, this research was an initiation collecting data from physicians who are using mHealth applications in practice, and providing information outlining differences among user and non-user physicians. In that regard, expanding the target group of research in different specialties would be a step as well as increasing the sample size. Furthermore, a longitudinal survey design would be a plus in order to report behavioral changes on mHealth application use over the time.

Institutional Review and Ethical Board Approval

In order to conduct survey study on human participants, it is required to get approval from the Institute of Review and Ethic of METU. The ethical permission was granted before the data collection and interviews. Please see the document below:



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APPENDICES

APPENDIX A

LITERATURE CHART

Study	Significantly related Variables	Model /Theory	Target Sample	Sample Size	Variance Explained	Resource
Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories	PU -BI Attitude-BI PBC-BI	Integrated model TAM-TPB	Physicians of telemedicine	408	0.43	(Chau & Hu, 2002)
Clinical acceptance of a low- cost portable system for postural assessment	PEOU-PU PU-BI	TAM	Physiotherapists	49	0.39	(Van Schaik, Bettany-Saltikov, & Warren, 2002)
An adaptation of the theory of interpersonal behavior to the study of telemedicine adoption by physicians	Self-Identity-BI Normative Factors- BI Habit- Affect	Theory of Interpersonal Behavior (TPB and TAM)	Physicians of telemedicine	519	0.81	(Marie-Pierre Gagnon et al., 2003)
Evaluating a Spoken Dialogue System for recording clinical observations during an endoscopic examination	Perceived System Response – PEOU	TAM	Clinicians	10	-	(Barker et al., 2003)
Does the extended Technology Acceptance	PU-BI Job relevance-PU	TAM2	Physicians (pediatricians)	89	0.54	(Chismar & Wiley-patton, 2003)

Model apply to Physicians?	Output Quality- PU					
Use of online systems in clinical medical assessments: an analysis of physician acceptance of online disability evaluation systems	Perceived Readiness-BI Attitude-BI Work Practice Compatibility-BI PEOU-PU PU-Attitude PEOU-Attitude	Integrated model by TAM, TPB and Task-Technology Fit	Physicians	141	0.44	(Horan, Tulu, Hilton, & Burton, 2004)
Understanding information technology acceptance by individual professionals: Toward an integrative view	Personal Innovativeness (PIIT)-PBC PIIT-Result Demonstrability (RD) PIIT- SN PIIT- PEOU PBC- BI PEOU- PU PU-BI SN- Image RD- PEOU RD- PU Image- PU	Integrated model by TAM and TPB	Physicians	222	0.57	(Yi et al., 2006)
The effects of creating psychological ownership on physicians' acceptance of clinical information systems	Attitude-Use PU-Use PU-Attitude PEOU-Attitude PEOU-PU Psychological ownership-PU Psychological ownership-PEOU	TAM	Physicians	91	0.55	(Paré, Sicotte, & Jacques, 2006)
Perceived system performance: a test of an extended technology acceptance model	Perceived System Performance-BI Perceived System Performance-PU Perceived System Performance - PEOU PEOU-PU PEOU-BI PU-BI	TAM	healthcare workers (managing patient records)	77	0.52	(L. Liu & Ma, 2006)

Obstacles to the adoption of radio frequency identification technology in the emergency rooms of hospitals	-	UTAUT	Emergency room medical teams	81	0.62	(C. Chen, Wu, & Crandall, 2007)
Physicians' acceptance of pharmacokinetics-based clinical decision support systems	Performance Expectancy-BI Effort Expectancy-BI	UTAUT	Physicians	140	0.43	(Chang et al., 2007)
ICT and OTs: a model of information and communication technology acceptance and utilization by occupational therapists	Effort Expectancy – BI Organizational facilitating conditions-Effort Expectancy Organizational facilitating conditions-Performance Expectancy Compatibility-Performance Expectancy Compatibility-BI Computer Anxiety – Effort Expectancy Performance Expectancy-Attitude Computer Self Efficacy-Effort Expectancy	UTAUT and TAM	Australian therapists	1605	0.63	(L. K. Schaper & Pervan, 2007)
Physician acceptance of information technologies: Role of perceived threat to professional autonomy (EMR and CDS: system comparison)	Perceived threat to autonomy -PU PU- BI PEOU- PU	TAM	Physicians	203,129	0.22, 0.18 (effect size)	(Walter & Lopez, 2008)

An extension of trust and TAM model with IDT in the adoption of the electronic logistics information system in HIS in the medical industry.	Perceived Financial Cost- BI Compatibility-BI Compatibility-PU PU-BI PEOU-PU PEOU-BI PEOU-Trust Trust- BI	TAM and IDT	Nurses	252	0.70	(Tung et al., 2008)
Paper vs. electronic medical records: The effects of access on physicians' decisions to use complex information technologies	Physical and Logical access -PEOU Physical and Logical access –PU Logical access- BI PEOU-PU PU- Attitude PEOU-Attitude PU-BI Attitude-BI	TAM	Physicians	199	0.64	(Ilie & Slyke, 2009)
Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model	Performance Expectancy-BI Effort Expectancy-BI	UTAUT	Health workers, nurses and public health specialists	1607	0.54	(Kijsanayotin et al., 2009)
Health IT acceptance factors in long-term care facilities: a cross-sectional survey	Image- BI Image- PEOU Subjective Norm- PU Subjective Norm- PEOU Job Role –PU Computer Level- BI Computer Level-PEOU PU-BI PEOU-BI PEOU-PU	TAM2	Caregivers	134	0.34	(Yu et al., 2009)

Using a modified technology acceptance model in hospitals	PU- Anxiety PU-BI PEOU-PU SN- BI Training-PEOU Training-Facilitating Conditions Facilitating conditions-PU/PEOU/ Anxiety/ Self-Efficacy Anxiety-Self Efficacy Anxiety-Attitudes towards Use PU- Attitudes towards Use PEOU-Attitudes towards Use	TAM and UTAUT	Members of medical, nursing and administrative personnel	283	0.87	(Aggelidis & Chatzoglou, 2009)
Applying the Technology Acceptance Model to the introduction of healthcare information systems	Information Quality- PU Service Quality- PU Service Quality-PEOU System Quality-PEOU PEOU- PU PU-BI PEOU-BI	TAM2 and IS Success Model	Nurses	366	-	(Pai & Huang, 2011)
Modeling the acceptance of clinical information systems among hospital medical staff: an extended TAM model	ICT feature demands- PU ICT Knowledge-PEOU PEOU- PU PU- Attitude Attitude- BI PEOU-Attitude PU-BI PEOU- BI	TAM	Physicians and medical staff	604	0.83	(Melas et al., 2011)

Explaining physicians' acceptance of EHCR systems: An extension of TAM with trust and risk factors	Information Integrity- Perceived Risk Information Integrity- Trust Perceived Risk- Trust Trust- PU Trust- PEOU Trust- Attitude towards Use PEOU- PU PU- Attitude Attitude- Intention to use	TAM	Physicians	254	0.96	(Ortega Egea & Román González, 2011)
Determinants of physicians' technology acceptance for e-health in ambulatory care	Intensity of IT utilization- PU Importance of Data Security- PU Importance of Documentation- PU e-Health Knowledge- PEOU Importance of Standardization- PEOU Process Orientation- PEOU PU- BI PEOU- BI PEOU-PU	TAM and UTAUT	German Physicians	117	0.55	(Dünnebeil et al., 2012)
Understanding physicians' acceptance of the Medline system for practicing evidence-based medicine: a decomposed TPB model	PEOU- PU PEOU- Attitude PU- Attitude Attitude- Usage Intention SN- Usage Intention PBC- Usage Intention Interpersonal Influence- SN Personal Innovativeness in IT- PBC Personal Innovativeness in IT- Self efficacy	TAM and TPB	Physicians in Taiwan	224	0.52	(S.-Y. Hung et al., 2012)

Pharmacy workers' perceptions and acceptance of bar-coded medication technology in a pediatric hospital	PU- BI SN- BI	TAM	Pharmacy Technicians	39	0.72	(Holden et al., 2012)
Towards an integrated model of IT acceptance in healthcare (Clinical management system)	PEOU -PU Enabling Factors- PEOU Information Quality- PU PU- ATT PEOU-ATT PU – Compatibility PEOU- Compatibility	Integrated TAM	Physicians, nurses, and allied health workers	346	0.23 (Att.)	(Moores, 2012)
Do hospital physicians' attitudes change during PACS implementation? A cross-sectional acceptance study	Performance Expectancy-BI Effort Expectancy-BI SN-BI BI- Use Facilitating Conditions- Performance Expectancy Facilitating Conditions- Effort Expectancy Facilitating Conditions- SN	UTAUT	Physicians	46- 61	0.26- 0.58	(Pynoo et al., 2012)
An investigation on physicians' acceptance of hospital information systems: A case study	Management support- PU Project-team competency – PEOU System quality- PEOU	TAM (extended with HOT-fit)	Physicians	124	0.81	(R.-F. Chen & Hsiao, 2012)

Factors Influencing Nurses' Intentions Toward the Use of Mobile Electronic Medical Records	Seniority – BI Compatibility – BI complexity – BI observability – BI	IDT	Nurses	720	0.50	(Hsu, Liu, Weng, & Chen, 2012)
Acceptance of hospital nurses toward sensor-based medication systems: a questionnaire survey	Image- PU Demonstrability- PU Personal Innovativeness - PU PU-BI	TAM and TAM2	Nurses	579	0.52	(Kummer et al., 2013)
Investigating primary health care nurses' intention to use information technology: An empirical study in Taiwan (primary health information system)	Compatibility-PU Perceived Trust (PT) - PU Compatibility –PT Social Norms –Attitude PU – Attitude PT- Attitude	TRA	Nurses	768	0.57	(S.-Y. Hung et al., 2014)
Electronic health record acceptance by physicians: Testing an integrated theoretical model	Professional Norm-BI SN- BI PEOU-BI Demonstrability of the Results (DR)- BI PEOU-PU Self-efficacy-PEOU DR - PU	Integrated model, psychosocial model and extended TAM	Physicians	150	0.44-0.55	(Marie-Pierre Gagnon et al., 2014)
Predictive factors of telemedicine service acceptance and behavioral intention of physicians	Self-efficacy – PEOU Self-efficacy – PU PEOU-PU Accessibility of medical records- PU	TAM	Physicians	183	-	(Rho, Choi, & Lee, 2014)

	Accessibility of patients – PU PU-BI PEOU-BI					
An investigation of the effects of cultural differences on physicians' perceptions of information technology acceptance as they relate to knowledge management systems	PU- BI PEOU- BI Perceived information security- BI SN- BI	Extended TAM	Physicians	106	0.68	(H.-C. Lin, 2014)
Physicians' acceptance of electronic medical records exchange: An extension of the decomposed TPB model with institutional trust and perceived risk	PEOU-ATT PU-PEOU Compatibility-ATT Interpersonal influence-SN Govn'tal influence- SN Self-efficacy – PBC Facilitating Cond.-PBC Institutional trust- User int. Percv. Risk-User int. ATT-User int. SN-User int. PBC-User int.	Extended TPB	Physicians	191	0.49	(Hsieh, 2015)
The effects of organizational contextual factors on physicians' attitude toward adoption of Electronic Medical Records	Management support- PU Management support-PEOU Involvement-PEOU Autonomy-PEOU Doc-Patient relationship-PEOU PU-USE PEOU-USE	TAM	Physicians	237	0.56	(Abdekhoda, Ahmadi, Gohari, & Noruzi, 2015)

Moderating Effects of Voluntariness on the Actual Use of Electronic Health Records for Allied Health Professionals	PE-Use EE-Use Fac. Cond.-Use Interest in internet and computer- Use (based on voluntariness)	UTAUT	Physiotherapists	93	0.165 in high voluntariness 0.346 in low voluntariness	(Chiu & Ku, 2015)
The moderating effects of demographic and individual characteristics on nurses' acceptance of information systems: A Canadian study	PU-ATT PEOU-ATT (Moderating factors: Education, Computer knowledge)	TAM	Nurses	197	0.32 (IS Use) (0.63, ATT)	(Ifinedo, 2015)
ACCEPTANCE STUDIES ON MOBILE HEALTH SERVICES						
PDA usage in healthcare professionals: testing an extended technology acceptance model	Personal Innovativeness - Actual Use PEOU- Actual Use Support-PEOU PEOU-PU Job Relevance- PU Compatibility-PU	TAM	Healthcare professionals in USA	119	0.62	(Liang, Xue, & Byrd, 2003)
Physicians' acceptance of mobile communication technology an exploratory study	PU-BI Age on ease of use-BI Age on compatibility-BI	TAM and UTAUT	Professional physicians	151	0.65	(Han et al., 2006)
Mobile computing acceptance factors in the healthcare industry: a structural equation model	Compatibility –Self Efficacy Compatibility-BI Compatibility-PU Compatibility-PEOU Self Efficacy-PU Self Efficacy-PEOU Technical support and training- Self efficacy	TAM and IDT	Physicians, nurses, and medical technicians in Taiwan	123	0.70	(J.-H. Wu et al., 2007)

	PEOU-PU PEOU-BI PU-BI					
An Examination of the Components that Increase Acceptance of Smartphones among Healthcare Professionals	Attitude –BI PU- BI PU- Attitude Self efficacy-PEOU Self efficacy - BI Compatibility - PU Task- Attitude Compatibility-PEOU	TAM-IDT	Physician and nurses	153	-	(J. Chen et al., 2010)
The adoption of mobile healthcare by hospital's professionals: An integrative perspective	Perceived Service Availability-PU Attitude- BI PEOU-PU PU- BI PU- Attitude Personal Innovativeness in IT- PEOU Personal Innovativeness in IT -PBC SN- BI PBC- BI Hospital type-BI	TAM and TPB	Hospital Professionals	140	0.63	(I.-L. Wu et al., 2011)
Are Physicians Likely to Adopt Emerging Mobile Technologies? Attitudes and Innovation Factors Affecting Smartphone Use in the Southeastern United States	Observability - ATT Compatibility -ATT job Relevance - ATT personal Experience – ATT Internal env'nt –ATT External env'nt -ATT	TAM and IDT	Physicians	103	Beta: 0,83	(Putzer & Park, 2012)

Factors Affecting Mobile Diabetes Monitoring Adoption Among Physicians: Questionnaire Study and Path Model	Overall Quality-Perceived Value SN-Intention Net Benefits-Intention Net Benefits-Perceived Value	IS success model	Physician	471	0,82	(Okazaki, Castañeda, Sanz, & Henseler, 2012)
Predicting Tablet Computer Use: An Extended Technology Acceptance Model for Physicians	ATT-Intention PU-Intention PU-ATT PEOU-ATT SN-PU Compatibility-PU Compatibility-PEOU Reliability-PU Reliability-PEOU	TAM	pediatricians	261	0.51	(Ducey & Coovert, 2016)
Analysis of the factors influencing healthcare professionals' adoption of mobile electronic medical record (EMR) using the unified theory of acceptance and use of technology (UTAUT) in a tertiary hospital	PE- ATT EE-ATT SI-BI Facilitating Cond.- BI	TAM and UAUT	Doctors and nurses	449	-	(Kim et al., 2016)
Physicians' motivations to use mobile health monitoring: a cross-country comparison	PI- Perceived value PI- Ubiquitous control PI-Compatibility Perceived value- Use Ubiquitous control – UseCompatibility-Use	IDT	Doctors from Spain and Japan	471 (Japan), 497 (Spain)	β =.11 - .57	(Okazaki et al., 2016)

APPENDIX B

SURVEY QUESTIONS

This survey has been designed to assess your attitudes towards the use of m-Health system. While you are answering the questions please take into consideration your experiences in using m-Health applications. The answers you provided will be solely used for scientific purposes and will not be shared with the third parties.

PART 1. DEMOGRAPHIC QUESTIONS

1. Gender: □ Female □ Male
2. Age: _____

3. Education Level:
   □ Have Bachelors degree □ Have Profession degree □ Have PhD degree
   What is your profession: _____

4. Experience in mobile device use?
   □ None □ Less than 1 year □ 1-3 years □ 4-6 years □ 7-9 years □ 10 years and more
5. What mobile devices do you use? □ Smart phone □ Tablet PC □ Laptop □Other

6. Skill Level in Mobile device use?
   □ Excellent □ Good □Moderate □ Bad

7. Have you ever used mobile health application before? □ Yes □ No

8. What is your mobile health application use frequency?
   □ None □ Once in a Month □ 2-3 times in a Month □ Once in a Week □ 2-3 times in a Week □ Everyday

9. Do you use the mobile health applications on voluntary basis? □ Yes □ No

10. How long have you been using the mobile health applications?
    □ None □ Less than one year □ 1-2 years □ 3-4 years □ 5 years and above

11. How can you define the type of your health institution?
    □ Medical center □ Regional hospital □ Local hospital
12. Which mobile health applications do you use?
    _____

PART 2. M-HEALTH QUESTIONS	**Answers** 1=I strongly disagree 2=I disagree 3= I have no idea 4= I agree 5=I strongly agree
I intend to use the m-health.	
I predict I will use m-health in the next 3 months	
I plan to use m-health in the next 3 months	
My interaction with m-health would be clear and understandable.	
It would be easy for me to become skillful at using the m-health.	
I would find the m-health easy to use.	
I would find m-health useful in my job	
Using the m-health increases my productivity	
Using the m-health enables me to accomplish tasks more quickly	
People who influence my behavior think that I should use the m-health.	
People who are important to me think that I should use the m-health.	
The senior health administration has been helpful in the use of the m-health.	
I frequently use mobile systems during my life.	
I feel like I must use m-health.	
The use of m-health has become a habit for me.	
If I heard about a new information technology, I would look for ways to experiment with it	
Among my peers, I am usually the first to try out new information technologies	
I like to experiment with new information technologies	
I have no difficulty telling others about the results of using a m-health.	
The results of using m-health are apparent to me	
I would have difficulty telling others about the results of using a m-health	
I could complete the job using m-health if there was no one around to tell me what to do as I go	
I could complete the job using m-health if I had never used a system like it before	
I could complete the job using m-health if I had used similar system before this one to do the same job	
The mobile system is somewhat intimidating the wrong to me	
I hesitate to use the m-health for fear of making mistakes that I cannot correct	
I feel apprehensive about using the system	
Specialized instruction and education concerning use of m-health is available to me	
A specific person (or group) is available for assistance with m-health difficulties	
Specialized programs or consultant about training are available to me	
I would be able to use m-health at any time, from anywhere.	
I would find m-health easily accessible and portable.	
m-health would be available to use whenever I need it	
Using m-health system is compatible with most aspects of my work	
Using m-health fits well with the way I like to work	
Using m-health fits into my work style	

Survey Questions (Turkish):

Bu anket sizlerin mobil sağlık uygulamalarına karşı olan tutumunuzu ölçme amaçlı oluşturulmuştur. Lütfen anketi doldururken mobil sağlık uygulamalarını kullanımından edindiğiniz deneyimlerinizi ve izlenimlerinizi göz önünde bulundurunuz. Verdiğiniz bilgiler sadece bilimsel amaçlı kullanılacak olup hiçbir şekilde 3. Kişilerle paylaşılmayacaktır.

Bölüm 1. Demografik sorular

1. Cinsiyet: □ Kadın □ Erkek

2. Yaş: _____

3. Eğitim Seviyesi:
   □ Lisans mezunu/ pratisyen □ Uzman □ Doktora derecesi
   Uzmanlığınız hangi branş üzerinedir: _____

4. Mobil cihaz kullanımı deneyimi
   □ Yok □ 1 yıldan az □ 1-3 yıl □ 4-6 yıl □ 7-9 yıl □ 10 yıldan fazla
5. Hangi mobil cihazları kullanıyorsunuz?
   □ Akıllı Telefon □ Tablet Bilgisayar □ Dizüstü bilgisayar □Diğer

6. Mobil cihaz kullanımındaki yetkinliğiniz
   □ Mükemmel □ İyi □Orta □ Kötü

7. Daha önce mobil sağlık uygulaması kullandınız mı? □ Evet □ Hayır

8. Ne sıklıkla mobil sağlık uygulaması kullanırsınız?
   □ Hiç □ Ayda bir □ Ayda 2-3 kere □ Haftada bir □ Haftada 2-3 kere □ Her gün

9. Mobil sağlık uygulamalarını gönüllü olarak mı kullanıyorsunuz? □ Evet □ Hayır

10. Ne zamandır mobil sağlık uygulamalarını kullanıyorsunuz?
    □ Hiç □ Bir yıldan az □ 1-2 yıl □ 3-4 yıl □ 5 yıldan fazla

11. Çalıştığınız sağlık kurumunu hangi kategoride değerlendirirsiniz?
    □ Sağlık/ araştırma merkezi □ Devlet Hastanesi □ Sağlık Ocağı/ Dispanser

12. Hangi mobil sağlık uygulamalarını kullanıyorsunuz?
    _____

Anket Soruları	**Cevap skalası** 1=Kesinlikle katılmıyorum 2=Katılmıyorum 3= Kararsızım 4= Katılıyorum 5=Kesinlikle katılmıyorum
Mobil sağlık uygulamalarını kullanmaya niyetim vardır	
Gelecek 3 ay içerisinde mobil sağlık uygulamalarını kullanacağımı tahmin ediyorum.	
Gelecek 3 ay içerisinde mobil sağlık uygulamalarını kullanmayı planlıyorum.	
Mobil sağlık uygulamaları ile açık ve anlaşılır bir şekilde etkileşim kuruyorum.	
Mobil sağlık uygulamaları kullanmada yetkin olabilmek benim için kolaydır.	
Mobil sağlık uygulamalarının kullamını kolay buluyorum.	
Mobil sağlık uygulamalarını işim için faydalı buluyorum.	
Mobil sağlık uygulamalarını kullanmak üretkenliğimi arttırır.	
Görevlerimi yerine getirmemde mobil sağlık uygulamalarını kullanmak süreci hızlandırır.	
Beni etkileyen insanlar/ çevrem mobil sağlık uygulamalarını kullanmamı söyler.	
Benim için önemli olan kişiler mobil sağlık uygulamalarını kullanmam konusunda beni teşvik eder.	
Kurum yönetimi mobil sağlık uygulamaları kullanımını destekler.	
Hayatım boyunca sıklıkla mobil sağlık uygulamalarını kullanırım.	
Mobil sağlık uygulamalarını kullanmak zorunda hissederim.	
Mobil sağlık uygulamalarını kullanmak benim için bir alışkanlıktır.	
Yeni bir teknolojinin çıktığını öğrenirsem, bu teknolojiyi kullanmak isterim.	
Arkadaşlarım arasında genellikle yeni teknolojileri ilk ben kullanırım.	
Yeni teknolojileri kullanmayı severim.	
Mobil sağlık uygulamalarını kullandıktan sonra sonuçlarını paylaşmakta sorun yaşamam.	
Mobil sağlık uygulamalarını kullanırken ulaşacağım sonuçlar beklediğim gibi olmaktadır.	
Mobil sağlık uygulamalarını kullandıktan sonra sonuçlarını paylaşmakta zorluk çekerim.	
Etrafımda yardım edecek biri yokken Mobil sağlık uygulamalarını üzerinden yapacağım bir işimi kendim tamamlayabilirim.	
Daha önce benzer bir uygulama kullanmamış olsam da Mobil sağlık uygulamalarını kullanarak işimi tamamlayabilirim.	
Daha önce benzer bir uygulama kullanırsam eğer Mobil sağlık uygulamalarını kullanarak işimi tamamlayabilirim.	
Mobil sağlık sistemleri bana bir şekilde caydırıcı ve yanlış gelmektedir.	
Düzeltemeyeceğim bir hata yapma çekincemden dolayı Mobil sağlık uygulamalarını kullanma konusunda tereddüt ederim.	
Mobil sağlık uygulamalarını kullanma konusunda endişeli yaklaşırım.	
Mobil sağlık uygulamalarını kullanma konusunda özel ders ve eğitim almam mümkündür.	

Mobil sağlık uygulamalarını kullanma sürecinde karşılaşacağım zorulukların üstesinden gelmek adına bana yardımcı olmak için yardımcı olacak kişi veya kişiler vardır.	
Mobil sağlık uygulamalarını kullanım konusunda katılabileceğim özel programlar veya danışmanım mevcuttur.	
İstediğim zaman ve istediğim yerde Mobil sağlık uygulamalarını kullanabilirim.	
Mobil sağlık uygulamalarını kolay erişilebilir buluyorum.	
Mobil sağlık uygulamaları istediğim zaman kullanıma hazır olmaktadır.	
Mobil sağlık uygulamalarını kullanmak benim işimde yaptığım çoğu görevle uyumludur.	
Çalışma alışkanlıklarımla mobil sağlık uygulamaları uyuşmaktadır.	
Çalışma stilimle mobil sağlık uygulamaları uyum göstermektedir.	

Updated Survey Questions after Pilot Study

This survey has been designed to assess your attitudes towards the use of m-Health system. While you are answering the questions please take into consideration your experiences in using m-Health applications. The answers you provided will be solely used for scientific purposes and will not be shared with the third parties.

PART 1. DEMOGRAPHIC QUESTIONS

1. Gender: ☐ Female ☐ Male
2. City you are currently working:
3. Age: _____
4. Education Level:
   ☐ Have Bachelors degree
   ☐ Have Profession degree
   ☐ Have PhD degree
   What is your profession: _____

5. Experience in mobile device use?
   ☐ None ☐ Less than 1 year ☐ 1-3 years ☐ 4-6 years ☐ 7-9 years ☐ 10 years and more
6. What mobile devices do you use? ☐ Smart phone ☐ Tablet PC ☐Other

7. Skill Level in Mobile device use?
   ☐ Excellent ☐ Good ☐Moderate ☐ Bad

8. Have you ever used mobile health application before? ☐ Yes ☐ No

9. What is your mobile health application use frequency?
   ☐ None ☐ Once in a Month ☐ 2-3 times in a Month ☐Once in a Week ☐ 2-3 times in a Week ☐Everyday

10. Do you use the mobile health applications on voluntary basis? ☐ Yes ☐No

11. How long have you been using the mobile health applications?
    ☐ None ☐ Less than one year ☐ 1-2 years ☐3-4 years ☐5 years and above

12. How can you define the type of your health institution?
    ☐Public hospital ☐Training research hospital ☐Health research center ☐Community clinic ☐Private hospital ☐on-site doctor ☐ others

13. Which mobile health applications do you use?
    _____

PART 2. M-HEALTH QUESTIONS	**Answers**
	1=I strongly disagree 2=I disagree 3= I have no idea 4= I agree 5=I strongly agree
I intend to use the m-health.	
I predict I will use m-health in the next 3 months	
I plan to use m-health in the next 3 months	
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It would be easy for me to become skillful at using the m-health.	
I would find the m-health easy to use.	
I would find m-health useful in my job	
Using the m-health increases my productivity	
Using the m-health enables me to accomplish tasks more quickly	
People who influence my behavior think that I should use the m-health.	
People who are important to me think that I should use the m-health.	
The senior health administration has been helpful in the use of the m-health.	
I frequently use mobile systems during my life.	
The use of m-health has become a habit for me.	
If I heard about a new information technology, I would look for ways to experiment with it	
Among my peers, I am usually the first to try out new information technologies	
I like to experiment with new information technologies	
I have no difficulty telling others about the results of using a m-health.	
The results of using m-health are apparent to me	
I could complete the job using m-health if there was no one around to tell me what to do as I go	
I could complete the job using m-health if I had never used a system like it before	
I could complete the job using m-health if I had used similar system before this one to do the same job	
The mobile system is somewhat intimidating and wrong to me	
I feel apprehensive about using the system	
Specialized instruction and education concerning use of m-health is available to me	
A specific person (or group) is available for assistance with m-health difficulties	
Specialized programs or consultant about training are available to me	
I would be able to use m-health at any time, from anywhere.	
I would find m-health easily accessible and portable.	
m-health would be available to use whenever I need it	
Using m-health system is compatible with most aspects of my work	
Using m-health fits well with the way I like to work	
Using m-health fits into my work style	

Updated Survey Questions after Pilot Study (Turkish):

Gönüllü Katılım Formu

Bu çalışma, Ortadoğu Teknik Üniversitesi, Enformatik Enstitüsü Doktora öğrencilerinden Emre Sezgin tarafından, Prof. Dr. Soner Yıldırım ve Doç. Dr. Sevgi Özkan Yıldırım danışmanlığında yürütülen bir çalışmadır. Çalışmanın amacı katılımcıların mobil sağlık uygulamalarına karşı olan tutum ve eğilimleri ile ilgili bilgi toplamaktır.

Çalışmaya katılım gönüllülük esasına dayanmakta olup sizden kimliğinizi belirleyici hiçbir bilgi istenilmemektedir. Vereceğiniz cevaplar gizli tutulacak ve sadece araştırmacılar tarafından analiz edilecektir. Edilecek bilgiler doktora tezi ve bilimsel yayınlarda kullanılacaktır. Ankette kişisel olarak rahatsız edici bilgiler yer almamaktadır. Bu şekilde hissettiğiniz taktirde pencereyi kapatarak uygulamadan çıkabilirsiniz. Katılımınız için teşekkürler.

Çalışma hakkında daha fazla bilgi almak için e-posta (esezgin @metu. edu. tr) ve telefon (+90 (312) 210 787 1) yoluyla bize ulaşabilirsiniz.

Yukarıdaki bilgileri okuduysanız ve katılmayı kabul ediyorsanız aşağıdaki bağlantıya tıklayarak ankete ulaşabilirsiniz.

Anket süresi = ~8-9 dakika

MOBİL SAĞLIK UYGULAMASI NEDİR?

Çalışmada konu olan mobil sağlık uygulamaları, tedavi ve tanı koyma sürecinde size yardımcı olan uygulamalardır. Bu kapsamda, ilaç bilgilerini kontrol ettiğiniz ve materyal ve referansları incelediğiniz uygulamalar (örn, Up To Date, Epocrates), branşınıza yönelik uygulamalar (örn, aliveECG, isabel) ve hatta medikal olarak not aldığınız ve hatta haftalık program oluşturduğunuz uygulamalar dahil (örn, Evernote, Google Takvim) bu süreçte kullandığınız bütün mobil uygulamaları lütfen göz önünde bulundurunuz. Mobil sağlık uygulamalarına örnek olarak şu bağlantıda yer alan up-to-date uygulamasını inceleyebilirsiniz. (http://www.tekdozdijital.com/dijital-doktorlar-ve-uptodate-uygulamasi.html)

Bölüm 1. Demografik sorular

1. Cinsiyet: ☐ Kadın ☐ Erkek

2. Çalıştığınız şehir:

3. Yaş: _____

4. Eğitim Seviyesi:
   ☐ Lisans mezunu/ pratisyen ☐ Uzman ☐ Doktora derecesi
   Uzmanlığınız hangi branş üzerinedir: _____

5. Mobil cihaz kullanımı deneyimi
   ☐ Yok ☐ 1 yıldan az ☐1-3 yıl ☐ 4-6 yıl ☐ 7-9 yıl ☐ 10 yıldan fazla
6. Hangi mobil cihazları kullanıyorsunuz?
   ☐ Akıllı Telefon ☐ Tablet Bilgisayar ☐Diğer

7. Mobil cihaz kullanımındaki yetkinliğiniz
   ☐ Mükemmel ☐ İyi ☐Orta ☐Kötü

8. Daha önce mobil sağlık uygulaması kullandınız mı? ☐ Evet ☐ Hayır

9. Ne sıklıkla mobil sağlık uygulaması kullanırsınız?
   ☐ Hiç ☐ Ayda bir ☐Ayda 2-3 kere ☐ Haftada bir ☐ Haftada 2-3 kere ☐ Her gün

10. Mobil sağlık uygulamalarını gönüllü olarak mı kullanıyorsunuz? ☐ Evet ☐Hayır

11. Ne zamandır mobil sağlık uygulamalarını kullanıyorsunuz?
    ☐ Hiç ☐ Bir yıldan az ☐ 1-2 yıl ☐ 3-4 yıl ☐ 5 yıldan fazla

12. Çalıştığınız sağlık kurumunu hangi kategoride değerlendirirsiniz?
    ☐Devlet hastanesi ☐Eğitim araştırma hastanesi ☐Sağlık/ araştırma merkezi ☐Sağlık ocağı/Dispanser ☐Özel poliklinik / hastane ☐İşyeri hekimliği ☐Diğer (lütfen belirtiniz)

13. Hangi mobil sağlık uygulamalarını kullanıyorsunuz? _____

Anket soruları	**Cevap skalası** 1=Kesinlikle katılmıyorum 2=Katılmıyorum 3= Kararsızım 4= Katılıyorum 5= Kesinlikle katılmıyorum
Mobil sağlık uygulamalarını kullanmayı isterim.	
Gelecek 3 ay içerisinde mobil sağlık uygulamalarını kullanacağımı tahmin ediyorum.	
Gelecek 3 ay içerisinde mobil sağlık uygulamalarını kullanmayı planlıyorum.	
Mobil sağlık uygulamaları ile açık ve anlaşılır bir şekilde etkileşim kuruyorum.	
Mobil sağlık uygulamaları kullanmada yetkin olabilmek benim için kolaydır.	
Mobil sağlık uygulamalarının kullamını kolay buluyorum.	
Mobil sağlık uygulamalarını işim için faydalı buluyorum.	
Mobil sağlık uygulamalarını kullanmak üretkenliğimi arttırır.	
Görevlerimi yerine getirmemde mobil sağlık uygulamalarını kullanmak süreci hızlandırır.	
Beni etkileyen insanlar/ çevrem mobil sağlık uygulamalarını kullanmamı söyler.	
Benim için önemli olan kişiler mobil sağlık uygulamalarını kullanmam konusunda beni teşvik eder.	
Kurum yönetimi mobil sağlık uygulamaları kullanımını destekler.	
Günlük hayatım boyunca sıklıkla mobil sağlık uygulamalarını kullanırım.	

Mobil sağlık uygulamalarını kullanmak benim için bir alışkanlıktır.	
Yeni bir teknolojinin çıktığını öğrenirsem, bu teknolojiyi kullanmak isterim.	
Arkadaşlarım arasında genellikle yeni teknolojileri ilk ben kullanırım.	
Yeni teknolojileri kullanmayı severim.	
Mobil sağlık uygulamalarını kullandıktan sonra sonuçlarını etrafımdakilerle paylaşmakta sorun yaşamam.	
Mobil sağlık uygulamalarını kullanırken ulaşacağım sonuçlar beklediğim gibi olmaktadır.	
Etrafımda yardım edecek biri yokken Mobil sağlık uygulamalarını üzerinden yapacağım bir işimi kendim tamamlayabilirim.	
Daha önce benzer bir uygulama kullanmamış olsam da Mobil sağlık uygulamalarını kullanarak işimi tamamlayabilirim.	
Eğer daha önce benzer bir uygulama kullandıysam, Mobil sağlık uygulamalarını kullanarak işimi tamamlayabilirim.	
Mobil sağlık sistemleri bana bir şekilde rahatsız edici ve yanlış gelmektedir.	
Mobil sağlık uygulamalarını kullanma konusunda kendimi rahat hissetmem, endişelerim vardır.	
Mobil sağlık uygulamalarını kullanma konusunda özel ders ve eğitim almam mümkündür.	
Mobil sağlık uygulamalarını kullanma sürecinde karşılaşacağım zorlukların üstesinden gelmek adına bana yardımcı olacak kişi veya kişiler vardır.	
Mobil sağlık uygulamalarını kullanma konusunda katılabileceğim özel programlar veya danışabileceğim kişiler mevcuttur.	
İstediğim zaman ve istediğim yerde Mobil sağlık uygulamalarını kullanabilirim.	
Mobil sağlık uygulamalarını kolay erişilebilir buluyorum.	
Mobil sağlık uygulamaları istediğim zaman kullanıma hazırdır.	
Mobil sağlık uygulamalarını kullanmak benim işimde yaptığım çoğu görevle uyumludur.	
Çalışma alışkanlıklarımla mobil sağlık uygulamaları uyuşmaktadır.	
Çalışma stilimle mobil sağlık uygulamaları uyum göstermektedir.	

APPENDIX C

FOCUS GROUP INTERVIEW –QUESTION FORM (TURKISH)

Introduction

Merhabalar, hoş geldiniz. bugün mobil sağlık uygulamalarının kullanımına yönelik bir çalışma yapmak için toplanık. Öncelikle şunu belirtmek isterim ki bu çalışma tamamen gönüllülük esasına dayanmakta ve istediğiniz zaman çalışmadan çıkabilirsiniz, bu konuda çekinceniz olmasın. Çalışma sırasında vermiş olduğunuz bilgiler tamamen bilimsel amaçlarla kullanılacaktır ve hiçbir üçüncü şahıslarla paylaşılmayacaktır. Katılımınız için şimdiden çok teşekkürler.

Konu hakkında daha detaylı bilgi vermem gerekirse çalışma doktora tezim kapsamında yürüttüğüm, mobil sağlık uygulamalarının doktorlar tarafından kullanımını etkileyen faktörleri inceleyen bir çalışmadır. Bu kapsamda halihazırda anket yoluyla doktorlardan bilgi topladık ancak daha kapsamlı bir inceleme için sizlerin kişisel fikirlerinize ihtiyacımız var. Taktir edersiniz ki anket yöntemi ile erişebileceğimiz bilgi kısıtlı. Dolayısıyla sizin vereceğiniz her bilgi önemli katkı sağlayacaktır.

Mobil sağlık uygulamaları nelerdir: mobil sağlık uygulamaları günlük hayatınızda, çalışmalarınızda ve rutininizde kullandığınız mobil uygulamalar olmak üzere ele alabiliriz. Bu konuda e-ilaç, up-to-date, tıbbi hesap makineleri gibi uygulamalar örnek verilebilir. Hatta randevu kayıtlarınızı tuttuğunuz uygulamalar ve programızı oluşturmak için kullandığınız takvim uygulaması da bu kapsamda msağlık uygulaması olarak değerlendirebiliriz. Dolayısıyla görüşmemiz sırasında cevap verirken bunları göz önünde bulundurabilirsiniz sevinirim.

- M-sağlık uygulamaları hakkında neler biliyorsunuz?
- Bana mobil sağlık denildiği zaman aklınıza ne geliyor söyler misiniz?
- Yani sizin için mobil sağlık nedir?
- m-sağlık uygulamalarının avantajları ve dezavantajları nelerdir sizce?
- M-sağlık uygulamalarını kullanırken yaşadığınız problemler nelerdir?
- Sizi kullanmaya motive eden etkenler nelerdir?
- Kullanıdğınız msağlık uygulamaları nelerdir?
- Yeterli sayıda ve kalitede uygulama var mı?
- En çok hangi amaçla msağlık app kullanılmakta?
- msağlık uygulamalarının hayati bir önemi var mıdır? Yada olacak mıdır?
- yeni nesil doktorların m-sağlık kullanımını nasıl buluyorsunuz?
- msağlık uygulamları tıp eğitiminin bir parçası olmalı mı?
- Sizce mevcuz işinizi m-sağlık aplikasyonu olmadan ne ölçüde yapabilirsiniz?
- Tamamen yapılamaz mı yoksa süreç yavaşlar mı?
- Mobil uygulamalar olmadan performans ne ölçüde azalır?

- bu görüşünüzü örneklendirebilir misiniz?
- İhtiyaç duyduğunuzda mobil uygulamalarına erişimde sorun yaşıyor musunuz?
- Peki msağlık uygulamaları için aynısı geçerli midir?
- Mobil Uygulamalara güveniyor musunuz?
- Sonuçların ayrıca sağlamasını yapıyor musunuz?
- mobil uygulama yerine arkadaşınızı aramak yada bilgisayardan bakmak daha mı uygun gelmekte?
- (anxiety gözlemlendiği halde kullanıyorsa) neler motive etmekte?
- Çevrenizde msağlık kullanımı konusunda kaygı taşıyan doktorlar var mı?
- Ne tür davranışlar sergiliyor?
- yeni teknolojilere karşı ilginizi nasıl değerlendirsiniz?
- Yeni bir teknoloji, telefon, televizyon veya bilgisayar gibi ürünler çıkınca almak kullanmak ister misiniz yoksa o kadar ilgi göstermez misiniz?
- Aynı ilgi mobil uygulamalar için geçerli midir? Peki msağlık için?
- Mobil uygulamalar mevcut sistemle uyumlu mu?
- Yani bilgisayarda halledebildiğiniz işlerinizi mobil cihazınızda uygulamalarla yapabiliyor musunuz?
- peki bunu mobil sağlık uygulamaları için de söyleyebilir miyiz?
- Son on yılda mesleğinizi icra etmenizi etkileyen yenilikler veya yeni teknolojiler var mıdır? Varsa nelerdir?
- Diyelim ki bir mobil uygulama var. Çok fonksiyonlu, biraz karmaşık ve öğrenmesi zor ama sizin işiniz için çok faydalı. bu uygulamayı kullanır mısınız?
- Peki mobil uygulamaları genel olarak kolaylıkla kullanabilir misiniz? Yoksa bu süreç biraz uzun mudur?
- Mobil uygulamaları sıklıkla kullanır mısınız? Peki msağlık uygulamalarını?
- Günlük kaç saat kullanırsınız mesela?
- Mobil uygulamalar sizin için bir alışkanlık mıdır?
- mobil uygulama kullanımında hiç etrafınızdan yardım istediğiniz oluyor mu?
- Peki bunu mSağlık uygulamaları için yapar mısınız?
- Mobil uygulamaları kullanımına karşı bir yatkınlığınız var mıdır?
- Arkadaşlarınızla yeni öğrendiğiniz veya keşfettiğiniz uygulamaları paylaşır mısınız?
- Eğer evetse bunu msağlık uygulamaları için de yapar mısınız?
- Mobil sağlık uygulamalarını kullanıma yönelik bir prosedür veya yönetim kararı var mıdır?
- Mobil uygulama kullanımında yardıma, asistana veya eğitime ihtiyaç hissettiniz mi?
- Peki mSağlık kullanımında ihtiyacını hissettiniz mi?
- Mesela düzenli eğitimler olsa ve bir yardım ekibi olsa nasıl olur?
- eğitim almak konusunda veya gelecek bu uygulamanın mevcut düzeninizi değiştirmesi konusunda bir sorun hissetmiyorsunuz?

APPENDIX D

CONSTRUCTS AND DEFINITIONS

Constructs	Definitions
Perceived Usefulness (PU)	"The degree to which a person believes that using a particular system would enhance his or her job performance"
Behavioral Intention (BI)	"An individual's performing a conscious act, such as deciding to accept (or use) a technology"
Perceived ease of use (PEOU)	"The degree to which a person believes that using a particular system would be free of effort"
Compatibility	"The degree to which the use of the system is perceived to be consistent with health- care professionals' existing values, prior experiences and needs"
Self-Efficacy	"The healthcare professional's perceptions of his or her ability to use the system in the accomplishment of healthcare task"
Technical support and training	"The technical support and the amount of training provided by individuals or groups with the system knowledge"
Attitude	"Individual's positive or negative feeling about performing the target behavior "
Task	"Task includes structure of the task, jurisdiction, and uncertainty"
Perceived Service Availability	"Perceived service availability refers to the degree to which an innovation is perceived as being able to support pervasive and timely usage"
Personal Innovativeness in IT	"Personal innovativeness represents the degree to which an individual is willing to take a risk by trying out an innovation"
Social Norms (SN)	"The degree to which the social environment perceives particular technology as desirable"
Perceived Behavioral Control (PBC)	"Reflects perceptions of internal and external constraints on behavior and encompasses self-efficacy, resource facilitating conditions, and technology facilitating condition"
Facilitating conditions	"The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system."
Computer anxiety	"The degree of an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers"
Effort expectancy	"The degree of ease associated with the use of the system."
Performance expectancy	"The degree to which an individual believes that using the system will help him or her to attain gains in job performance."
Job relevance	"Individual's perception regarding the degree to which the target system is relevant to his or her job"
Image	"Individual's perception regarding the degree to which the target system is relevant to his or her job"
Output quality	"The degree to which an individual believes that the system performs his or her job tasks well."
Result demonstrability	"Tangibility of the results of using the innovation"
Voluntariness	"The extent to which potential adopters perceive the adoption decision to be non-mandatory"

APPENDIX E

MHEALTH APPLICATION CATEGORIES AND SPECIALTIES

Field of Expertise/ Category / Purpose	Information Management	Time Management	Health Record Maintenance and Access	Communications and consulting	Reference and Information Gathering	Clinical Decision Making	Patient Monitoring	Medical Education and Training
Emergency medical service	**X**	**X**	-	**X**	**X**	**X**	-	-
Primary care	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
immunology and allergy	-	**X**	-	**X**	**X**	**X**	-	**X**
Anesthesia	**X**	**X**	-	**X**	**X**	**X**	-	**X**
Surgery	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Pulmonology	-	-	-	**X**	**X**	**X**	-	**X**
Pediatrics	**X**	-	-	**X**	**X**	**X**	**X**	**X**
Dermatology	-	**X**	-	**X**	**X**	**X**	-	**X**
Internal medicine	-	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Dentist	**X**	**X**	**X**	**X**	**X**	**X**	-	**X**
Dietetician	-	**X**	-	**X**	**X**	**X**	**X**	-
Physical medicine and rehabilitation	-	**X**	**X**	**X**	**X**	**X**	-	-
Genetics	-	**X**	-	**X**	**X**	**X**	-	-
Ophthalmology	-	-	-	**X**	**X**	**X**	-	**X**
Aviation medicine	**X**	-	-	**X**	**X**	**X**	-	-
Hematology	**X**	-	-	**X**	**X**	**X**	-	-
Gynecology	**X**	-	-	**X**	**X**	**X**	-	-
Cardiology	**X**	**X**	-	**X**	**X**	**X**	**X**	**X**
Otorhinolaryngology	-	-	-	**X**	**X**	**X**	-	**X**
Neurology	**X**	-	-	**X**	**X**	**X**	-	
Oncology	**X**	**X**	-	**X**	**X**	**X**	-	
Orthopedics	**X**	-	-	**X**	**X**	**X**	-	
Pathology	**X**	-	-	**X**	**X**	**X**	-	
Psychiatry	**X**	**X**	-	**X**	**X**	**X**	-	
Radiology	**X**	-	-	**X**	**X**	**X**	-	
Urology	**X**	**X**	**X**	**X**	**X**	**X**	-	
Pharmacology	**X**	**X**	**X**	**X**	**X**	**X**	-	
Medical biochemistry	-	**X**	-	**X**	**X**	**X**	-	-
General practitioner	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Doctoral degree	**X**	**X**	-	**X**	**X**	**X**	-	**X**

APPENDIX F

SUMMARY OF THE RESEARCH

<table>
<tr><th>Research Questions</th><th>Data Sources</th><th>Variables</th><th>Instruments</th><th>Data Analyses</th></tr>
<tr><td rowspan="2">RQ1: What are the factors /determinants influencing health professionals' intention to use m-Health applications as assistive mobile technology in decision making processes?

RQ2: What are the relationships among the factors influencing the use of m-Health applications?</td><td>Pilot study: Responses from 56 physicians</td><td rowspan="2">• Behavioral intention
• Effort expectancy
• Performance expectancy
• Social influence
• Habit
• Personal innovativeness in the domain of IT
• Result demonstrability
• Compatibility
• Mobile Self efficacy
• Mobile anxiety
• Technical support and training
• Perceived service availability</td><td rowspan="2">- Questionnaire</td><td>Pilot Study:
- Internal consistency
- Correlational analysis</td></tr>
<tr><td>Main study: Physicians actively working in a Turkish health institution. (271 physicians participated)</td><td>Main Study:
- CFA
- SEM</td></tr>
<tr><td>Qualitative approach</td><td>Physicians</td><td></td><td>- Focus group interview questions
- Observations</td><td>- Contextual analysis
- Coding
- Memoing</td></tr>
<tr><td>Research design</td><td colspan="4">• Non-experimental research design
✓ Explanatory sequential Mixed Method
✓ Pragmatism</td></tr>
</table>

CURRICULUM VITAE

PERSONAL INFORMATION

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M.Sc.	Middle East Technical University, Information Systems, 2010
B.A.	Anadolu University, Business Administration, 2007

WORK EXPERIENCE

2008 – 2009	Atılım University, Dept. of Comp. Eng.	Research Assistant
2009 – 2016	METU, Grad. School of Informatics	Research Assistant

FOREIGN LANGUAGES

Native Turkish

Advanced English

PUBLICATIONS

A. International

A1. SSCI indexed:

E. Sezgin & S.Özkan-Yıldırım (2016), "A Cross-sectional Investigation of Acceptance of Health Information Technology: A Nationwide Survey of Community Pharmacists in Turkey ", Research in Social & Administrative Pharmacy (Elsevier), IN PRESS. DOI: 10.1016/j.sapharm.2015.12.006.

A2. Book chapters:

E. Sezgin & S.Özkan-Yıldırım (2016), "Current Trends of Factors Affecting the Acceptance of Health Information Systems by Professionals", Encyclopedia of E-Health and Telemedicine (IGI-Global), pp. 1090-1109. DOI: 10.4018/978-1-4666-9978-6.ch085

E. Sezgin & S. Özkan (2014), "Assessment of Information Technology Use in Small and Medium-sized Enterprises: Empirical Investigation in Five Cases", Information Systems and Small and Medium-sized Enterprises (SMEs) - State of Art of IS Research in SMEs (Springer), pp. 97-121. ISBN: 978-3-642-38244-4

E. Sezgin, T.D. Medeni, M.B.K. Önaçan, R. Kömürcü, Ö. Dalbay and İ.T. Medeni (2013), "The Perception of Electronic Document Management Systems (EDMS) As a Transformational Information and Communication Technology (ICT) for Public Institutions in Turkey",Public Administration Reform Market Demand from Public Organizations, (Routledge -Taylor &Francis), pp.279-300, ISBN: 978-0-415-83667-8

A3. Conference proceedings:

E. Sezgin, O. Alaşehir & S.Özkan (2014), "Work in Progress toward Adoption of an e-Health application by Healthcare personnel: A model validation", Procedia Technology (Elsevier), Vol.16, pp.1317-1326.

E. Sezgin & S.Özkan (2014), " A Literature Review on Attitudes of Health Professionals towards Health Information Systems: From e-Health to m-Health", Procedia Technology (Elsevier), Vol.16, pp.1327–1333.

E. Sezgin & S.Özkan (2013), "A Systematic Literature Review on Health Recommender Systems", Proceedings of e-Health and Bioengineering Conference (IEEE), pp.1-4, Iasi, Romania.

O. Alaşehir, E. Sezgin & S. Özkan (2013), "The role of Gender in Pharmacists Attitudes towards E-pharmacy Application", Procedia-Social and Behavioral Sciences (Elsevier), Vol. 83, pp. 1111-15.

E. Sezgin and S. Özkan (2011), "Assessing Information Technology Use in Organizations: Developing a Framework", Communications in Computer and Information Science (Springer), Vol.220, P.2, pp.388-397.

E. Sezgin, S. Ozkan & O. Alasehir (2011), "Attitudes of Pharmacists towards E-Pharmacy Application: A Work In Progress Research on Medula Project", Proceedings of 6th International Symposium on Health Informatics and Bioinformatics –HIBIT (IEEE), pp.8-15, Izmir- Turkey.

A4. Monograph (M.Sc. thesis):

E. Sezgin & S.Özkan (2011), Assessment of Information Technology Use: Developing A Framework and Its Practice, LAP LAMBERT Academic Publishing- Saarbrücken, ISBN 978-3-8443-0301-8

B. National

B1. Conference Proceedings

E. Sezgin & S.Özkan (2013), "Users' Adoption of Mobile Services: A Work in Progress Study on Mobile -Seat-Reservation System for restaurants" International Journal of eBusiness and eGovernment Studies, Vol. 5 (2), pp. 24-33. ISSN: 2146-0744

E. Sezgin & S. Özkan (2012), "A Systematic Review on Acceptance of Electronic Document Management Systems", IIB Academic Social Sciences Journal, Vol. 3 (6), pp. 127-134.

C. Submitted/ in progress publications:

Journal paper (Under Review- Journal of Information Development [SSCI]): "Understanding the perception towards using mHealth applications in practice: Physician's perspective"

Journal paper (Under Review- Journal of Health Policy and Technology [SSCI]): "Physicians' intentions towards using mobile health applications: An empirical investigation in Turkey"

Book [Editorship] (in progress): "Mobile Health: Adoption, Implementation and Use of Current and Emerging Technologies" (Springer)