

**Investigation of national readiness for e-Health in a South East European country: technology acceptance for electronic health records**

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# Abstract

**Background**

The successful implementation of information and communication technology (ICT) in healthcare presents many challenges; the failures outnumber the successes in the implementation of ICT in the health sector**.** A better understanding of technology acceptance among healthcare professionals will be useful for managers in overcoming barriers to adopting ICT in healthcare.

**Aim and objectives**

The principal gap in the literature that this research was intended to address was the lack of knowledge about the implementation and acceptance of e-Health and electronic health record (EHR) technologies among healthcare professionals in the Republic of Macedonia, in South East Europe (SEE). This research was intended to assess national readiness for acceptance of e-Health/EHR systems in an SEE country through technology acceptance, and to identify the main predictors of behavioural intentions towards e-Health/EHR. Using these findings, it was hoped to propose management, policy and government measures to increase healthcare professionals’ acceptance of e-Health/EHR systems. The ultimate aim of this is to improve the quality of services for patients and provide better health care.

**Methods**

A positivist quantitative approach was used for the research undertaken for this Thesis. A research instrument based on modified technology acceptance models was developed and six hypotheses were tested. Attitudes of healthcare professionals to the new e-Health/EHR systems were assessed through two studies. A new model presenting healthcare professionals’ attitudes to the e-Health/EHR systems was developed, and technology acceptance predictors were identified.

**Results**

Hierarchical linear regression, stepwise linear regression, and structural equation modelling indicated that perceived ease of use and effort expectancy are the strongest determinants of healthcare professionals’ attitudes concerning their intention to use future e-Health/EHR systems. Perceived usefulness and performance expectancy were excluded, or showed a weak effect in the overall prediction model.The findings on the importance of technology acceptance constructs (perceived ease of use and effort expectancy) are novel, and differ from those described in the relevant literature, where perceived usefulness and performance expectancy were identified as the most effective predictors of behaviour in healthcare settings. Technology acceptance variables such as job relevance, subjective norm, facilitating conditions, descriptive norm, and social influence were identified as having a strong influence on intentions to use prospective e-Health/EHR systems.

**Conclusions**

This research assessed the national readiness for acceptance of future e-Health/EHR systems in an SEE country, and yielded novel findings that contribute to our current knowledge of technology acceptance in healthcare. Therefore, the findings of this Thesis can serve as a basis on which to build a bridge between policy makers, (i.e., government and management), industry, (i.e., producers of ICT hardware and software for healthcare), and end users (i.e., healthcare professionals). A set of specific measures are proposed for future managerial and policy interventions concerning the implementation of e-Health/EHR systems in a developing country in SEE. Finally, this may have many benefits, including reducing time and costs, making the adoption of e-Health/EHR systems more efficient and providing more effective healthcare.

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# Glossary

AMA = American Medical Association

ANOVA = Analysis of variance

ATC = Anatomical therapeutic chemical classification system

CA = Certificate authority

CAS = Central authorisation system

CD = Compact disc

CI = Confidence interval

CICS = University of Sheffield Corporate Information and Computing Services

CMS = Card management system

COMPUSE = Computer use (technology acceptance variable)

CRL = Certificate revocation list

GP = General Practitioner

DICOM = Digital imaging and communications in medicine

DN = Descriptive norm (technology acceptance variable)

DRG = Diagnosis-related group

EE = Effort expectancy (technology accepetance variable)

EHC = Electronic health card

EHR = Electronic health record

EMR = Electronic medical record

EPR= Electronic patient record

EU = European Union

FITT = Fit between individuals, task and technology

FC = Facilitating conditions (technology acceptance variable)

GDP = Gross domestic product

HIF = Health Insurance Fund (Republic of Macedonia)

HIS = Health information system

HL7 = Health level 7

ICD-10 = International classification of diseases version 10

ICT = Information and communication technology

IHP = Institute for Health Protection (Republic of Macedonia)

INT = Intention (technology acceptance variable)

IOM = Institute of Medicine (USA)

ISHIMR = International Symposium for Health Information Management Research

IT = Information technology

MIS = Management information system

NHS = National Health Service (UK)

ONCHIT = Office of the National Coordinator for Health Information Technology (USA)

PASWTM = Predictive analytics software

PHC = Primary health care

PBC = Perceived behavioural control (technology acceptance variable)

PC = Personal computer

PE = Performance expectancy (technology acceptance variable)

PEOU = Perceived ease of use (technology acceptance variable)

PHR= Personal health record

PIN = Personal identification number

PU = Perceived usefulness (technology acceptance variable)

PKI = Public key infrastructure and management

RA = Registration authority

REL = Job relevance (technology acceptance variable)

SAT = Satisfaction (technology acceptance variable)

SEE = South East Europe

SEERC = South East European Research Center

SFRY = Socialist Federative Republic of Yugoslavia

SI = Social influence (technology acceptance variable)

SN = Subjective norm (technology acceptance variable)

SPSSTM = Statistical package for social sciences

SSL = Secure sockets layer

TAM = Technology acceptance model

TAM2 = Technology acceptance model 2

TAM3 = Technology acceptance model 3

TPB = Theory of planned behaviour

TRA = Theory of reasoned action

USAID = United States Agency for International Development

UTAUT = Unified theory of acceptance and use of technology

VPN = Virtual private network

# Publications

**Journal article**

Ketikidis, P., Dimitrovski, T., Lazuras, L. & Bath, P. A. (2012). Acceptance of Health Information Technology in Health Professionals: an Application of the Revised Technology Acceptance Model. *Health Informatics Journal, 18*(2), 124-134. Available from: <http://eprints.whiterose.ac.uk/77894/2/WRRO_77894.pdf>

The above paper was developed from the following conference paper, which was selected for onward publication in the Health Informatics Journal:

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<http://www.worldcat.org/title/ishimr-2011-proceedings-of-the-fifteenth-international-symposium-for-health-information-management-research-8-9-september-2011-zurich-switzerland/oclc/794810628>

**Conference papers**

Dimitrovski, T., Ketikidis, P., Lazuras, L. & Bath, P. A. (2013). Adoption of Electronic Health Records (EHRs): a Review of Technology Acceptance Studies. *Proceedings of the 16th International Symposium on Health Information Management Research – ISHIMR 2013, held in Halifax, Nova Scotia, 27–28 June 2013*. Available from:

<http://ppr.cs.dal.ca/ishimr/FILES/ISHIMR_2013_Proceedings.pdf#page=63>

Dimitrovski, T., Bath, P. A., Lazuras, L., & Ketikidis, P. (2015). Acceptance of Electronic Health Records by General Practitioners: Utilisation of the UTAUT Model. *Proceedings of the 17th International Symposium on Health Information Management Research – ISHIMR 2015, held in York St. John University, York, England, UK, 25-26 June 2015.* Available from: <http://www.wikicfp.com/cfp/servlet/event.showcfp?eventid=40695&copyownerid=11691>

Dimitrovski, T., Bath, P. A., Lazuras, L., & Ketikidis, P. (2018). General Practitioner's Readiness to Accept and Use an Electronic Health Records System. *In preparation.*

# Introduction

## Introduction to the Thesis

The development of information and communication technology (ICT) has led to new a field in health and social care, i.e., e-Health. The possibilities that new technologies offer to healthcare are significant and attractive to managers and policy makers. The new technologies include new ways of storing medical data and other information about individual patients, such as electronic/digital health records, which can be used for individual patients care as well as for planning and coordinating health services. Health managers, policy makers, and healthcare professionals face new challenges due to the increased use of information technology in healthcare. This Thesis aims to explore the attitudes of healthcare professionals in the Republic of Macedonia to the development of e-Health and EHR systems in healthcare. The national readiness for e-Health/EHR systems will also be investigated. The researcher hopes to contribute to knowledge about technology acceptance with respect to e-Health/EHR. The situation in the Republic of Macedonia is that it is a country in transition, with new political and economic structures: trying to implement the latest ICTs within healthcare. The results of this study can be used to develop a better understanding for managers and policy makers when implementing information technology (IT) in the health sector in the country.

First within this chapter the background of the research topic and the environment where this research was conducted are presented. Sections 1.2 to 1.4 outline the background of the Republic of Macedonia, including its history, demography, political structure, health system, as well as the national e-Health strategy and current developments. Section 1.5 provides an introduction to e-Health and the concept of technology acceptance. Section 1.6 states the aim and objectives of the study, and the overall structure of the Thesis, and Section 1.7 concludes with suggestions for future research steps.

## Republic of Macedonia in the former Yugoslavia and its independence

From 1945 until 1991, the Republic of Macedonia was one of the six constituent republics of the former Socialist Federative Republic of Yugoslavia (SFRY). The Republic of Macedonia gained its independence from SFRY on 8th of September 1991 following a referendum. As part of the SFRY, all the industry and other institutions, including healthcare facilities, in the Republic of Macedonia were nationalised in 1948 and remained publicly owned until the collapse of the SFRY in 1991.

Today, the Republic of Macedonia is a parliamentary democracy, a candidate for membership in the European Union (EU) and NATO. Since independence and to date, most of the industrial capacity in the country has been privatised, but most healthcare institutions have remained public.

### The Republic of Macedonia, geography, demographic figures, economy

In order to understand the context in which the study in this Thesis was carried out, it is important to provide some details about the country. Located in South East Europe, the Republic of Macedonia has a total surface area of 25,713 km2 (State Statistical Office 2011), and is divided into 84 municipalities. The latest population census, conducted in 2002, recorded a total population of 2,022,547 (State Statistical Office 2011). The latest estimate of the population at the end of 2010 was 2,057,284. The capital Skopje is the largest city and the administrative, business, cultural and education centre of the country. The latest estimate put the capital city’s population at 668,518 (U.S. Department of State 2011).

The Republic of Macedonia’s GDP in 2010 was 8.9 billion USD (State Statistical Office 2011). The services industry is gaining importance contributing more than 45% to Gross domestic product (GDP). The industrial sector is becoming secondary contributor to the GDP, but still remains as leading export sector. The agriculture is becoming less important contributor to GDP (U.S. Department of State 2011).

Although during the socialist era the Republic of Macedonia managed to build an efficient healthcare system based on socialist standards, following the collapse of SFRY and the end of the communist era, the former socialist healthcare system almost collapsed. Consequently, in the past twenty years, the Republic of Macedonia has been rebuilding its health system as part of a complete political and economic structural reform.

The Macedonian government is now facing modern challenges with the implementation of new standards in IT usage in all fields of society (Ministry of Information Society and Administration 2009). As part of the government’s efforts to implement IT in the country, the Republic’s Ministry of Health (2011) is dedicated to developing an e-Health system that will improve healthcare services for the public.

The use of computers and the Internet in Republic of Macedonia was on the rise. According to the Macedonian Ministry of Information, Society and Administration (2011), 58.9% of the total population aged 15-74 used computers, while 56.7% (primarily pupils and students) used the Internet. However, 55% of Macedonian households had Internet access in the first quarter of 2011, which was an increase of 8.9% compared to the same period in 2010. By 2013, 61.2% of the population in the country was using the Internet.

Only a few years ago, the United States Agency for International Development (USAID) survey (2006) showed that overall computer use in the Republic of Macedonia was 43%, overall Internet use was 27%, and only 13% of households were connected to the Internet. Almost 37% of the households in the Republic of Macedonia owned a computer, while 48% of homes in the capital Skopje had personal computers (PCs). The Internet connections were used by 21% of inhabitants in Skopje. However, the Internet for work purposes was less frequently used in other areas in the country. Young people are the fastest growing population of the Internet users. Overall, 26% of inhabitants have started to use the Internet in the past few years, while 37% of young users began using it in 2005 (USAID 2006).

## The Ministry of Health of the Republic of Macedonia

The primary purpose of the Ministry of Health, as a part of the government of the Republic of Macedonia, is to protect and maintain the health of the population. The Ministry of Health (2011, p.1):

“has responsibilities in the following areas:

* provision of health protection and healthcare insurance to the population;
* provision of contingency for air, water, soil and life consuming products;
* organisation and development of the health system;
* protection of the population from contagious diseases, the influence of gases, noise, air, water and soil pollution;
* provision of medicines, additional medications, medical supporting assets, medical equipment, sanitary offices and materials; and
* monitoring the distribution of poisons and drugs.”

### The Health Insurance Fund of the Republic of Macedonia

The Health Insurance Fund of the Republic of Macedonia was established in 2000, and it is the only insurance organisation responsible for mandatory health insurance on the principles of mutual solidarity in the whole territory of the Republic of Macedonia. The basic responsibilities of the Health Insurance Fund of the Republic of Macedonia (2011) are:

* regulations and policies for the development and promotion of healthcare associated with mandatory health insurance;
* planning and the collection of funds from mandatory health insurance;
* securing the exercise of rights from mandatory health insurance;
* payment for healthcare services on behalf of insurers to healthcare institutions;
* providing funds for the monthly salaries of public healthcare employees;
* determining the rates for public healthcare services deriving from mandatory health insurance;
* determining reference prices for medicines, medical devices, medical equipment, prostheses and orthopaedic devices used in public healthcare;
* developing IT systems with all the data necessary for mandatory health insurance;
* implementing international agreements in the field of mandatory health insurance; and
* maintaining oversight and control of the agreed volume and type of healthcare services provided.

The Macedonian government provides funding for all public hospitals through the Health Insurance Fund. All public hospitals cover their basic expenses, salaries, medicines, and medical devices with their own budgets serviced by the Health Insurance Fund.

### Public hospitals and other healthcare institutions

The leading healthcare institutions in the Republic of Macedonia are the 27 clinics and six institutes in the capital, Skopje. In the past, they were part of the University Clinical Centre, Skopje. From 2007 until now, they have operated as separate clinics and institutes, closely connected to the Medical Faculty (Ministry of Health of the Republic of Macedonia 2011). There are 11 general hospitals in the country, mostly in the major cities. All healthcare professionals that work in these institutions are considered as hospital healthcare professionals. However, there are 37 Health Centres in the country, most of them staffed by specialist doctors. However, according to authors personal communication with official in Macedonian Ministry of Health, more of the 80% of the hospital healthcare services are centralised and delivered through hospitals in the capital Skopje.

All General Practitioners (GPs) in Macedonia are private, although they are part of the public healthcare system. The government provides GP healthcare for publicly insured patients, because almost all GPs have contracts with the Health Insurance Fund, which pays a certain amount, so-called capitation, for every patient registered with a GP. In 2014, there were 1631 GPs registered in the national Health Insurance Fund.

### Private healthcare

Private healthcare services in public hospitals are limited at present. Private healthcare in the Republic of Macedonia has been available in the last decade. Currently there are few private general hospitals: Sistina, Remedika, Filip II, and St. Lazar. There are a few private diagnostic centres, mostly in the capital Skopje and in other larger cities. All healthcare services in private hospitals and diagnostic centres are paid by patients. Some services, such as cardiac surgery and in vitro fertilization, are reimbursed by the government in the private healthcare. Health insurance in the Republic of Macedonia is public and mandatory.

Although it is difficult to say exactly, according to the author’s personal communication with healthcare officials, more than 80 per cent of the healthcare services in Macedonia are offered within the public health system. Having introduced the healthcare system within Macedonia, the following section describes the latest developments in e-Health in the country.

## Current e-Health policies in the Republic of Macedonia

Given that the Republic of Macedonia is a relatively small country, it might be expected that it would be possible to build a national e-Health system. In such a setting, it is also possible to study the implementation of the e-Health system at a national level. This setting would provide access to all healthcare professionals around the country with the benefits of developing a national overview.

The Ministry of Health works closely with its key partners, the Health Insurance Fund of Macedonia, the Institute for Public Health, and other health institutions from all segments of the healthcare system to implement e-Health projects (Ministry of Health of the Republic of Macedonia 2011). The Ministry of Health established a data centre with necessary resources to safely store and secure access to data collected at all levels of the health system. The following software solutions will be implemented at the centre:

* software for primary healthcare, medical practices and hospital activities;
* an interface for hospitals;
* an application for public health registers, central registers, code lists; and
* an interface for pharmacies (Ministry of Health of the Republic of Macedonia 2006).

All IT solutions will be integrated into one e-Health system with the following aims:

* implementation of new processes in healthcare institutions with the introduction of the EHR;
* e-prescriptions, electronic referrals (the ‘My term’ system), electronic appointments, and other services;
* reduction of duplicated examinations, fast communication and consultations between primary, secondary, and tertiary healthcare;
* better service and reduced risks of erroneous medical decisions;
* financial savings through reducing existing paper referrals and prescriptions;
* provision of accurate information for all segments of the system; and
* access via the Internet for all segments covered by the healthcare system (Ministry of Health of the Republic of Macedonia 2006).

### Strategy for developing a ‘Macedonian Integrated Health Information System’

Over ten years ago, the Ministry of Health (2006) adopted the ‘Strategy for Developing the Macedonian Integrated Health Information System’. The strategy indicated that Macedonian health ICT system should not be built as a single information system, but coordinated set of processes advancing to integrated information system. The basic idea of the Macedonian health ICT system was that the information is common value of the healthcare organisations and must be accessible to all stakeholders in the process (Ministry of Health 2006). Figure 1.1 presents the Macedonian healthcare information system.

Figure 1.1: The Macedonian healthcare information system



HEALTH INSURANCE FUND OF R. MACEDONIA



PHARMACIES



CENTER FOR PUBLIC HEALTH



PRIVATE HOSPITALS / ORDINATION

INSTITUTE FOR PUBLIC HEALTH



PATIENTS/CITIZENS



GENERAL PRACTICE



HOSPITAL



Interfaces

IHP IT Subsystem

EHR, EPR, EMR, coding table

GPs subsystem

Hospitals subsystem

VPN

VPN/

VPN/IP Sec

Hospital interface VPN/IP Sec

VPN

VPN

SSL

SSL

SSL

VPN

e

Source: redrawn from Gavrilov and Davcev (2011)

The concept of the Macedonian integrative health information system is shown in Figure 1.1. The encrypted EHR, electronic patient record (EPR) and electronic medical record (EMR) should have a central place in the system. Public healthcare professionals would have access to the system through an encrypted connection. The Health Insurance Fund, the Centre for Public Health, the Institute for Public Health, privately owned pharmacies, hospitals, and GPs would also have access to the system. The Ministry of Health (2006) in the ‘Health Care Strategy’ acknowledged that efficient implementation of the system will depend on the skills and knowledge of healthcare professionals. The main vision of the ‘Strategy’ was that it would provide reliable information for all stakeholders in the process.

Before the implementation of the e-Health system, the Health Insurance Fund and public hospitals were supplied with incomplete databases. Public hospital software was very weak and data were used only for financial purposes. A unified platform for the Health Insurance Fund was developed for the intermediate phase. Although electronic health cards, e-prescription, and electronic medical referrals were planned for the mid-term phase, they were not implemented (Ministry of Health 2006). The Heath Insurance Fund developed unified data registers, but the data were still being imported to the system through compact discs (CDs). The Diagnosis-related groups (DRG) system was implemented in 2011, but the EHR system implementation, although planned for 2011, was postponed. However, in 2017 this strategy was not fully implemented. The Ministry of Health in 2017 was in process of preparing of the new strategy. This strategy included three phases. The immediate phase was planned for the period of 2006 to 2007. A mid-term phase was planned for 2008-2010. Finally, a long-term phase was planned for the period after the 2011. Table 1.1 presents the Macedonian e-Health system implementation plan.

Table 1.1: Macedonian e-Health system implementation plan

|  |  |  |  |
| --- | --- | --- | --- |
| **Phase** | **Initiative** | **Steps** | **Timing** |
| Immediate | A. Completion of the IT system in the Health Insurance Fund (HIF) | 1. To allow nation-wide collection of data (now the data is limited to the 18 district offices of the HIF);  2.To provide management information system (MIS) and reporting for cost control and policy making;  3. To provide mechanism for cross-checking of data on national level gathered from services rendered in primary health care and participating hospitals | 2006 -  2007 |
| B. Implementation of Hospital Information Systems (HIS) in selected hospitals | 1.Patient-centric health information system HIS with ability to provide medical information and workflows, plus financial data for administration;  2.Reporting on financial data to the HIF;  3.Reporting of medical and health-statistical data to the Institute for Health Protection (IHP);  4.Patient data to be collected on health incident basis;  5.Collection of health indicator data in the hospitals and reporting to the HIF and IHP |
| C. Development of unified registers | 1.Design of coding systems for the:   * Chamber of Medical Doctors; * Chamber of Dentists; * Drugs Bureau; and * Healthcare providers (legal institutions);   2.The registers to reside in the entities where the data originates;  3.Applications to be developed and deployed for maintaining of the registers;  4. The code tables to be available (on the web or similar) for public use (in limited extent) and for use by applications within the integrated health information system |
| Mid-term | A. Primary health care (PHC) providers to implement ICT in order to provide electronic reporting | 1.HIF and IHP to provide ICT infrastructure for processing of electronic reporting by PHC providers;  2.HIF to provide information requirements for reporting/invoicing of health services and health indicators;  3.The IHP to provide information requirements for reporting of medical/ health-statistical data and health indicators | 2008 -2010 |
| B. Electronic health card (EHC)  To be implemented | 1.Healthcare providers, HIF and pharmacies to implement ICT infrastructure for use of EHC in:   * Patient identification; * Health insurance data; * Basic medical data (allergies, blood group, implants, etc.; * Paperless drug prescription; and * Other applications of EHC;   2.Possibilioty of use of personal ID card to be explored on technical and logistical levels:   * The new Macedonian ID card provides features that (technically) can be used for EHC applications |
| Long-term | A. Diagnosis-related groups (DRG) | To be implemented as planned | 2011- |
| B. Electronic health record (EHR) | Not implemented |

Source: redrawn from ‘Strategy for the Development of the Macedonian Integrated Health Information System’ (2006)

To this end, Gavrilov and Davcev (2011) studied the Macedonian healthcare information system. They concluded that it should be considered as a complex system integrating hospitals, clinics, and other healthcare units. In the past (before 2011) these systems were relying on partial solutions, which were non interoperable. The integration of the current systems is seen as an urgent priority for Macedonian healthcare officials.

### The EHR system in the Republic of Macedonia

The implementation of the EHR system in the Republic of Macedonia, although scheduled for 2011, was postponed due to the failure of the private provider that had a contract with the Ministry of Health to produce an effective EHR system. As initially planned, the EHR would work only within public healthcare. However, GPs are generally private practices, although they have active contracts with the National Health Insurance Fund. According to the author’s personal communication from healthcare officials, the EHR faces major challenges in the future, so we can expect more developments in this field in the coming years. The Macedonian EHR system had not been implemented by the time the second study (Chapter 5) of this research was conducted.

### The ‘Electronic health card’ system

The electronic health smart card may be used as an efficient tool for access to the centralised EHR system. For this reason, the Health Insurance Fund of the Republic of Macedonia started the implementation of the ‘Electronic health card’ (EHC) system in 2011. The Macedonian ‘Electronic health card’ system consists of two parts: a public key infrastructure and management (PKI), and ‘Management and authorisation system’ (card management system with a central administration system). The PKI is an efficient solution for issuing certificates, which provides the opportunity for secure electronic transactions that combine digital signature technology with encoding. The Macedonian health PKI will manage digital keys and certificates transparently, providing a secure networking environment for Macedonian Healthcare Information System. The ‘Management and authorisation system’ consists of two segments: a central authorisation system (CAS) and a card management system (CMS). The CAS and CMS systems are inter-connected with the Health Insurance Fund IT system through various protocols for interchange data. The electronic health cards will serve for the authentication and storage of minimal data sets and as pointers to the appropriate data within the network. The electronic health card will be used as a data transfer medium for public health insurance in what is a complex e-Health system. The electronic health card will enable access to all future available online e-Health services. The ‘Electronic health card’ system with the key components is shown in Figure 1.2.

Figure 1.2: The Macedonian ‘Electronic health card’ system

Patients

Professionals

EHC holders



HIF branch offices

Registration offices

HIF Card management server

Personalization of

EHC

RA

Corporate

CA

CRL

EHC holders

Data preparation

HIF Web Server

(e-HIF online

application)

Central

authorization server

HIF Web server

(EHC online application)

HIF

database

LAN

LAN

Source: redrawn from Gavrilov and Davcev (2011)

One important consideration when investigating the national readiness to implement e-Health systems in the country is that doctors and other healthcare professional may not be aware about the differences between the EHR and the ‘Electronic health card” and they might regard them as a single system. However, the Macedonian ‘Electronic health card’ system was fully implemented when the second study (Chapter 5) of this research was conducted.

### The ‘My term’ referral system

This system is an online application by the Macedonian Ministry of Health (2011) that enables scheduling of appointments for patients in all public healthcare institutions. The main aim of the national ‘My term’ referral system is to shorten waiting lists in public healthcare. This system should reduce the number of duplicated examinations and interventions in the healthcare system in Macedonia. The ‘My term’ system has to provide high quality health services with less administrative work. It comprises a detailed workflow for patients’ visits to all hospital doctors. However, patients do not have direct access to the system. All referrals are made by healthcare professionals, and patients can visit hospital doctors only through referrals provided by the system.

The ‘My Term’ system will serve as a basis for the future EHR system, enabling fast and accurate evidence of all patient transactions with unified and verified patient data. The system has to be interactive with the e-prescription system, and should enable fast communication and consultations between all levels of healthcare. It will also have financial benefits by reducing paper work costs. This system enables proper remuneration in public healthcare, as it measures the number of visits and interventions conducted by each healthcare professional. This system was fully implemented when the second study of this research was conducted in 2011.

### Current level of ICT usage in the Macedonian health system

The Ministry of Health conducted screening in 2006 to assess the status of ICT in the healthcare system. This review of ICTs revealed numerous variations in the use of ICTs and digital technologies across the country’s healthcare system; however, overall there was a lack of ICT use in the healthcare system. A few hospitals were equipped with ICT but were not able to exchange clinical data with other parts of the healthcare system. The Ministry of Health do not have precise numbers of actual use of ICT usage within the Macedonian healthcare system as that kind of assessment was not made. According to the author’s personal communication with officials at the Ministry of Health, there had been only minor developments in the levels of ICT usage between 2006 and 2018.

### Major challenges of the Macedonian health information system

The Macedonian health information system can be considered as a complex structure with a large number of components. The Ministry of Health and the Health Insurance Fund are separate institutions involved in developing the Macedonian e-Health system. Given the complexities, it is important to understand how well the system will work.

The Macedonia can learn from EU countries that are more advanced in terms of introducing e-Health systems. On the other hand, Republic of Macedonia is a SEE country in transition, with its own characteristics and a difficult recent history, which presents a real challenge to the implementation of a carbon copy of an EU e-Health system. Part of the problem is that professionals in the country did not interact with IT in previous years (Macedonian Ministry of Information Society and Administration 2011). One of the major challenges is how to implement IT systems with a target group that in the past had no interaction with IT, while there has been a dramatic rise in IT usage in Macedonian society in general. The differences in IT usage between older and younger generations in Macedonia should be taken into consideration. There is also a need to examine the differences in IT acceptance between the capital Skopje and other parts of the country.

To address these issues, it is necessary to utilise research methods and practices from other disciplines. An interdisciplinary approach is needed to understand healthcare professionals’ attitudes to new technologies. IT specialists on their own are not aware of healthcare professionals’ needs and behaviours. It is possible that the behaviour of healthcare professionals in SEE is different from their counterparts in the EU. In the implementation of IT technologies, the importance of the human aspect is often underestimated.

### The latest developments in the e-Health sector in the Republic of Macedonia

At the beginning of November 2012, the Health Insurance Fund of the Republic of Macedonia announced the start of the official use of the ‘Electronic health card’ system (Health Insurance Fund 2012). According to Health Insurance Fund officials, the card will provide access to the basic personal data of the patient and level of services that can be covered through their health insurance (Health Insurance Fund 2012). However, the author’s research and communication with healthcare professionals throughout the country indicated that there are major difficulties with the implementation of health smart cards, and at the end of 2012 they were not widely used in the public health sector.

Finally, the ‘Electronic health card’ and ‘My term’ systems were the only effective e-Health systems in the country. By the end of 2017, all appointments in public healthcare were made through the ‘My term’ system. All patients used their electronic health cards when seeing a physician. However, the electronic card was used only as a tool to access to basic patient information (name, address, insurance status). In the period from 2012 to 2017, there were no major changes in the field of other ICT implementation in healthcare in the country. By the beginning of 2018, the EHR system was not yet implemented. Table 1.2 presents the implementation timeframe of the Macedonian e-Health, before and after the research for this Thesis was undertaken.

Table 1.2: Actual implementation time frame of the Macedonian e-Health system

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2006** | **2011** | **2012** | **2018** | **Status** |
| ‘Strategy’ |  |  |  | Implementing |
|  | EHR |  |  | In preparation/not implemented |
|  |  | ‘My term’ system |  | Implemented |
|  |  | ‘Electronic health card’ system |  | Implemented |
|  |  |  | New ‘Strategy’ | In preparation |

### EHR system in the Republic of Macedonia

The EHR system was initially planned to be introduced in 2011. Due to delays the EHR system was not introduced in the beginning of 2018. There is no proposed EHR design for the Republic of Macedonia for the moment. However, as it is recommended in the literature, the assessment of intentions of future users towards the EHR system can be made prior to the implementation (Amatayakul 2005).

## e-Health, EHR, technology acceptance

This section is a short introduction to e-Health, EHR and technology acceptance before presentation of aims and objectives of this research. e-Health is a relatively new field in the science reflecting an intersection of public health, health informatics, and healthcare business. It also describes the electronic exchange of data in healthcare. The EHR presents longitudinal record of patient’s health. It provides the capability to share medical data among stakeholders in the healthcare. These concepts are presented in further detail in the next chapter.

### Technology acceptance: the driving force for the successful implementation of e-Health

Managers implementing ICT in the health area may not have understanding of healthcare professionals’ needs and their acceptance of these systems. In many cases, the human aspect is underestimated. A complex system will deliver positive outcomes only if all components function perfectly.

The Macedonian government is trying to implement advanced ICT systems in the public health sector. The limited acceptance of digital health technologies in healthcare will end with poor implementation of e-Health systems and ineffective management of patient data. In his seminal study of the implementation of health information systems, Berg (2001) reported that there are more failures than success stories. Kaplan et al. (2009) reported that despite the research which has pointed out success factors for implementation of ICT in healthcare, the majority of projects fail. Sligo et al. (2017) stressed indicated that implementation of ICT in healthcare settings is still a problem, and there are implementation shortcomings and failures. Therefore, these issues initially reported by Berg in 2001, are still actual today. However, using models from research, e.g., technology acceptance models can help providing useful information how systems might be developed. Davis’ original technology acceptance model (TAM) was initially developed to identify how well IBMTM employees accepted new software that had been developed (Davis, 1986).

A study conducted by Lee et al. (2003) on one hundred and one articles published in leading IT journals and conferences concluded that the TAM is the most widely applied theoretical model in the field of information science. However, the study also stressed that, besides its accomplishments, the model has some limitations which will be discussed in detail in the literature review in Chapter 2.5. Other more effective technology acceptance models such as TAM2 (Venkatesh and Davis 2000) and the unified theory of acceptance and use of technology (UTAUT) developed by Venkatesh et al. (2003) were introduced more recently building on the original TAM model.

## Research aim and objectives

The overall aim of this research was to “Assess the overall readiness of healthcare professionals to accept proposed e-Health/EHR systems in the Republic of Macedonia”. More specifically, the objectives of the Thesis were to:

* identify the factors that predict how well the proposed e-Health/EHR systems will be accepted among healthcare professionals in the Republic of Macedonia;
* develop a new, healthcare oriented technology acceptance model based on the situation in the Republic of Macedonia;
* contribute to new knowledge in the area of technology acceptance in healthcare that may help other countries developing e-Health/EHR systems, for example, in other parts of SEE; and
* identify and propose policies for better technology acceptance of prospect e-Health/EHR systems in the country.

No technology acceptance studies of the Macedonian e-Health/EHR systems have been conducted before. This research considered the application of a modified version of technology acceptance models described in Chapter 2 to assess the relevant attitudes for acceptance of e-Health/EHR systems in a sample of health professionals. The main outcome of this research was to measure the intentions of healthcare professionals to use e-Health/EHR systems.

### Overview of Thesis structure

This section presents the whole structure of the Thesis. Chapter 1 introduced an overview of the Republic of Macedonia’s political structure, economy and the health system. Special attention was given to describing the Macedonian e-Health system.

A detailed review of the literature on e-Health, EHR and technology acceptance will be presented in Chapter 2. Peer reviewed scientific articles from relevant databases will be presented in this chapter. Gaps in knowledge in these areas will be identified, and research questions will be posed.

Chapter 3 discusses the methodology applied in this research. Current knowledge based on quantitative and qualitative methodology approaches will be presented in this chapter. Research ethics and sampling techniques will be also explored.

Chapter 4 presents the first study: “Study of hospital healthcare professionals” conducted in three hospitals in Skopje. This study is conducted on hospital healthcare professionals with aim to assess their views on e-Health acceptance.

Chapter 5 presents the second study: “Study of General Practitioners”, in which the attitudes of GPs to the EHR system on the national level are assessed. This study applies modified research instrument based on findings from the first study.

Chapter 6 shows the progress of thinking and the development of the research instrument throughout the Thesis. It presents the results of the two studies side by side, discusses them, and relates the findings to the relevant literature. Finally it provides a conceptual diagram explaining the final outcome of the research.

Chapter 7 summarises the findings, presents outcomes on aims, objectives, research questions, and hypotheses. It assesses the national readiness for e-Health, presents a novel contribution to the current knowledge, proposes future research, measures for management, and policy making.

## Conclusions

This chapter presented an introduction to the following research. The essential part of this chapter is the description of the Macedonian e-Health system. The Ministry of Health of the Republic of Macedonia adopted a ‘Strategy’ (2006) to implement an integral health information system for public healthcare at the national level. All healthcare institutions, professionals, and management will have direct access to a single e-Health system. As the Republic of Macedonia is a relatively small country, it is possible to study the national e-Health system in its entirety.

IT professionals and policy makers in the Republic of Macedonia are not fully aware of the attitudes, understanding and needs of e-Health end-users. In searching for solutions, it is necessary to draw on research from other disciplines, particularly how other disciplines assess user needs and behaviours. A revised technology acceptance models applied in healthcare settings could be considered as a possible tool to assess the intentions of healthcare professionals.

When policy makers implement a national e-Health system, it is necessary to go to the work floor and examine the needs of end users. Only after assessing their needs is it possible to devise management policies to increase acceptance of IT in healthcare. A literature review based on the topics discussed in the introduction is presented in the next chapter.

# Literature review

## Introduction

After the introduction to the Macedonian e-Health system, in Chapter 1, there is a need for an in-depth literature review in these areas. Many governments have allocated huge funds for development of ICT in healthcare. The aim of the European Commission’s ‘Digital Agenda for Europe’ (2013) is to promote research in the area of health informatics and to develop products that are more innovative and will achieve better healthcare. This chapter presents a review of the literature on the latest developments in e-Health, with a focus on models of EHR and technology acceptance. To begin, the search strategy, the range of terms, databases used and time frame are presented in Section 2.2. Section 2.3 is a general review of the e-Health literature as an introduction to the main topic. Health informatics, e-Health, digital health, health smart cards, and online appointment systems in healthcare are presented in this section. Section 2.4 introduces the EHR research. The EHR system as an essential part of this research takes a central part of the literature review. Technology acceptance models and current research are presented in Section 2.5. This large section explores current technology acceptance approaches. Section 2.6 outlines the synthesis of current knowledge on technology acceptance on e-Health and EHR systems, and serves as a base for creation of the future research questions. Therefore, sections 2.3 to 2.6 present the literature that was available before the conduction of the research in this Thesis. However, the literature review was updated after the research that was undertaken in this Thesis and this is presented in Section 2.7 with the aim of reassessing the current knowledge in these areas. Section 2.8 concludes this chapter, and proposes steps for future research.

## Search strategy

A detailed search of the relevant literature was undertaken for the literature review, to develop a clear understanding of the issues relating to factors affecting the implementation of e-Health and EHR systems through technology acceptance and to identify gaps in the literature. Peer-reviewed research articles published in scientific journals, conference proceedings, and/or edited books were included in review and were the main source of material for the review. The search was limited to articles published in English. The initial literature review indicated that there are hundreds of published articles on technology acceptance on e-Health and EHR systems.

### Range of terms

For the purpose of the study, the range of terms used in the literature search included: e-Health, health informatics, digital health, EHR, electronic patient record (EPR), electronic medical record (EMR), personal health record (PHR), technology acceptance, technology acceptance model (TAM), technology acceptance model 2 (TAM2), technology acceptance model 3 (TAM3), and unified theory of acceptance and use of technology (UTAUT).

### Databases and time frame of the literature review

The following databases were mainly used: Web of Science, Scopus, Pubmed, and Google Scholar. However the following databases were also searched EBSCO, MEDLINE, LISA, and CINAHL. The literature review was conducted in 2011 and 2012, and studies published between 1990 and through 2012 were included initially in the literature review with the aim of presenting the existing knowledge before the research in this Thesis was carried out. However, the literature search for keywords EHR and technology acceptance (empirical studies only) continued until the commencement of the second study of this Thesis in 2014.

As the literature review (before the research in this Thesis) was conducted mainly in 2011 and 2012, there is no exact information of how many articles were retrieved from each database which is a limitation discussed in Section 6.3.1. Table 2.1 presents articles used in the literature review before the research in this Thesis.

Table 2.1: Articles presented in the literature review before the research in this Thesis

|  |  |  |
| --- | --- | --- |
| **Keywords** | **Number of articles used in the literature review** | **Sections were articles are presented** |
| General use of search terms:  Health informatics, Digital health, e-Health, EHR, EPR, EMR, & PHR | 73 | 2.3 & 2.4 |
| General use of search terms:  Technology acceptance, technology acceptance model, TAM, TAM2, TAM3, & UTAUT | 42 | 2.5 |
| Combination of search terms:  Technology acceptance and e-Health | 33 | 2.6.1 |
| Combination of search terms:  Technology acceptance and EHR (empirical testing only) | 13 | 2.6.2 |
| **Total number of articles presented before the research in this Thesis** | **161** |  |

Sections 2.3, 2.4, and 2.5 present articles which describe generally the research area of this Thesis. Section 2.6 presents articles which include combination of search terms e-Health and technology acceptance (2.6.1), and EHR and technology acceptance (2.6.2), which were used for creation of the research instrument of this Thesis. The articles were selected with respect to search terms, relevance to this research and no specific pool of countries was selected. However, as a result of this selection some specific countries appear in the literature review.

An additional search of the literature was conducted in the beginning of 2018 in same databases, after the completion of the research in this Thesis with search terms: e-health and technology acceptance; and EHR and technology acceptance, with aim to compare the new reports in the literature with findings from the Thesis. Most of the articles were identified and retrieved from Web of Science and Scopus. This resembles Oliveira et al.’s (2017) study which indicated that Web of Science and Scopus encompassed 95% of the published researched articles. Almost all of the articles are also available through Google Scholar. Table 2.2 presents articles with specific keywords and databases from where they were identified after the research in this Thesis.

Table 2.2: Articles identified after the research in this Thesis

|  |  |  |
| --- | --- | --- |
| **Database** | **Number of articles found for the literature review** | |
| **Keywords:**  **e-Health & technology acceptance** | **Keywords:**  **EHR & technology acceptance** |
| Web of Science | 90 | 52 |
| Scopus | 66 | 29 |
| Pubmed | 49 | 33 |
| Medline  (Core clinical journals) | 45 | 54 |
| **Total number of articles identified** | **418** | |

Further, articles that included empirically tested studies were selected and presented. However, few studies reconfirming the importance of technology acceptance in healthcare after the research in this Thesis were presented as well. These studies do not empirically test the model, but were selected as relevant to this Thesis. Therefore, 26 new articles were added to the literature review, and new Section 2.7 was created. These articles were used to reassess the effectiveness of technology acceptance in healthcare after research in this Thesis and compare the findings. Table 2.3 presents articles used in the literature review after research in this Thesis.

Table 2.3: Articles presented in the literature review after research in this Thesis

|  |  |  |
| --- | --- | --- |
| **Database** | **Number of articles** | **Number of articles/search terms** |
| Web of science | 16 | 11/e-Health & technology acceptance  5/EHR & technology acceptance |
| Scopus | 4 | 1/e-Health & technology acceptance  3/EHR & technology acceptance |
| Medline | 4 | 2/e-Health & technology acceptance  2/EHR & technology acceptance |
| Pubmed | 2 | 2/e-Health & technology acceptance |
| **Total number of articles presented after the research in this Thesis** | **26** |  |

## Information technology in healthcare

The successful development and implementation of new ICT can provide shift from older approaches to the modern healthcare delivery. When healthcare and technology sciences are investigated together there will be an opportunity to create results with significant impact on clinical and social care. The new technological approaches have the potential to improve management of healthcare delivery through new ICT solutions. Articles in the following sections are presented and discussed chronologically with the aim to present the development of these issues in the last decades. However, it was also possible to discuss these articles by specific topic. This is a limitation discussed in Section 6.3.1.

### Health informatics

The term ‘health informatics’ first appeared in the late 1960s, but was rarely used until the 1990s, when it became a more established term in the research literature. Even today there is no widely accepted definition of health informatics, and it is generally accepted as a description of how information technology is used in the health sector. Imhoff and Webb (2001, p. 179) definition of health informatics was:

“health informatics is the development and assessment of methods and systems for the acquisition, processing and interpretation of patient data with the help of knowledge from scientific research.”

Imhoff and Webb (2001) in their study indicated that health informatics cannot be considered as a simple application of computers, but information management within healthcare settings. According to the authors, information overload in the healthcare sector and mistakes in medical decision-making processes necessitate the use of information systems to support medical decisions. They proposed that health informatics will reshape the way we deliver healthcare. Bath (2008, p. 505) used the following working definition:

“health informatics is the use of information, and information and communication technologies to improve the quality of care and health and well-being of patients, their families and careers, and the general public.”

### Digital health

Digital health is a concept that covers the use of electronic technology in a way that captures, stores, and processes medical and healthcare data. It reflects healthcare information system’s possibilities to provide accurate and relevant data for consumers and providers in healthcare (Kreps 2004). However, the author has acknowledged that digital health processes did not achieved their peak which has resulted in limited feedback. Finally, he proposed that there is still long road ahead for digital health systems to achieve their full potential.

Kostkova (2015, p. 1) indicated that digital health includes disciplines such as: “computer science, engineering, information science, journalism, economy, clinical medicine, public health, epidemiology, and others… the use of information and communications technologies to improve human health, healthcare services, and wellness for individuals and across populations.”

According to Khan et al. (2017) digital health can be used in healthcare addressing lifestyle modifications such as: smoking cessation, diet, obesity, and physical inactivity. Digital health can also develop cost-effective modalities for self-management, lifestyle modification, and medication adherence in healthcare. However, still little evidence exists about the type of technologies available and how they deliver functionality, effectiveness, and application.

According to Gouda and Steinhubl (2018, p. 189) digital health presents:

“the intersection between smartphone-enabled mobile computational and connectivity capabilities, but also encompass genomics, information systems, wireless sensors, cloud computing and machine learning with modern healthcare.”

Patients through digital health can play more active role in the process of healthcare. Medicine can become more personalised and adjusted to each individual patient based on his medical analyses and personal history. However, security concerns, cost effectiveness, and clinical effectiveness remain major issues for digital health (Gouda and Steinhubl 2018).

### e-Health

The term e-Health emerged in the 21st century with reference to the use of electronic information and communication technology in the health sector. It was initially used by managers together with other ‘e-words’ (e.g., e-commerce, e-business) and offered  a glimpse of the new possibilities the Internet was opening up to the area of healthcare. In the last decade, e-Health has attracted the attention of researchers, and a number of research studies have been published.

Eysenbach (2001) defined e-Health as an intersection of business, public health, medical informatics. Eysenbach however, considered e-Health not only as a technical development, but also as a way of global thinking or an attitude, which, by use of information and communication technology and networking, can improve healthcare at all levels. Nazi’s (2003, p. 36) definition of e-Health was: “e-Health can be defined as the use of Internet technology and electronic communications to support the delivery and management of healthcare services.”

Nazi saw e-Health as a powerful technology tool which could improve the quality of care and services delivered, could add new dimensions to the patient-provider relationship, and can be used to explore new models of access to care. Cashen et al. (2004) described e-Health as a term used to describe electronic exchange of data in healthcare. European Union research programs have been supporting e-Health since the early 1990s, putting Europe in a leading position in the use of EHR and health smart cards. The European Commission (2004) considered e-Health as a tool for substantial productivity gains, and an instrument for healthcare that is more clearly oriented towards its citizens. However, e-Health also has many risks and challenges, mainly in patient health data. Kind and Silber (2004) focused on other challenges in e-Health, such as ethics. Professionals need to take responsibility for policy development addressing the ethics of online doctor–patient interaction and relationships.

Harrison and Lee (2006) summarised the goals of e-Health as: improved quality of healthcare, increased efficiency in healthcare, increased commitment to evidence-based medicine, and the development of a new relationship between patients and health professionals. The authors described the managerial implications of e-Health, concluding that e-Health programs are good tools for improving efficiency and reducing costs in healthcare institutions. Furthermore, they focused on policy implications, concluding that e-Health can decrease costs whilst, at the same time, improving healthcare within the population. Harrison and Lee (2006) suggested that e-Health could provide efficient and cost-effective healthcare for the rise in the population of elderly people.

Kluge (2006) proposed that e-Health required not only the national standardisation of professional education and protocols, but also global interoperability of regulations and laws. Anderson (2006) in turn noted the social, ethical, and legal barriers such as: lack of sufficient funds, complexity of the systems, insufficient data standards, legal barriers, and privacy concerns. Macdonald et al. (2018, p.1) defined e-Health as:

“a broad term referring to the application of information and communication technologies in the health sector, ranging from health records to telemedicine and multiple forms of health education, support, and tools.”

However, as can be seen from definitions provided in sections 2.3.2 and 2.3.3, terms like digital health and e-Health describe similar concepts rather than anything fundamentally different. e-Health has many components, and more are emerging, including telemedicine, telecare, telehealth, mobile computing, public health informatics, pharmacy informatics, e-nursing, etc. Sections 2.3.4 and 2.3.5 present the e-Health components which are related to this Thesis: electronic smart cards and online appointment system, and Section 2.4 presents the EHR.

### Health smart cards/medical smart cards

A smart card is a pocket size card with embedded electronic circuits or chips. The term ‘smart card’ is used to distinguish it from cards with magnetic stripe on the side. While magnetic stripe cards carry data of about 200 characters, smart cards carry data of about 8000 characters or even more stored in electronic memory. The data stored on a smart card is protected from unauthorised use by the personal identification number (PIN) of the owner and an authorised reader system. Smart cards are used in healthcare, and terms health and medical smart cards are used interchangeably although describing same thing. However, there is no widely-accepted term in the literature for these cards.

Chan (2000) highlighted the potential advantages of combining the use of smart cards and the Internet to achieve mobile healthcare management system. Gundem and Armagan (2005) summarised the advantages of smart cards as: reduced costs, faster administration formalities, secured payments, increased data protection, verified insurance data, and flexibility for additional programs. Liu et al.’s (2006) survey showed prolonged service time for patients in 60.6% of hospitals, three months after the introduction of the smart card system. Although the authors recommended public awareness programmes and education of the public on the proper use and storage of cards, healthcare professionals also need training in this area.

In their survey of smart card use in drug allergy history, Hsu et al. (2009) indicated that data stored in smart cards are incomplete in many cases, and a patient’s drug allergy history is not consistent. They offered suggestions for standardising drug allergy history records. Hsu et al. (2010) studied the use of smart cards in cases when the patient with the same illness changes healthcare institutions without a referral. As there is no efficient infrastructure for information sharing, this could result in these patients being prescribed duplicate medications, which could have adverse consequences for them. They proposed the use of smart cards to solve the problem of duplicate medication for patients visiting multiple hospitals.

There is large amount of data that is created in modern healthcare. However, the use of health smart cards is limited to providing basic patient’s information, or as an access point to the larger databases where all information can be securely stored (large clinical examinations files, laboratory tests, etc).

### Online appointment systems

In recent years, online appointment systems in healthcare have been developed alongside other commercial booking systems (hotels, flights, restaurants, etc.). Technology achievements, such as online appointment systems have made the appointment procedures easier for patients and healthcare professionals. Online appointment systems are Web-based applications that allow end users to conveniently and securely make appointments online through a digital device, e.g., a tablet or PC. These systems are often convenient and easy to use, and have many benefits. Complex medical appointments sometimes require an assistant, a specific type of equipment, various calendars coordination, and availability of personnel etc. Online appointment systems are designed to accommodate all requirements, evaluate the patient’s needs and check the availability of resources. They give powerful assistance to personnel, who would otherwise spend a lot of time manually checking the availability of resources (Gupta and Denton 2008).

More advanced applications include automated e-mail and massages options, which the application sends to patients with the aim of reminding them about the appointment. Other applications have recording options which enables access to data generated by a specific appointment. However, these systems face a few challenges, such as late cancellations, no-shows and overbooking (Gupta and Denton 2008). They also add a cognitive load to healthcare professionals’ everyday working practice.

## Electronic health record

This section explores different aspects of EHR generally, as this is related to this research. Therefore, this section presents general environment of the EHR systems before the commencement of the research. However, studies those are most relevant to this Thesis’ research instrument, and reflect focused technology acceptance on EHR systems are presented in Section 2.6.2 and summarised in Table 2.4. The literature review on the latest developments in EHRs was updated after the completion of the two empirical studies of this Thesis and presented in Section 2.7.

EHRs are one of the most important components of e-Health. EHR term was first used in the UK White Paper ‘Information for Health’ by Burns (1998). Donaldson et al. (1999) at their highly cited study reported that between 44000 and 98000 American citizens die every year because of medical errors. However, James (2013), in his literature review, reported that more than 400000 patients die in hospitals in USA due to medical errors. Therefore, despite the advances in ICT in healthcare it is evident that number of deaths due to medical errors is rising.

Brown and Sonksen (2000) stressed the need for EHR when they proposed that if we aim to increase efficiency and deliver better healthcare, all results and documents from diagnostics and therapy should be carefully documented and available for communication between healthcare providers. The need to digitise patients’ data was also described in Blobel’s work. East (2005) reported that simple collection of patient information is not sufficient for an effective EHR. The author proposed increased sophistication with the aim to achieve more advanced EHR systems. According to (Middleton (2005), the EHR system should be capable of exchanging patient data in a secure way between the stakeholders in the system. The author indicated that when a patient sees a medical doctor a large number of transactions and information sharing occur.

Ewing (2007) suggested that it is too easy to receive the wrong treatment or medicine in the emergency departments, as doctors do not have access to basic patient documentation. Ewing (2007) suggested that lack of accurate information when needed is one of the major problems in modern healthcare.

EHRs can therefore be considered as a potential solution to the problem of sharing patient information among providers. According to Meidani et al. (2012) the process of developing EHR system is complex process integrating many building blocks.

### EHR definitions and similar concepts

Electronic patient record (EPR) and EHR are terms used to describe similar concepts (Burns 1998). In order to avoid confusion, Burns (1998, p. 25) proposed:

“electronic patient record (EPR) describes the record of the periodic care provided mainly by one institution. Typically this will relate to the healthcare provided to a patient in a hospital. EPRs may also be held by other healthcare providers, for example specialist units or mental health NHS Trust… The term EHR is used to describe the concept of a longitudinal record of a patient’s health and healthcare – from cradle to grave. It combines both the information about patient contacts with primary healthcare as well as subsets of information associated with the outcomes of periodic care held in the EPRs.”

The International Organization for Standardization (2005, p. 2) defined an integrated care EHR as:

“a repository of information regarding the health status of a subject of care in computer processable form, stored and transmitted securely, and accessible by multiple authorized users. It has a standardized or commonly agreed logical information model which is independent of EHR systems. Its primary purpose is the support of continuing, efficient, and quality integrated healthcare and it contains information which is retrospective, concurrent, and prospective.”

Ambinder (2005, p. 57) also underlined the difference between EMR and EHR and formulated the concept of EHR as: “a tool to integrate an individual’s multiple, physician-generated, electronic medical records, and patient-generated personal health record.” Tang et al. (2006) presented the differences between EHR and personal health record (PHR) systems. They indicated that the EHR system consists of data that can be entered and used by healthcare professionals, while PHR systems includes health data entered by patients. The PHR system may include decision support systems which can help patients to cope easier with chronic diseases.

Electronic medical record (EMR) and EHR terms are used interchangeably in the USA. Garet and Davis (2006) indicated that the EMR and EHR present different concepts and various users have created confusion with the meaning of those concepts. The authors proposed that an EMR can be created in healthcare institutions and may serve as data source for the EHR system. The EHR system has the capability to share medical data between all stakeholders in the process. Garets and Davis (2006) concluded that the effective EMR should be a base for successful EHR system. This is similar to the findings of Terry and Francis’ (2007) study, which indicated that the EMR presents usage of electronic records by individual healthcare professionals, and when these records are linked and shared with multiple healthcare providers they are called an EHR.

Baron (2007) emphasised the need for standardisation of EHR systems. The author also pointed out that patients do not present their personal information in a standardised data format, and the users need to translate the information into a format that can be used by the EHR system. The information created by different healthcare professionals need to be standardised with possibility to be used by other computers in the system.

Amatayakul (2007) noted that EHR is not merely a computer application, but should be considered as a set of highly integrated sets of systems. Hoerbst and Ammenwerth (2010, p. 320) described EHR as a: “concept of a comprehensive, cross-institutional, and longitudinal collection of a patient’s health and healthcare data.”

Slaveykov et al. (2013, p. 135) defined the EHR as a: “secure, real-time, point-of-care, patient centric information resource for clinicians.” Henricks et al. (2015, p. 307) defined the EHR as “a longitudinal record of a patient's health care spanning inpatient and ambulatory environments”. However, the authors acknowledged that the EHR includes decision support system which is much more than simple digital information related to the patient and his health status.

Therefore, this Thesis with respect to EHR, is adopting the combination of Slaveykov et al. (2013, p. 135) definition: “EHR is secure, real-time, point-of-care, patient centric information resource for clinicians.”, and the concept of Amatayakul (2007, p. 53) who noted that” “EHR is not merely a computer application, but should be considered as a set of highly integrated sets of systems.”

### EHR advantages for patients, confidentiality, security of data

A EHR is a complex system depending on various stakeholders’ inputs in the whole process. This section presents patients’ interactions with EHR generally, without focus on technology acceptance.

Patients need to have a positive attitude to the EHR system in order to obtain as much good-quality data on their health and medical history as possible. Munir and Boaden (2001) in their survey and interviews study found that some wished to be empowered by viewing their health record electronically. The authors indicated that 74% of patients preferred to use paper-based records probably for further examination. However, this study was based on few interviews and its findings cannot be generalised.

Walsh (2004) suggested that patients who are able to share their personal information with doctors often achieve better outcomes. However, the authors claims were not supported by empirical evidence. Hassol et al.’s (2004) survey showed that patient’ attitudes to the use of Web messaging and online access to their EHR were largely positive. However, a minority of patients in this study were concerned about confidentiality when learning their test results electronically.

Through EHR, doctors can provide a comprehensive overview of basic health parameters for patients visiting medical practices (Baron et al. 2005). Patients can easily have answers to questions, such as differences in their cholesterol levels or body weight. Patients in some systems, can control which parts of an individual’s EHR may be used for which purposes and where they can be displayed (Gunter and Terry 2005). For example, a patient can choose to make available data related to his/her psychotropic prescriptions to all prescribing doctors, but only mental health professionals can view his/her psychiatrist's discharge order. However, this option in some cases can hamper the secondary goals of EHR, such as research support, increased access, and improving quality. Gunter and Terry (2005) described this process as anonymisation, but it is really pseudonymisation. However, this study has a positive contribution as the authors showed that patient data can be securely shared between all stakeholders through an encryption system.

Kalra (2006) reported that patients can have access to their EHR, which allows them to play a more active role in their own health management. As modern healthcare delivery shifts progressively from large clinics to community settings or even patient homes, the author suggested that EHRs will play a major role in the future. Ventres et al. (2006) studied EHRs from the perspective of the patient and doctor encounter. The authors defined EHR as like a third party to a conversation, and their work showed that the EHR implementation could not be considered automatically and universally positive. They have also found that structural, educational, and relational factors play an important role in EHR use.

Since ancient times, patients’ medical histories have been confidential, and known only to their doctor. Agrawal and Johnson (2007), proposed that with the employment of advanced data mining and anonymisation techniques, data from EHR could be analysed without revealing individual patients’ identities. Angst and Agarwal (2009) proposed that factors such as concerns over information privacy have important effects on patients’ attitudes to the use of EHR. The authors defined the need for further work on the interrelations between patient privacy, attitudes, beliefs, and actual behaviour.

Tejero and Torre (2012) underlined that when discussing patient data security within the EHR, text data and medical images should be protected. Although they can be compressed and transmitted, they can be easily intercepted, and there is a need for special security measures. As Heart and Kalderon (2013) indicated, the proportion of older adults in the population is steadily increasing causing healthcare costs to rise dramatically. Therefore, they described the need for implementation of health-related ICT to assist in providing more cost-effective healthcare to this population. However, this research shows that patients lag behind in adoption of healthcare ICT systems.

Stauch et al. (2014) reported that data protection laws have proven to be complex in relation to the secondary usage of health data in EHRs for medical research. The authors indicated an ongoing tension between the privacy interests of patients and the risk of harm if such sensitive data are compromised, and the potential value of utilizing the data for the benefit of medical science. They proposed a consideration of the applicable provisions of the EU data protection directive, and outlined a general approach to patient data handling for research, which they believe is compatible with relevant legal and ethical requirements.

Terry (2015) examined claims for health-care data protection exceptionalism and competing demands such as data liquidity. He has reported that healthcare-data exceptionalism remains a valid imperative and that even current concerns about data liquidity can be accommodated in an exceptional protective model. The author concluded that re-calibrating of the protection of healthcare data residing outside of the traditional healthcare domain is challenging, currently even politically impossible. Quinn (2017) reported that some data protection laws allow processing of personal health data for scientific research, and such data may be used without consent where it is in the ‘public interest’. Whilst, if carried out properly, the result may be that the research value of the data is reduced or even destroyed.

It is evident that EHR system may bring lot of advantages for patients. Complex EHR systems allow the home of the patient to become point of care. However, confidentiality and data protection remain the main challenges nowadays. The data collected through EHR is an important value for the medical research. On the other hand, there are lots of concerns by the patients themselves, and finally all patient data security related issues should be compatible with national and international laws.

### Healthcare providers and EHR

This section presents general information on healthcare providers and EHR relations, i.e. without technology acceptance, which is discussed in Section 2.6.2.

Hippisley-Cox et al. (2003) wrote that EHRs could reduce the incidence of errors, as a result of overcoming problems with handwriting and physical storage requirements. Moody et al. (2004) descriptive study on nursing staff indicated that EHR was more of an aid than an obstacle to care, while 75% of respondents believed it resulted in improved documentation. More than half (54%) indicated that EHR is more secure than traditional paper-based records, and 76% believed that EHR would improve the quality of healthcare services in the future. These studies showed the initial development of EHR in healthcare. At that time the EHR systems were capable of basic storage of information only.

Walsh (2004) wrote that the cognitive load for some doctors is lower when writing by hand compared to entering data in a computer, and that doctors working on a computer will have a higher cognitive load, which may impede the use of EHR. On the other hand, an EHR does have some benefits, such as: “prompting reminders, mnemonics, algorithms, references, risk calculators, decision trees, and best-evidence resources, which are not available in traditional paper-based records.” (Walsh 2004, p. 1186) This study, at that time, indicated how the EHR systems would develop into the future. With the advance of ICT in healthcare it was possible to develop the EHR system from simple paperless application to a complex set of systems.

Ambinder (2005) wrote about the advantages of adopting EHRs for healthcare professionals. He stressed that the overriding reason for using EHRs is that the information needed for patient treatment, management and education must be available for patients at the point when they receive their healthcare. The author focused on oncologists’ needs for support in their clinical decisions, which are patient-specific. Electronic data sharing among caregivers should facilitate a collaborative and coordinated approach, and enhance the tracking and monitoring of all activities regarding healthcare. The author underlined other important reasons for adopting EHRs, which are the reduction of medical errors and reduction of lost paperwork. Ambinder (2005) also suggested that EHRs can contribute to the development of a national healthcare system built on evidence-based medicine responsive to all end users’ needs. However, although the author generalised the findings to healthcare professionals generally, the study focused only on the needs of oncologists.

Miller et al. (2005) underlined other benefits of EHRs for healthcare providers: improved data organisation, accessibility, and legibility. Most healthcare professionals state that EHRs can be accessed from their home, which enables them to leave the workplace earlier and have more free time available. Doctors who have immediate access to EHR can use it in urgent cases as an efficient tool to establish the correct diagnosis. Similar to Miller et al. (2005), Poisant et al. (2005) noted the time-efficiency impact of EHR on doctors and nurses. These studies discussed an important advantage of EHR systems, i.e., time efficacy and accessibility.

Amatayakul (2005) wrote that, although EHR have many benefits associated with improved e-Health, many risks are also inherent in adopting EHR. The author proposed that a formal readiness assessment could help organisations to identify and develop strategies to address this challenge. She concluded that EHRs are not prefabricated products that can be set up relatively quickly, but they should be considered as an important structure designed to last for many years. The formal readiness assessment proposed by this author resembles the situation in Republic of Macedonia and may therefore be used for this Thesis.

Pizziferri et al. (2005) wrote that doctors might use EHR to identify chronically ill patients due for health tests and send them letters to schedule tests. They also stressed the need for facilitated access to clinical information, which would result in more data being available for patient care. Their findings showed that after the adoption of EHR, in comparison with traditional paper-based records, doctors spent .5 minutes less per patient during clinical sessions. One further important advantage of the EHR system is that doctors may have time to see more patients per day.

Powell and Buchan (2005) focused on one important aspect of EHRs as a potential benefit to clinical research. The EHR can facilitate the interaction between care and research environments, providing accurate information which can lead to improvements and efficiency of research. Information for future studies can be collected with ease after the full implementation of EHR. The authors also predicted that EHR would lead to the establishment of national registers of diseases and treatments. This could, in turn, lead to accelerated and expanded epidemiological research. In addition, EHR would provide an efficient method for providing data in clinical trials and longitudinal studies (Powell and Buchan 2005). This is also an important attribute of the EHR system. The EHR can advance from simple paperless application to complex data base rich of information that can be used by many stakeholders.

According to Ford et al. (2006) the EHR implementation represents a disruptive change in the healthcare workplace. For the successful implementation of EHR, the authors proposed re-engineering the job design of healthcare providers in order to achieve the aim. They also noted that general-purpose technology does not deliver results immediately upon its introduction. However, the authors’ claims were not backed by empirical testing. In line with this arguments, Nielsen and Loranger (2006) in their research on web simplicity proposed that web users should be able to find the necessary information quickly, to browse quickly, and access information in a logical manner.

EHR-based decision support can reduce the incidence of medical errors, reduce labour costs, and lower staffing ratios (Sidorov 2006). Furthermore, readily available and retrievable medication lists can help healthcare providers to administer the appropriate therapy. Linder et al.’s (2006) study in primary healthcare indicated that the majority of healthcare professionals did not use the EHR system. Various barriers, including professional, social, and technical issues, were among the factors that influenced their use of EHR in front of patients, and are described in the authors’ survey. According to the authors, the most frequently cited barriers to lower EHR usage during patient visits were: “loss of eye contact with patients, falling behind schedule, computers being too slow, inability to type quickly enough, feeling that using the computer in front of the patient is rude, and they had a preference for writing long prose notes.“ (Linder et al. 2006, p. 1) However, some of these issues, such as slow computers and using a computer in front of the patients, have been overcome more recently.

Although there are numerous scientific papers on EHR, little is known about doctors’ actual use of these systems (Simon et al. 2007). These authors proposed that future work was needed to emphasise the factors that affect the actual use of all available functions. This study also opens discussion on actual use of EHR systems. Valerius (2007) wrote that while EHR applications for IT professionals are part of their daily routine, this is not necessarily a happy task for healthcare providers, whose primary aim is to care for patient’s health. This is an important conclusion, as many healthcare professionals are primarily trained to practise healthcare rather than utilise ICT.

Menachemi et al. (2007) indicated that EHRs are comprised of several distinct technologies, or functionalities, which have to be used in an integrated manner if their full potential is to be realised. They stressed that it is possible for doctors to partly adopt an EHR system by using only a few selected functionalities from the system. EHR functionalities such as clinical decision support systems and electronic prescribing tools are among the most complex to use, and contribute primarily to patient safety. The increased technological complexity of EHR systems reduces end-users willingness to fully exploit them. Widespread partial EHR adoption may occur, according to the authors, without achieving the targeted gains in clinical outcomes, patient safety and cost control. They also stressed that, despite the growing data on EHR adoption, little is known about the configuration of EHR attributes that are adopted and used. Therefore, the authors proposed measuring both the implementation rate and the degree of functionality adoption of EHRs. This study has stressed the partial adoption of the EHR system, i.e. final users are not using systems’ attributes to their full extent.

Chen et al. (2009) study pointed out that EHR implementation resulted in a 26.2% decrease in the annual total office visit rate, but on the other hand, the numbers of scheduled telephone visits and secure messaging increased. The authors reported that the implementation of EHR provided more patient-centred, non-traditional healthcare, while maintaining the quality of care and patient satisfaction. On the other hand, the authors stated that EHRs might increase the time needed to document patient visits.

Ford et al.’s (2012) study suggested that the EHR currently available were unlikely to achieve full diffusion within the planned timeframes. They also concluded that healthcare was decades behind other industries with respect to IT adoption. The authors also proposed future research to obtain more in-depth information on how doctors and other providers respond to standards introduced by the governments.

Berges et al. (2012) confirmed that most healthcare institutions have developed their IT systems autonomously, and that it was difficult to achieve interoperability, and that the various systems are incompatible and do not talk to each other. The design and development of EHR disease registries does not appear to have been carried out systematically or comprehensively (Liaw 2014). There are no reports in the literature that any countries have achieved building a national database for diseases and treatments in that manner which will allow various stakeholders to use the available data.

This section has presented the benefits and some problems of the EHR system related to healthcare professionals perspective (without technology acceptance) before the development and use of the research instrument used in this Thesis. However, the latest relevant studies related to EHR system use were identified and presented after the completion of the two studies of this Thesis and presented in Section 2.7.

## Technology acceptance: an evidence-based approach to technology acceptance and utilisation

This section presents the technology acceptance (without e-Health and EHR). Understanding the way in which employees react to the acceptance of new technologies is of great importance to management and policy makers. The low acceptance of ICT can result in delays or failure to successfully implement the systems.

The implementation of ICT is causing evident changes in almost all industrial areas. However, healthcare and healthcare professionals are lagging behind in adopting such technologies (Yarborough and Smith 2011). Providing a better understanding of technology acceptance among healthcare professionals will be a useful tool for managers to overcome barriers to adopting ICT in healthcare.

Davis et al. (1989, p. 982) noted that: “end users are often unwilling to use available computer systems that, if used, would generate significant performance gains.” Venkatesh and Davis (2000, p. 186) confirmed that: “despite impressive advances in hardware and software capabilities, the troubling problems of underutilized systems continue.” Despont-Gros et al.’s (2005) review of healthcare informatics literature showed that organisational and managerial matters are the main reasons for the failure to implement ICT systems in organisations, and that technical problems account for less than 20% of all failures. This makes it clear that when implementing a new technological application, managers and policy makers should have a profound knowledge of factors that encourage technology acceptance among employees, and accordingly use this knowledge in the decision-making and implementation process.

It is therefore important to understand how and why employees decide to use or discard specific software or technological applications, as the behavioural aspect of technology acceptance appears to be far more important than the technical details of system failure. Research on technology acceptance models provides a wealth of information about the personal, social, and structural aspects of technology acceptance across various professional domains.

### Theory of reasoned action and theory of planned behaviour

Before examining actual technology acceptance models, it is worth describing more general theories of human decision making and action initiation. Two important theories in this domain are the theory of reasoned action (TRA) and the theory of planned behaviour (TPB), which has served as the basis for the technology acceptance theoretical models described below.

The TRA was introduced by Fishbein and Ajzen (1975), and assumes that people can make rational decisions based on their estimates of the benefits and costs. The authors proposed three components of TRA: behavioural intentions, attitudes, and subjective norms (SN). Behavioural intentions are people’s explicit motivation and determination to perform the behaviour in question (e.g., the intention to utilise new software). Attitudes are evaluative beliefs, and reflect outcome expectancies or beliefs about the consequences of performing a given action. Subjective norm reflect perceptions of social approval or disapproval of a given behaviour by specific referent groups, usually significant others or colleagues, depending on the context of the study. According to TRA, attitudes and subjective norm have influence on behaviour indirectly, through intentions, meaning that the stronger the attitudes and normative pressures, the greater the intention that will later lead to actual behaviour. However, to the extent that someone does not care very much about what others think, then subjective norm will have little effect on intentions and subsequent behaviour. At that time, TRA as a psychological/behavioural theory was used to understand various behaviours such as voting, exercising, dieting and condom use (Sheppard et al. 1988; Albarracin et al. 2001). The TRA is shown in Figure 2.1.

Figure 2.1: Theory of reasoned action

Attitude toward act or behavior

Subjective norm

Behavioral intention

Behavior

Source: redrawn from Fishbein and Ajzen (1975)

Research on TRA identified the potential limitations of the theory and led to the development of its successor, TPB, by Ajzen (1991). The TPB is presented in Figure 2.2.

Figure 2.2: Theory of planned behaviour

Source: redrawn from Ajzen (1991)

The main distinction between the TRA and the TPB is that the latter considers perceived behavioural control as an additional predictor of both intentions and subsequent behaviour. Ajzen (1991, p. 183) noted that: “perceived behavioural control (PBC) reflects peoples' perception of the ease or difficulty of performing the behaviour of interest”. The original TRA can predict behaviours that are under volitional control, but in cases with constrains on action, mere intention is insufficient to predict behaviour, and it is this condition that requires consideration of PBC (Armitage and Conner 2001). TRA and TPB have been influential and widely applied across behavioural domains. In relation to the present Thesis, TRA sets the basis for the development of theoretical models intended to predict and explain the adoption and utilisation of emerging technologies in various business settings.

Technology acceptance theories emerged as a new field in the science in the late 1980s with the introduction of the technology acceptance model. Since then, new technology acceptance models and other technology acceptance variables have emerged. The main aim of all these models is to understand end users’ acceptance of new technologies. These are described in next sections.

### Technology acceptance model

The first model on technology acceptance based on the basic tenets of TRA was introduced by Davis (1989). This approach, named the technology acceptance model (TAM), was developed with the aim of better understanding IBMTM employees’ acceptance of new software. TAM as described by Davis (1989) and Davis et al. (1989) posits that the intention (INT) to use software corresponds to acceptance of the software. In turn, the predictors of intentions include employees’ attitudes to the software based on the effect of perceived usefulness (PU) and perceived ease of use (PEOU). The model describes the relationship between the independent variables of perceived usefulness and perceived ease of use and the dependent variables of user attitudes, intentions, and computer use behaviour. Attitude was first used in the model, but was later replaced by the behavioural intention variable to capture the direct influence of perceived usefulness on actual system use.

**Perceived usefulness**

Perceived usefulness suggests that people will use (or not use) the software application based on their beliefs about the expected utility and actual positive impact of the application on job performance. Specifically, Davis (1989, p. 320) defined perceived usefulness as: “the degree to which a person believes that using a particular system would enhance his or her job performance.” In addition, he claimed that in organisational contexts, employees are motivated to perform well by pay rises, promotion, bonuses and other forms of incentive.

**Perceived ease of use**

Furthermore, perceived ease of use is defined by Davis (1989, p. 320) as: “the degree to which a person believes that using a particular system would be free of effort.” Perceived ease of use has a direct effect on attitudes and an indirect effect through perceived usefulness. He also argued that if a technology application is perceived to be easy to use, it is more likely to be accepted by end users. Finally, Davis posited that perceived usefulness and perceived ease of use determine one’s attitudes, which in turn, predicts usage intentions. The original TAM is shown in Figure 2.3.

Figure 2.3: The original TAM

Source: redrawn from Davis et al. (1989)

Perceived usefulness

Perceived ease of use

Behavioral intention to use

Actual system use

In a field study with 112 end users, Davis (1993) found that perceived usefulness was 50% more influential than perceived ease of use in determining usage. The application of TAM in the late 1990s was limited only to research studies conducted in the USA (Straub et al. 1997). However, this has changed recently, and according to Lee et al. (2003), almost 10 per cent of all research publications in ICT are based on articles related to TAM. However, there are no newer reports in the literature with respect to percentage of TAM articles in research publications. Bagozzi (2007) suggested that TAM is a gold standard in research on the intention to use ICT. Meta-analyses by Ma and Liu (2004) and King and He (2006) supported the postulates of TAM. The results of Ma and Liu’s (2004) work generally confirmed Davis’ findings, although they found a stronger relationship between perceived usefulness and technology acceptance, while perceived ease of use influence on technology acceptance was weaker in their meta-analyses. King and He’s (2006) meta-analysis of 88 TAM studies involving 12000 observations confirmed that TAM’s perceived usefulness and behavioural intention were reliable, and the authors proposed that TAM could be used in different contexts.

The TAM measuring effect was limited to perceived usefulness and perceived ease of use and could not go beyond this. It is difficult to define the reasons behind the perceived usefulness and perceived ease of use prediction effect. TAM focuses on voluntary environments without considering mandatory settings. There were no prediction variables included in the model that can assess the effect of mandatory or voluntarily use. Therefore, there was a need to extend the basic TAM.

### Technology acceptance model 2

Venkatesh and Davis’ (2000) study showed that, over 20 years, research on technology acceptance had expanded considerably and become the main theoretical approach to understand users’ acceptance of ICT. The authors used empirical findings to judge the importance of traditional TAM constructs, and proposed a revised model known as technology acceptance model 2 (TAM2). They indicated that TAM has limited capabilities in explaining end users’ intentions, and proposed new technology acceptance variables. They retained perceived usefulness and perceived ease of use, as they considered these two variables as strong drivers of intentions to use technology. They also considered attitude as an unnecessary predictor of IT use, which, can adjust the influence of perceived usefulness and perceived ease of use, and added other variables such as subjective norm (SN) in order to capture social influences. The authors believed that a further explanation of the factors that determine the perceived usefulness may build managerial interventions, which could increase user acceptance and the use of new systems. In addition, Venkatesh and Davis (2000) proposed that perceived ease of use has less influence on usage intentions. However, the authors also indicated that: “the easier a system is to use, the more using it can increase job performance.” (Venkatesh and Davis 2000, p. 196) Figure 2.4 shows the original TAM2.

Figure 2.4: The original TAM2

Subjective norm

Perceived usefulness

Perceived ease of use

Usage behavior

Intention to use

Voluntariness

Result demonstrability

Output quality

Job relevance

Image

Experience

Source: redrawn from Venkatesh and Davis (2000)

Venkatesh and Davis (2000) used the basic TAM variables perceived usefulness and perceived ease of use as a starting point, adding other social influence processes to the model, including subjective norm and image. Cognitive instrumental processes such as job relevance (REL), output quality, and result demonstrability were included in the prediction model. Experience and voluntariness were proposed as factors that may moderate the effect of subjective norm. Therefore, compared to the original TAM, TAM2 considerably expanded the range of indirect effects of distal predictors (subjective norm and job relevance) on usage intentions, while emphasising the central role of perceived usefulness and perceived ease of use.

**Subjective Norm (SN)**

First used in TRA and TPB in work by Ajzen and Fishbein (2000), subjective norm was conceptualised as an indicator of social influences assessing the beliefs of other people who were important to them, e.g., senior staff, etc. It was proposed that normative beliefs reflecting other colleagues’ behaviour (i.e., believing that most colleagues would endorse and utilise the new technology) predicted stronger intentions to use e-Health among healthcare professionals. Subjective norm can also be related to the end user’s beliefs about how much other colleagues will accept and use new technology. Subjective norm effectiveness was later confirmed in findings by Holden and Karsh (2010). A quantitative meta-analysis of Schepers and Wetzels (2007) showed that subjective norm had a significant influence on TAM2 variables. Venkatesh and Davis (2000, p. 187) defined subjective norm as:

“people may choose to perform behaviour, even if they are not themselves favourable toward the behaviour or its consequences, if they believe one or more important referents think they should.”

Davis et al.’s (1989) and Matheison’s (1991) studies showed the insignificant influence of subjective norm on user intentions, and proposed future research in that area. However, Taylor and Todd’s (1995) study showed that subjective norm had a significant influence on user intentions. Therefore, there are different and sometimes conflicting results in the literature with respect to the influence of subjective norms on future intentions. As this variable is rarely used in the literature there is a need for future assessment of its influence on intentions.

**Image**

Image as a predictor construct is defined as the user’s aim to have a good image among his or her colleagues as a response to social normative influences. Kelman (1958) discussed the individual’s willingness to have a good image within a group as a response to social normative influences. Based on Kelman’s theory, Venkatesh and Davis (2000) theorised that subjective norm would have a positive effect on image, which would elevate a person’s status within the group. In addition, an elevated status would increase the person’s power and influence, which would lead to greater productivity. The TAM2 model proposed that subjective norm would have a positive effect on image, which would influence perceived usefulness.

**Job relevance**

Venkatesh and Davis (2000, p. 191) defined job relevance as an: “individual’s perception regarding the degree to which the target system is applicable to his or her job.” The authors also related job relevance to a “set of tasks the system is capable of supporting within a person’s job.” Venkatesh and Davis (2000, p. 191) Other studies (Fishbein and Ajzen 1975; Ajzen 1991) have set similar goals, hierarchical models related to human-computer interactions, which were used as a basis for making job relevance a component of TAM2. Job relevance can be related to an individual’s perception of the degree to which a target system is applicable and pertinent to the everyday tasks of end users.

**Output quality**

Output quality reflects the individual’s consideration to use the system if it is capable of performing tasks that will be same with his/her job goals. If the system is capable of performing tasks that match an individual’s job goals, then the individual might consider using the system. Based on this idea, Venkatesh and Davis (2000) included the output quality norm as a tool that could influence perceived usefulness. Davis et al. (1992) also found a relationship between output quality and perceived usefulness.

**Result demonstrability**

Result demonstrability is the correlation between the tangibility of the system’s results and perceived usefulness. This variable explains to the end user how tangible or apparent the results of the new technology use are. Moore and Benbasat (1991) reported the correlation between the tangibility of results and perceived usefulness. Based on Moore and Banbasat's (1991) findings, Venkatesh and Davis (2000, p. 192) proposed that result demonstrability would have a positive influence on perceived usefulness: “if the co-variation between usage and positive results is readily discernible.” However, if the system produces results that are obscure to the user, then he or she would be less motivated to use it.

**TAM2 moderation variables**

Voluntariness and general work experience were introduced to TAM2 as moderating variables that can affect a relationship between prediction constructs.

**Voluntariness**

Venkatesh and Davis’ (2000) TAM2 model posited voluntarinessas a moderating variable. A moderating variable is one that weakens or strengthens a relationship between two (or more) other variables. For instance, voluntariness might influence the way subjective norm predicts intentions to use e-Health. In cases where voluntariness is high, the effects of subjective norm on intentions can be higher. On the other hand, when voluntariness scores are low, the relationship between subjective norm and intentions decreases.

Hartwick and Barki’s (1994) study, based on the fact that user participation and involvement are different depending on whether system use is mandatory or voluntary, showed that subjective norm has a significant influence on usage intention only in mandatory settings, but not in voluntary settings. In addition, even if the system is organisationally mandated, usage intentions may vary when end users are unwilling to comply.

**Experience**

Venkatesh and Davis (2000, p. 190) described the effect of experience on subjective norm as:

“the directive effect of subjective norm on intentions for mandatory usage contexts will be strong prior to implementation and during early usage, but will weaken over time as increasing direct experience with a system provides a growing basis for intentions towards ongoing use.”

The authors based their involvement of the experience variable on subjective norm based on previous studies (Doll and Ajzen 1992; Hartwick and Barki 1994; Agarwal and Prasad 1997), where the effect of subjective norm weakened over time due to end users' direct experience with the system. However, the authors of TAM2 believed that the effect of image on performance expectancy would not fade over time, because status gained from the system would be present with other group norms.

TAM2 can provide more detailed explanations of a user’s behaviour and intentions than TAM. Venkatesh and Davis (2000) also indicated that TAM2 performed well in both voluntary and mandatory settings. Subjective norm had no effect in voluntary settings but was an efficient assessment tool in mandatory settings.

A common feature of TAM and TAM2 is that they do not use exactly the same measures of technology acceptance variables and predictors of technology. However, as TAM and TAM2 provide a general framework, new extended technology acceptance variables can be added to the model, as long as they are theoretically relevant and their addition reflects evidence-based decisions. The legacy of technology acceptance in more recent years includes alternative and more robust models. These are described in following sections.

### Unified theory of acceptance and use of technology

Venkatesh et al. (2003), unifying the existing IT acceptance literature, presented a unified theory of acceptance and use of technology (UTAUT). The authors defined four constructs that have a significant role in user acceptance and behaviour: performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC). The theory had many similarities to the initial TAM and TAM2 approaches, as it incorporated perceived usefulness into performance expectancy as the same underlying construct reflecting the individual’s anticipation of improved or reduced performance resulting from technology use. Perceived ease of use is transformed into effort expectancy reflecting the user’s perceptions of the ease of using the new technology. The subjective norm variable from previous technology acceptance models was transformed into social influence. Facilitating conditions was introduced as a new variable not explicitly addressed in the previous models, denoting the degree to which end users perceive that there will be organisational and technical support to enable more efficient and easier use of the new technology. Furthermore, the authors proposed four moderators: gender, age, experience, and voluntariness, which would have an influence on the key constructs.

According to the authors, UTAUT provides a useful tool for researchers needing to assess how successful the introduction of new ICT might be. This model could help managers and policymakers to understand the drivers of acceptance, and could enable them to design proactively interventions, such as training, policy making, marketing etc. The original UTAUT model is presented in Figure 2.5.

Figure 2.5: The original UTAUT model

Performance expectancy

Effort expectancy

Social

influence

Facilitating conditions

Gender

Age

Behavioral intention

Voluntariness of use

Experience

Use

behavior

Source: redrawn from Venkatesh et al. (2003)

**Performance expectancy**

Venkatesh et al. (2003, p. 447) described performance expectancy as: “the degree to which an individual believes that using the system will help him or her to attain gains in job performance.” Various authors proposed that performance expectancy would be the strongest predictor of intentions (Davis 1989; Davis et al. 1989; Venkatesh and Davis 2000). Venkatesh et al. (2003) also proposed that the effect of performance expectancy on intentions would be moderated by gender and age factors. According to the authors, the influence of performance expectancy on intentions is moderated, and the effect is stronger for males, particularly younger male users of the technology. Gender and age differences in technology acceptance were found in studies by Morris and Venkatesh (2000) and Venkatesh and Morris (2000). Therefore, the performance expectancy construct might be moderated by gender and age.

**Effort expectancy**

Venkatesh et al. (2003, p. 450) defined effort expectancy as: “the degree of ease associated with use of the system.” They transformed TAM’s perceived ease of use into effort expectancy, based on previous studies by Venkatesh and Morris (2000), Venkatesh et al. (2000) and Morris and Venkatesh (2000). The authors of the model proposed that effort expectancy would be a stronger determinant in women, particularly those who are older and have little job experience (with limited exposure to technology). Therefore, the effort expectancy construct might be moderated by gender, age, and experience.

**Social influence**

Venkatesh et al. (2003) defined social influence as the employee’s perception if those in higher positions believe he or she should use the new system. The social influence construct as a direct determinant of behaviour is represented in TAM2 as subjective norm. Each of these constructs, with different names across technology acceptance models reflects the same notion: that an individual’s behaviour is influenced by the way users believe that important others in the workplace will view them. Social influence is significant only in mandatory settings in the early stages of experience, weakening over time (Hartwick and Barki 1994; Agarval and Prasad 1997; Venkatesh and Davis 2000). Women have been reported to react more sensitively to important others’ opinions (Morris and Venkatesh 2000; Venkatesh et al. 2000; Venkatesh and Morris 2000). According to the authors, the effect of social influence on intentions is stronger among older women. This effect is stronger in mandatory settings and within employees with less work experience. Therefore, the social influence construct is moderated by gender, age, voluntariness, and experience through complex interactions.

**Facilitating conditions**

Morris and Venkatesh (2000) indicated that facilitating conditions are assessing employees’ belief that the technical and organisational infrastructure within the organisation could facilitate the use of the system. Venkatesh (2000) indicated that the effect of facilitating conditions on intentions will be mediated by effort expectancy and becomes stronger. When performance expectancy and effort expectancy are present, the effect of facilitating conditions on intentions becomes insignificant. The effect of facilitating conditions is expected to increase with experience and age,meaningthatolder workers attribute more importance to receiving help and assistance on the job. Therefore, the facilitating conditions variable is moderated by age and experience. The authors’ early tests provided strong empirical support for the model, accounting for 70% of the variance in intentions and 50% in actual use. UTAUT presents direct determinants of factors affecting people’s intentions to use the system (performance expectancy, effort expectancy, and social influence) and determinants of behavior (facilitating conditions and intentions). Moderators such as gender, age, previous work experience, and voluntariness were included in the original UTAUT model.

### Technology acceptance model 3

Venkatesh and Balla (2008) combined TAM2 with the model of the determinants of perceived ease of use created by Venkatesh (2000) and developed an integrated model of technology acceptance 3 (TAM 3). Venkatesh (2000) proposed that employees would be influenced by early perceptions of perceived ease of use on a system based on several anchors, such as control, intrinsic motivation, and emotion. The authors proposed that end users will form their perception on the perceived ease of use about the system by anchoring their perceptions to specific computer beliefs: “computer self efficacy, perceptions of external control, computer anxiety, and computer playfulness.” (Venkatesh and Balla 2008, p. 278) The control anchor was conceptualised as computer self-efficacy, intrinsic motivation was related to computer playfulness, and emotion were conceptualised as computer anxiety. They suggested that, later on, end-users adjust their perceived ease of use based on real experience with the specific system (perceived enjoyment and objective usability). Venkatesh’s ‘model of the determinants of perceived ease of use’ is shown in Figure 2.6.

Figure 2.6: Model of the determinants of perceived ease of use

mputer Self-Efficiency



Technology acceptance model

Adjustments

Anchors

Computer self-efficiency

Computer playfulness

Computer anxiety

Perceptions of external control

Perceived enjoyment

Objective usability

Behavioral intention to use

Perceived ease of use

Perceived usefulness

Source: redrawn from Venkatesh (2000)

The anchors of computer self-efficacy, perceptions of external control, and computer anxiety represented individual beliefs concerning computers and computer use. Computer playfulness represented the intrinsic motivation related to the usage of new IT. In TAM 3, the determinants of perceived ease of use did not influence the determinants of perceived usefulness, and vice versa, i.e., the perceived usefulness determinants did not influence the perceived ease of use determinants. The original TAM 3 is shown in Figure 2.7.

Figure 2.7: The original TAM3

Adjustment

Anchors

Computer self-efficiency

Computer Playfulness

Computer anxiety

Perceptions of external control

Perceived enjoyment

Objective usability

Behavioural intention

Perceived usefulness

Perceived ease of use

Image

Job relevance

Output quality

Result demonstrability

Subjective Norm

Voluntariness

Experience

Use

behaviour

Source: redrawn from Venkatesh and Balla (2008)

According to Venkatesh and Bala (2008), the subjective norm, image, job relevance, output quality, and result demonstrability are directly related to the individual’s judgments of perceived usefulness. The determinants of perceived ease of use are traits and emotions such as computer self efficacy, computer anxiety, and computer playfulness. Control of the system, computer playfulness, and perceived enjoyment did not mean that the system would make the employee more effective. Venkatesh and Bala (2008, p. 279) theorised that perceived ease of use is: “associated with individual’s self-efficacy beliefs and procedural knowledge, which requires hands-on experience and execution of skills.” For the authors, experience was a strong moderator, as with time the user would have more information on how easy or difficult it was to use the system. Another example of the influence of experience is the effect of computer anxiety on perceived ease of use, which should diminish with time.

All features of newly developed technology acceptance models are too complex (i.e. they are presented through detailed figures) to be presented and summarized together in one place or table, as they would lose their basic meaning. However, the modified technology acceptance models used in this Thesis are presented in detail, side by side, in Chapter 6 (Tables 6.1 and 6.2).

### Technology acceptance: cross-cultural, gender and age differences

This section explores cross-cultural, gender and age differences explored through empirically-tested technology acceptance models. However, the literature review indicated that only few studies have addressed these issues.

Straub et al. (1997) conducted a comparative study of TAM use in the United States, Japan, and Switzerland. They found that the TAM was applicable for the United States and Switzerland, but not for Japan. The study was conducted by using the same research tool to airplane employees using the same ICT in these three countries. The major finding from this study was that TAM may not predict technology acceptance equally in all countries. Straub et al. (1997, p. 2) stressed that: “cultural differences that exist between different countries may affect a multinational organisation’s ability to adopt and utilise IT.” Therefore, the authors concluded that TAM may not hold equally across cultures, and whether or not the finding proves to be reproducible in other studies, this will have significant implications for researchers who study acceptance and for practitioners who implement ICT.

Venkatesh and Morris (2000) investigated gender differences with respect to adoption and usage of new technology among 445 employees from five organisations in USA. The main finding from this study was that the male users’ decisions were strongly associated with their perceptions of usefulness, while women users were associated with ease of use and subjective norm. However, the effect of subjective norm diminished over time in women respondents. Perceived ease of use was not associated with male respondents at any point of time in the study. Male users were associated with ease of use of the system. However, with increasing experience the ease of use effect was becoming less significant. Declining perceived ease of use in female respondents played a major role in their technology acceptance. Subjective norm was not associated with male respondents at any time, while female respondents considered it important at the initial stage of technology adoption. However, after three months of experience, female respondents did not show a significant emphasis on this construct. This research indicated that gender is an important predictor of technology adoption.

Zakour (2004) proposed an extension of TAM with the aim of understanding how cultural differences explain behaviour towards ICT. He proposed the integration of well-established cultural value dimensions from the literature on TAM to assess the high variability between countries. Zakour (2004, p. 156) proposed six cultural value extensions for TAM: ”individualism/collectivism, power distance, masculinity/femininity, uncertainty avoidance, monochromic/polychromic time, and high context/low context.” The author proposed extending the TAM to cross-cultural settings.

Srite (2006) examined technology acceptance differences in the adoption of IT in China and USA. In the Chinese sample, the relation between perceived usefulness and intentions was non-significant, while there was an association between subjective norm and intention to use the system. Contrary findings were indicated in the US sample, where perceived usefulness and intentions had a significant relationship. The perceived ease of use and intentions association was significant only in the US sample. The author indicated that there was limited research in the field of technology acceptance association with national culture. He has also proposed that end users have different reactions towards IT implementation across cultures. Therefore, different implementation strategies in different cultural settings should be considered.

TAM was developed in the USA, and has recently been used in other countries. McCoy et al. (2007, p. 81) on TAM’s use in other cultural settings indicated that:

“transferring a model to another cultural context should be subject to rigorous testing, and a few studies have begun to examine the applicability of TAM in a small variety of cultures.”

The authors also stressed that their data analyses revealed that TAM does not hold for certain cultural orientations. McCoy et al. (2007, p. 81) indicated that: “low uncertainty, avoidance, high masculinity, high power distance and high collectivism seem to nullify the effects of perceived ease of use and/or perceived usefulness.”

Oshlyanski et al. (2007) studied technology acceptance implementation in nine countries (Greece, India, United Kingdom, Malaysia, United States, New Zealand, South Africa, Saudi Arabia, and Czech Republic). The authors indicated that UTAUT may reveal cultural differences and that the UTAUT constructs have different measuring effect in each country. Social influence was shown to have higher influence in Saudi Arabia than in the other participating countries. The anxiety construct emerged as a technology acceptance predictor in all countries except the Czech Republic. Effort expectancy and performance expectancy were shown to be technology acceptance predictors in all countries except India. However, the Indian sample in the study was problematic. The authors proposed that UTAUT might be useful in providing insight into cross-cultural differences in technology acceptance.

An et al. (2007) reported gender differences with respect to technology acceptance and usage behaviour on use of the Internet. They stressed that men, at that time were using the Internet more frequently than women. They concluded that there had been minimal technology acceptance related research with respect to gender differences and proposed future studies in this area. Bandyopadhyay and Fracastoro (2007) suggested that culture may play a significant role in ICT usage and adoption. Their TAM interview study in India found that social influence based in culture has significant explanatory value regarding behavioural intentions to use technology.

Venkatesh and Zhang (2010) examined the attitudes of 300 employees from an organisation which operated both in the USA and China. The UTAUT model explained nearly 70% of the variance in the USA, while in China it explained only 64%. The effect of performance expectancy was different across gender and age, and had strongest effect among younger males. Effort expectancy had variations across gender, age, and experience, with strongest effect among older employees in later experience stages. Finally, the authors found different relationships (from the original UTAUT model) between social influence and intentions in the Chinese sample.

Experience moderated the effect of social influence on behavioural intention, with the effect being stronger for workers with increasing experience in China in Venkatesh and Zhang (2010) study. Age, gender, and voluntariness were not shown to be moderators of the social influence construct in the Chinese sample. This research showed that the way the UTAUT model works in China is quite different from the USA. The social influence construct has a different influence in China from what has been theorised for the USA. The authors proposed that while the moderation effect of gender, age, voluntariness, and experience are pertinent regarding the role of the social influence construct in the USA, in China, the effect of this moderator is irrelevant.

Im et al. (2011) indicated that the UTAUT model does not include cultural factors. As ICTs are utilised in many countries, it is crucial to obtain a better understanding of the impact of culture on technology adoption. Im et al. (2011) compared the behavioural intentions of students and full time workers in South Korea and the USA. They found that the effects of behavioural intention on end users behaviour were greater in the USA sample compared to the sample from South Korea. The effect of performance expectancy did not significantly differ between two countries. The difference in effort expectancy implies that users in the USA are affected by how easy technology is to use.

Jimoh et al. (2012) conducted a quantitative survey in 25 health facilities in five rural states in Nigeria. Their study indicated significant differences in the perceived ease of use and perceived usefulness across the states. However, there were no interactions among different workers’ groups and age. They also found that healthcare employees’ preferences for ICT systems varied across different groups, and were contrary to government and employer priorities. The authors proposed mandatory application of extended TAM on pre-implementation processes among healthcare employees in sub-Saharan Africa.

Liu and Guo (2017) explored how gender differences influence the acceptance of mobile devices in higher education among Asian college students using the modified technology acceptance model. Male students were influenced by perceived influence and social benefits while female students preferred social and utilitarian orientation. However, the authors acknowledged that the results of this survey should be interpreted as speculative and cannot be relied upon as an accurate depiction of behaviour.

Cross-cultural, gender, and age differences with respect to technology acceptance can be summarised as:

* in different countries, people might have different perceptions and views about information technology. Uneven economic development levels across different countries might affect the attitudes toward technology use in different populations.  End users from different countries may have different understandings about technology use, and different views towards the usefulness of technology, which can influence their intentions; and
* gender (of the end-users) has not been included in any prediction model on technology acceptance across the research studies. Although there are a few studies that have explored gender differences, this variable (gender) cannot be considered as predictor of intentions. However, the gender at the UTAUT model can be assessed as a moderator on performance expectancy, effort expectancy and social influence effects on intentions.

### Limitations of technology acceptance models

The effectiveness of technology acceptance models has been shown in many studies. However, this approach has some limitations. The main criticism is that technology acceptance research instruments use self-reported tools instead of real data. Legris et al. (2003) reported that self-reported data is subjective and is unreliable for actually measuring a system. They also proposed that technology acceptance should be applied to business processes applications in real business environments instead of in laboratory settings or to students. Technology acceptance studies of participants in controlled environments, such as students or other small closed and controlled groups, cannot be generalised to the real world (Lee et al. 2003).

Bagozzi (2007) questioned the poor theoretical linkage between the different constructs formulated in the TAM. He also questioned the strength of the link between intention to use a system and actual use, and indicated that behaviour cannot be considered as an actual goal. He also argued that an intention might not be representative of actual use, as there is a period between intention and adoption that can be full of uncertainties and other factors that might influence a user’s decision to use technology.

Technology acceptance models usually use predefined research instruments in the form of structured questionnaires. This notion is followed with the aim of assessing the attitudes of the targeted population. With this approach it is possible to acquire unified data and to draw conclusions. However, open-ended questions, which can be added to the model, may obtain additional information on users’ attitudes.

## The need for research of technology acceptance in healthcare

This section presents the need for studying the technology acceptance in healthcare settings before the research in this Thesis. However, these issues were explored again in the literature after the completion of two studies of this Thesis, and were presented in Section 2.7.

The optimal functioning of ICT systems in healthcare settings requires effective relationships between the functionality of the system and skills and work-oriented healthcare professionals (Berg 1999). Berg stressed the fact that patient care information systems often fail to deliver because of organisational and managerial issues. In his seminal work, Berg (2001, p. 143) defined a major managerial challenge when implementing ICT systems:

“the implementation of comprehensive information systems in healthcare practices has proved to be a path ridden with risks and dangers. It has become evident that there are many more failure stories to tell than there are success stories — and the more comprehensive the technology, or the wider the span of the implementation, the more difficult it appears to achieve success…whether an information system is successful or not is decided on the work floor.”

Berg (2001) discussed the degrees of success in the implementation of patient care information systems. He stressed that not all parties involved in the implementation process may agree on how to measure effectiveness. For instance, IT system implementation may be declared a success by management insofar as the system is up and running. However, the actual use of the system and the appreciation of end users do not necessarily mean that they completely agree with management.

Chau and Hu (2001) reported a difference in acceptance attitudes between healthcare professionals and administrative staff. Their review of technology acceptance studies showed that different authors find that perceived usefulness and perceived ease of use variables do not have the same influence in all studies as predictors of behaviour. Furthermore, the meaning of perceived usefulness and perceived ease of use variables may differ from study to study. In healthcare, some basic variables such as perceived usefulness or social influence may have contexts and meanings different from their usage among the other professionals.

Yarbrough and Smith (2007) conducted a systematic review of peer-reviewed articles published between 1996 and 2006, with the aim of developing a new TAM, contextualised to healthcare settings. The authors identified barriers to technology acceptance that were unique to the physician population, such as financial and time costs of implementation, and organisational issues such as physician reimbursement structures, and proposed that doctors’ perceptions of new technology utilities should be included in the new model. Finally, they proposed a new enhanced technology acceptance model modified to healthcare settings. Yarbrough and Smith (2007) proposed future research for the better comprehension of the factors contributing to physician technology acceptance of EMR. However, these claims need further empirical testing.

Simon et al. (2007) examined the degrees of success of the EHR system. They concluded that although a number of studies focused on EHR adoption, knowledge of the capabilities of these systems and their actual use is very poor. Simon et al. (2007, p. 507) suggested:

“electronic health records have great potential to improve quality and safety in healthcare, but this improvement will occur only if clinicians have access to key functions in EHR systems and use them regularly.”

Schapper and Pervan (2007, p. 213) suggested that: “while technology acceptance research is a mature field in information systems research, its application in the health sector is in its infancy.” Holden and Karsh (2010, p. 10) concluded:

“TAM was developed outside healthcare, and therefore some of its core concepts and measures may not appear relevant to healthcare investigators. For example, the focus on personal productivity as a measure of usefulness may not be meaningful, and certainly not sufficient, in a healthcare context.”

Boonstra and Broekhuis (2010) conducted a systematic literature review based on research papers published between 1998 and 2009 in four databases. The authors identified 22 papers that reported considerable barriers to EMR adoption by doctors. They identified eight main categories of barriers: financial, technical, psychological, social, legal and organisational, as well as time constraints and change management. Finally, the authors proposed the adoption of different management perspectives that could develop barrier-related interventions to overcome these problems. Egea and Gonzalez (2011) suggested future work to explore the role of alternative factors such as external social behaviour and perceived behavioural control, and external variables, such as socio-demographic variables in ICT acceptance among healthcare providers.

Berg (2001), Short et al. (2004), and Simon et al. (2007) stressed the under-utilisation of existing ICT in healthcare settings. They highlighted the importance of research in real environment with aim of understanding how healthcare employees accept e-Health systems in their day-to-day work. Morton and Wiedenbeck (2010) indicated that the findings were inconsistent with respect to the predictors of attitudes in healthcare are. Therefore, there is an evident need for future research of technology acceptance in health care.

The next two sections present empirical studies of technology acceptance in healthcare (studies which do not test empirically technology acceptance were excluded). These two sections represent a critical appraisal of the literature before the research in this Thesis was carried out, and were used for the creation of the research instrument. However, empirical testing studies published after the research in this Thesis was undertaken were reviewed, appraised, and are presented in Sections 2.7.1 and 2.7.2.

### Technology acceptance and e-Health

This section initiates an introduction of technology acceptance in healthcare and represents an appraisal of the knowledge in these areas before the research was undertaken in this Thesis.

Technology acceptance empirical usage in healthcare settings began in the late 1990s. Hu and Chau (1999) and Hu et al. (1999) examined the acceptance of telemedicine technology among hospital doctors practicing at Hong Kong public hospitals. While perceived usefulness was established as a significant predictor of attitudes, the predictive effect of perceived ease of use was weaker.

Perceived usefulness was also found to have an effect on technology acceptance among doctors practicing in public tertiary hospitals in Hong Kong, but perceived ease of use and subjective norm were not shown to be predictors of professionals' intentions (Chau and Hu 2001). The authors reported differences in technology acceptance between healthcare professionals and administrative staff. Finally, they proposed that the management of healthcare organisations implementing telemedicine technology should place a strong emphasis on communicating its usefulness to doctors. It is evident that technology acceptance was becoming a major challenge for e-Health implementation in the last century.

Van Schaik et al.’s (2002) survey of the clinical acceptance of a portable system for postural assessment among physiotherapists from the local National Health Service (NHS) trust and the University of Teesside in the UK showed substantial levels of technology acceptance in terms of perceived usefulness, perceived ease of use, and intention to use. Although they reported a stronger relationship between perceived usefulness and intention to use compared to perceived ease of use and intention, they acknowledged TAM as a pivotal factor in clinical acceptance. The authors noted that improvements in the perceived ease of use of the system will increase perceived usefulness, while improvements in functionality will lead to increased intention to use. Finally, the authors concluded that both perceived usefulness and perceived ease of use were prerequisites for technology acceptance. However, this study is limited to one smaller group of health care professionals in one region in the UK.

Chismar and Patton (2002), in their study using the revised TAM2, excluded the voluntariness and experience constructs, and tested the model on acceptance of computers and Internet-based technologies among paediatricians. TAM2 was partially supported, as perceived usefulness was found to be a strong predictor of intention, while perceived ease of use was not a significant predictor of the intention to use.

Ammenwerth et al.s’ (2003) quantitative questionnaire study of user acceptance of computer-based nursing documentation at the University hospital in Heidelberg, Germany found that computer knowledge is a significant predictor of final user acceptance. The author also stressed the importance of task requirements and functionality of the system in higher user acceptance. Finally, she proposed long-term evaluation studies of information technology in healthcare in order to make information systems genuinely supportive for healthcare professionals. This study represents the views of smaller group of healthcare professionals in one university hospital.

Mohd and Mohamad (2005) used a modified version of TAM as an investigation of EMR acceptance among doctors, nurses, clinicians, and patients in Malaysia before successful implementation. However, they proposed further studies before the model is finalised. Liu and Ma (2005) extended TAM by embedding perceived service level as a causal antecedent for the purpose of their study in the USA. They found that perceived service level is a strong determinant of behavioural intention. However, their extended TAM was tested on surrogate subjects, and there was a need for further empirical testing.

Wu et al. (2007) used the revised TAM to examine the acceptance of mobile healthcare systems by healthcare professionals in private and public hospitals in Taiwan. Their results show that compatibility, perceived usefulness, and perceived ease of use significantly influenced end-users' behavioural intentions.

Chen et al. (2007) applied UTAUT to address the problem of technology acceptance in emergency rooms in hospitals in North Carolina in the USA. With the UTAUT model they investigated factors that contributed to the adoption of radio frequency identification technologies by healthcare professionals. A mixed model methodology based on UTAUT and consisting of three phases was used by Schaper and Pervan (2007) to collect quantitative, qualitative, and longitudinal data on technology acceptance among occupational therapists in Australia. Their analyses showed that performance expectancy was a key determinant of technology acceptance. However, the findings from this study supported a mixed methods methodology.

In a study conducted by Wu et al. (2008) the determinants perceived usefulness, perceived ease of use, and subjective norm were found to have a significant effect on the intention to use. They tested TAM on healthcare professionals and administrative staff who worked with an adverse event reporting system in hospitals in Taiwan. They also proposed that management support influenced perceived usefulness, perceived ease of use and subjective norm. This study emphasised the effect of subjective norm, which had not been widely used by researchers as a technology acceptance construct.

Ward et al.’s (2008, p. 81) study of ICT use in the UK National Health Service (NHS) suggested that: “attitudes of practitioners are a significant factor in the acceptance and efficiency of use of IT in practice.” The authors also proposed training and education as a factor for encouraging the use of IT systems. They added a range of other key issues, such as the need for flexibility and usability, software being fit for purpose and careful planning when introducing ICT.

Tung et al. (2008) tested the revised TAM in predicting nurses’ intention to use an electronic logistics information system in ten medical centres and hospitals in Taiwan. Their results strongly supported the notion that the basic TAM variables perceived usefulness and perceived ease of use, as well as new variables, compatibility and trust, have a positive influence on behavioural intentions to use. Finally, they proposed that TAM can help practitioners and researchers understand nurses’ resistance to the electronic logistics information system, can predict how nurses will respond to the system, and increase acceptance by improving implementation techniques and processes. New variables, such as compatibility and trust, were used in addition to the basic TAM variables, which is one of the strengths of this research.

Walter and Lopez (2008) conducted a mail survey of 1000 randomly selected doctors selected from a directory of doctors affiliated with major insurance companies and major medical information services management companies in the USA. The authors modified Davis’ TAM, with the aim of developing a scale to measure the perceived threat to professional autonomy construct. The survey items were measured on a 5-point Likert scale. The authors proposed that doctors might perceive clinical decision support systems closely associated with EHR as a threat to their professional autonomy. According to the authors, professional autonomy is defined as professionals’ control of the conditions, processes, procedures, and content of their work. Walter and Lopez (2008) concluded that, besides perceived usefulness and perceived ease of use, other factors, such as perceived threat should be considered when examining user acceptance of ICT in healthcare. The findings from this study confirmed that doctors might have a different approach to user acceptance decisions from other users. However, this study had some limitations, such as self-selection bias, i.e., doctors familiar with EHR might have been more likely to have responded, and a potential gender bias, i.e., 77% of the respondents were male.

A reduced version of UTAUT was used in a study conducted by Wills et al. (2008) to determine the acceptance of EMR by nurse practitioners and physician assistants. Their findings showed that UTAUT could provide a reasonable explanation of healthcare professionals’ acceptance of EMR. However, another important finding in their study was that social influence plays a greater role in EMR acceptance, especially among women, compared to the smaller roles of performance expectancy and effort expectancy.

An extended version of TAM was used in Aggelidis and Chatzoglou’s (2009) study, the aim of which was to examine the acceptance of the health information system by hospital personnel in Greece. Their results indicated that perceived usefulness, perceived ease of use, social influence, attitude, facilitating conditions, and self-efficacy have a strong impact on hospital personnel’s behaviour. This is one of the few studies on technology acceptance that has been conducted in South East Europe.

A modified version of TAM2 was used by Yu et al. (2009) to examine the e-Health acceptance prior to implementation in 15 healthcare facilities in Sydney and Illawarra, Australia. The study shows that perceived usefulness, perceived ease of use, and computer skills had a significant positive impact on health professionals’ intentions, whereas image had a significant negative influence. Image as a technology acceptance construct was used in this study, although this construct is used rarely in the literature. Computer skills were established as a predictor of technology acceptance in this study.

Kijsanayotin et al. (2009) used the modified UTAUT to determine the factors that influence the adoption of general IT in community health centres in 12 provinces in Taiwan. One of the aims of their study was to measure the IT adoption model in a developing country. Their findings show that performance expectancy, effort expectancy, social influence, and voluntariness all influenced IT acceptance. Experience and facilitating conditions could predict IT usage. However, the limitation of this study was the fact that the model was tested on IT adoption in general, and the authors acknowledged that the results might vary in UTAUT application to specific technology acceptance.

A study by Tsiknakis and Kouroubali (2009) presented the ‘Fit between individuals, task and technology’ (FITT) framework in the assessment of socio-organisational-technical factors that influence the adoption of ICT in healthcare settings. The research was conducted in ‘Regional Health information Network’ in Crete, Greece. They concluded that the FITT framework is applicable helping to explain the complex structure of implementation of ICT in healthcare settings.

TAM2 was tested by Zhang et al. (2010) to assess the acceptance of mobile information technology by homecare nurses in Canada. The data analyses showed that perceived usefulness was the main predictor of nurses’ adoption of mobile technology. Subjective norm and image (technology acceptance construct) were found to be the only significant antecedents of perceived usefulness from TAM2. Job relevance, result demonstrability, and output quality were found to have no influence on adoption intention. The authors noted the different levels of exposure to technology as a limitation of the study.

Holden (2010) carried out semi-structured interviews with 20 doctors from two large Midwest hospitals in the USA with the aim of identifying and describing doctors’ stance on the use of EMR and computerised provider order entry. Holden’s aim was to define the factors that influence IT usage behaviour within the unique context of healthcare. The author based this study on TPB and its extensions to elicit doctors’ beliefs about EMR and computerised provider order entry. Doctors commonly believed that EMR and computerised provider order entry can both improve and sometimes decrease the efficiency and effectiveness of the outcomes of patient care. Although the doctors were encouraged by management and colleagues to use the system, they also had personal and moral reservations concerning its use. Finally, the author proposed that future research be undertaken in this area to develop a theoretical model contextualised to e-Health that can explain and predict e-Health acceptance and usage. Having a small sample size limited the ability to generalise findings to the broader population of doctors. There is also a need to understand other healthcare professionals’ beliefs about EHR. This study also did not determine to what extent doctors’ beliefs about EHR were related to actual use and acceptance.

Nov and Schecter (2012) applied TAM in their web-based survey of 72 doctors working in surgery and internal medicine departments in a large hospital in California, USA. Perceived usefulness and perceived ease of use were found to be significant determinants of EMR use. In addition, the authors found that perceived time loss as a functional determinant was strongly associated with EMR use. Perceived time loss influence was reported to have both a direct and indirect influence on perceived usefulness, being associated with doctors’ belief that EMR is not useful to their work. However, this study was limited to one hospital in California, USA.

The literature review in this section suggested that most of the authors were using TAM and UTAUT models in the original or modified versions. However, when the technology acceptance model was modified, it was achieved by adding only few variables to the original model (Mohd and Mohamad 2005; Wu et al. 2007; Tung et al. 2008; Yu et al. 2009).

### Technology acceptance of electronic health record systems, empirically testing studies

This section presents peer-reviewed articles of technology acceptance models on EHR systems. Studies which include predictors of intention, i.e., technology acceptance constructs that have influence on healthcare professionals’ attitudes, were included in this section. Empirically tested technology acceptance studies on EHR acceptance were chosen in the context of this research, as the Republic of Macedonia will be implementing a national EHR system, as described in Section 1.4. Other, similar concepts, such as EMR, EPR, and PHR were presented in the previous section. Their difference from EHR is explained in Section 2.4.1. This was done to achieve appropriate complexity of the study (Eisenhardt 1989). However, this section represents the appraisal of knowledge in these areas before the research in this Thesis was conducted, and new articles on these issues, published after this research, were identified and are presented in Section 2.7.2.

There are many other scientific articles on technology acceptance and EHR, but they do not describe empirical studies of technology acceptance on EHR, rather, they describe or relate these issues. This is why these articles were not included in this section. The main reason behind this step is that technology acceptance constructs used by researchers and presented in this section were applied in the creation of the main research instrument used in this Thesis (Sections 4.2.5 and 5.2.4). The findings from this section were compared with those from the Thesis in Section 6.4.9. The studies discussed in the previous sections open the way for future challenges for technology acceptance models in healthcare. Technology acceptance models have made considerable advances in understanding end users' behaviour towards ICT in many areas. Overall, healthcare settings provide a totally different environment for technology acceptance research.

Menachemi et al. (2007) applied the TAM in a survey mailed to all primary care doctors in ambulatory settings in Florida, USA, with the aim of measuring the adoption and use of EHR system attributes. In addition, the mail survey was distributed to 25% randomly chosen (from Florida Department Health list) doctors practising in ambulatory settings, such as medical and surgical specialists, general surgeons, dermatologists, and psychiatrists. They developed a conceptual framework with the application of TAM for the prediction of EHR adoption rates and the degree to which system capabilities were implemented by doctors. Special emphasis was given to the relation between the timing of adoption and the physician’s choices in selecting the available EHR functionalities. Logistic regression was used for data analyses. According to the authors, the EHR innovators and early adopters, who accounted for approximately 16% of the market, were crucial to the acceptance of the new technology. The next major segment comprised the early majority of adopters, who contribute 34% to the market. They found that basic EHR attributes, such as clinical notes, were more prevalent than complex ones, such as electronic order entries. They stressed that the variability of EHR key functionalities’ availability suggested that published estimates of EHR adoption rates might overestimate the true level of meaningful EHR system availability. According to the authors, several of the 10 key functionalities were not available in a quarter or more of the EHR systems used in Florida. These trends might indicate that the realistic EHR adoption rate may have been 25% lower than the published studies suggested. Furthermore, the attributes that were frequently lacking in the adopted EHR system tended to hold most promise for improving patient safety and providing important benefits for them. Finally, the authors concluded that the lack of these functionalities in EHR system adoption raised questions about the potential to improve care and reduce costs. However, this study focused only on one state and might not be relevant to other regions in the USA or beyond. As the study was conducted through a mail survey, it had a suboptimal response rate (a total of 4203 returned surveys, response rate 28.2%), and may have largely depended on the willingness of respondents to participate and give accurate information.

Wilkins (2009) conducted a quantitative study on 94 health information managers in Arkansas, USA with the aim to examine the factors that influence adoption of the EHR system. TAM constructs were assessed on a Likert scale (strongly agree to strongly disagree). Demographic questions such as age, professional credentials, and years of experience in service were included in the research instrument. The author stressed that, at that time, there was not sufficient research on the mandatory implementation and use of health information technology. There were barriers to EHR implementation, and most of the studies were focused on the process barriers such as cost issues and interoperability. The author applied TAM with the aim to assess the influence of perceived usefulness, perceived ease of use, and behavioural intention on participants’ acceptance of the EHR system. The survey was conducted through the Internet. Every participant in the survey represented one hospital. The results showed differences in perceived usefulness and perceived ease of use between participants who have been using the technology and those preparing to adopt the EHR system. Respondents already using the EHR felt that the system brings benefits to their work. The author proposed that if manager understands that the system can improve his work environment (perceived usefulness) and it is easy to use (perceived ease of use) than he will take the leading role in implementation of the system. The author also proposed that this study may be used as a guide for information mangers which are planning to implement EHR system. Therefore, he proposed development of educational tools which can guide implementation process and minimise employees’ resistance. This study had 74.5% response rate, as participants were information managers. One limitation of this study was that it was conducted in only one state in the USA, and there is a need for nationwide survey. Likewise, there is a need for further studies of healthcare professionals and other healthcare providers.

Morton and Wiedenbeck (2009) in their first study applied modified TAM and diffusion of innovations theory in the University of Mississippi Medical Centre in Jackson, Mississippi. The aim of the first study was to predict future acceptance of the EHR system among doctors. The system was not implemented when the study was conducted. A self-reporting online research instrument was administered to 802 doctors with aim to identify the factors that can assess participants, acceptance of the EHR system. The research instrument comprised eight technology acceptance constructs: “perceived usefulness, perceived ease of use, management support, attitude, adequate training, physician involvement, physician autonomy, and the doctor-patient relationship.” (Morton and Wiedenbeck 2009, p. 3) Technology acceptance constructs were assessed on a 5 point Likert scale (strongly disagree to strongly agree). Structural equation modelling was used for data analyses. Management support, doctor-patient relationship, and physician involvement accounted for 30% of the variance in perceived ease of use. The perceived ease of use and doctor patient relationship explained 46% of the variance of perceived usefulness. The proposed technology acceptance variables explained over 73% of the variance in attitude for future EHR system use. The individual doctors’ characteristics did not correlate with the technology acceptance constructs. Majority of participants (67%) were under the age of 40, and probably they were exposed to IT prior to their service in medical practice. The authors reported strong correlation between perceived usefulness and positive attitude to EHR system. Perceived ease of use has expressed indirect effect on EHR adoption through perceived usefulness. However, perceived ease of use did not have direct effect on attitude to EHR system use. The management support and physician involvement expressed positive effect on perceived ease of use. The doctor-patient relationship expressed negative significant influence on perceived ease of use. The effect of adequate training was not significant. Adequate training, physician involvement, and management support expressed weak effect on perceived usefulness, while doctor-patient relationship had significant negative effect on perceived usefulness. Physicians’ autonomy had a strong negative effect on users’ attitudes. The findings of this research highlighted the importance of management support and physician leadership when adopting EHR system. This study was limited to younger participants in one university centre had a low response rate (29.8%). However, Morton and Wiedenbeck (2009) proposed the creation of EHR systems that should be customisable and flexible.

A model combining TAM, task-technology fit, and user-centred methods was used in a study by Hyun et al. (2009) with the aim of eliciting nurses’ perceptions of the functional requirements of an electronic nursing documentation system based on an EHR. The questionnaire used in this study included ten perceived usefulness and perceived ease of use constructs, and rated them on a 5-point Likert scale (strongly disagree to strongly agree). The proposed model was tested on seven nurses from Columbia University medical centre in New York, USA. Almost all of participants either agreed or strongly agreed for 28 out of the 30 constructs associated with perceived usefulness, perceived ease of use, and task technology-fit variables. The authors also believed that user frustration could be related to the system being perceived differently by users and designers. Finally, the authors proposed that the nursing documentation system should be built on an EHR model with user interfaces designed from the nurses’ perspective. The system should be evaluated through a user-oriented theoretical foundation in order to obtain the full advantage of health ICT. However, this study was limited to a relatively small sample in only one healthcare institution and may not be applicable to other healthcare professionals in other institutions. Furthermore, this study was limited only to assessing nurses’ perceptions of the EHR system.

The modified TAM and diffusion of innovations theory were used by Morton and Wiedenbeck (2010) in the second of their two-part study examined EHR acceptance factors in academic-based healthcare systems. The aim of the second study was to gain a deeper insight into the antecedents of EHR adoption attitudes. The authors indicated that in many situations other variables besides perceived usefulness and perceived ease of use predicted intentions. Therefore, they proposed an extended technology acceptance model to explain factors that influence users’ acceptance by examining the behavioural, social, and organisational processes that affect, and are affected by, clinical information systems. This study was designed to correlate individual doctors’ characteristics such as: “age, years in practice, clinical specialty, health system relationship, and previous computer experience with social and technical factors to explain the behavioural intentions of the participants.” (Morton and Wiedenbeck 2010, p. 2) The authors applied an online research instrument to 802 doctors at the University of Mississippi medical centre in Mississippi, USA. Technology acceptance items were assessed with a 5-point Likert scale. The overall response rate of the study was 29.8%. Individual physician characteristics were not shown to be predictors of EHR acceptance. In their study, social and behavioural factors were proved to be accurate predictors of EHR adoption, and they should be addressed during the EHR planning phase. They also proposed application of robust project management processes to achieve successfully implement the EHR system. This study was limited to only one large academically-based healthcare system and may not be relevant to other physician populations.

Devane et al. (2010) used the modified TAM to assess doctors’ attitudes to e-prescribing adoption in the context of EHR in Everett Clinic in Washington State, USA. They used a theoretically-based 38-question online survey distributed to 188 participants, including prescriber doctors and staff. Demographic questions such as gender, age, education degree, and type of primary care practice were included in the questionnaire. The survey instrument covered four domains: perceived usefulness, perceived ease of use, intention, and finesse. Two additional technology acceptance constructs, i.e., PC use at home and self-assessed computer knowledge were included in the research instrument. Technology acceptance constructs were assessed on a 5-point Likert scale (strongly disagree to strongly agree). However, self-assessed computer knowledge was assessed through a 7-point scale (1-novice to 7-expert). The study instrument’s performance was assessed by calculating internal consistency reliability by employing the Cronbach’s α coefficient. The overall response rate was 62%. The data were analysed with regression models. The authors found that finesse, intention, perceived usefulness, and perceived ease of use were strong constructs predicting technology acceptance among healthcare professionals. In addition, the TAM extensions self-assessment of computer use at home and computer knowledge predicted attitudes to EHR adoption. This study may not represent an entire population of users, as it was conducted with primary care staff in one clinic. The surrounding system and culture, i.e., subjective norm, were not assessed in the study.

Spil et al. (2010) conducted 73 qualitative interviews with doctors from 18 hospitals in the Netherlands to examine the EHR system’s implementation at the national level. The interviews were based on the TAM, USE-IT model, Delone & Mclean model, and 4E model, and measured three constructs: facilitating conditions, subjective norm, and managerial interventions. Their findings showed that subjective norm was too low to create incentives for using EHR in all the hospitals included in the study. The authors concluded that, although subjective norm is a key determinant for success, only increasing all three constructs would have a positive impact on overall success. The quality of the EHR system was limited, and no hospital had reached third generation EHR functionality. The authors did not test the relationship between the three proposed dimensions, which was a limitation of their study.

Egea and Gonzalez (2011) used an extended version of TAM to explain doctors’ acceptance of EHR systems in southern Spain. The research instrument was a combination of basic constructs such as perceived usefulness, perceived ease of use, attitudes, and intentions, extended with trust- and risk-related factors, including: doctors’ perceptions of institutional trust, perceived risk, and information integrity. Demographic questions such as age, gender, medical specialty, and computer use (personal computer, email for communication with patients, and the Internet) items were assessed on a 5-point Likert scale (strongly disagree to strongly agree). The authors used postal mail sent to 1500 private medical practices in the region. The Cronbach’s α coefficient was used to measure the instrument’s reliability, and multivariate analyses were used to test the assumptions. In their study, perceived usefulness, perceived ease of use, and attitude were noticed as direct determinants of doctors’ intentions to use the EHR. In addition, the proposed extended constructs (trust- and risk-related factors) were reported as strong predictors, either directly or indirectly, through the original TAM constructs. The authors proposed several measures, such as: the need to develop a positive attitude among doctors, the management of doctors’ attitudes and intentions, information and training sessions, specialised forums and conferences aimed at increasing the adoption of EHR. This study was conducted in only one region of Spain, which raised concerns about generalising the findings. Furthermore, it was conducted through ordinary mail, and this study had a very low response rate of 18%.

Archer and Cocosila (2011) proposed a theoretical model comprising behavioural factors based on TRA, TAM, TAM2, and UTAUT. Basic technology acceptance constructs such as performance expectancy (perceived usefulness), effort expectancy (perceived ease of use), social influence, and intentions were assessed by questionnaire. Job relevance and innovativeness from other technology acceptance constructs were identified and tested as factors that may influence EHR adoption. The perceived overall risk factor was assessed as a possible obstacle to EHR adoption. The model was tested through an online cross-sectional survey of doctors in Canada in both English and French languages. The study involved participants with varying levels of EHR experience. The authors designed two versions of the survey, one for doctors using EHR, and the other for those without experience with the EHR. The only difference between the two sets of surveys was in the questions capturing various technology acceptance perceptions of the doctors of the EHR: the questions were formulated in the present tense for the group using EHR, and in the conditional present for the group without experience with EHR.

Demographic questions such as gender, years of medical experience and number of doctors per medical practice were tested in Archer and Cocosila (2011) study as potential control variables. Items were assessed on a 7-point Likert scale (strongly disagree to strongly agree). Participant recruitment and survey administration were outsourced through a private company, taking into consideration the equal distribution of the search instrument among doctors working in clinics using EHR and doctors without experience of EHR. A total of 102 (EHR users) and 83 (EHR non-users) questionnaires were eligible for analysis. The questionnaire’s reliability was assessed through the Cronbach’s α coefficient. Structural equation modelling was used for the data analyses. The proposed technology acceptance model explained 55.8% of the variance in behavioural intentions for EHR use among doctors already using EHR, and 66.8% of the variance in doctors that had not used EHR. The most important finding of this research was that performance expectancy and effort expectancy concerning EHR are significant positive adoption factors. Job relevance, social influence, and perceived overall risk were found to be stronger predictors among EHR non-users in comparison with EHR users. Effort expectancy had a more significant influence on performance expectancy among EHR users. The authors proposed adequate measures to stress that the EHR system is relevant and easy to use, the presentation of highly usable, easily learned interfaces and decision support capabilities. However, this study had a low response rate, and the sampling was not undertaken correctly.

Harle and Dewar (2012) studied preparedness for the use of EHR with respect to performance expectancy and effort expectancy among doctors in an academic health centre in South-Eastern USA. They conducted a paper-based survey of 256 doctors based on the TAM, TAM2, and UTAUT models before the implementation of an EHR system. Effort expectancy and performance expectancy were assessed in the survey. Other technology acceptance constructs such as: gender, age, self efficacy, openness to change, and personality were included in the research instrument. Technology acceptance items were assessed on a 7-point Likert scale (strongly disagree to strongly agree). Cronbach’s α was used to assess the questionnaire reliability. Unadjusted effects of demographic factors were explained with *t*-tests and Pearson correlations. Three different regression models were applied to assess the effects of performance expectancy and effort expectancy. Their findings indicated that the future EHR system should be useful (performance expectancy) and easy to use (effort expectancy). There was a lower association of effort expectancy with younger participants, and participants with higher self-efficacy. This was expected, as ICT is more frequently used by younger people apply as part of their everyday life. However, age and computer self-efficacy did not have effect on performance expectancy. Males reported higher effort expectancy and performance expectancy than females. This study was of a small academic group and may not be generalised to doctors from other non-academic healthcare institutions.

Gagnon et al. (2014) used an electronic questionnaire including four theoretical models (TAM, extended TAM, psychosocial model, and integrated model) administered to 6000 members of the Quebec Medical Association in Canada with the aim of identifying the main determinants of doctors’ acceptance of EHR. Age, gender, previous EHR experience, and specialisation were tested as socio-demographic characteristics. Perceived usefulness, perceived ease of use, computer self-efficacy, demonstrability of results, personal identity, subjective norm, professional norm, and resistance to change constructs were tested in the study, and showed a statistically significant correlation with physician’s intentions to use the EHR system. The resistance to change (construct used in the study) association with behavioural intention to use was non-significant. Cronbach’s α values ranged from .75 to .93, except for the demonstrability of results and computer self-efficacy constructs. Multivariate linear regression was used to test the data, and the overall model explained 44% of the variance in the doctors’ intentions to use the EHR system. Perceived usefulness, perceived ease of use, professional norm, subjective norm, and demonstrability of results were found to be strong predictors of doctors’ intentions to use EHR. Age and specialisation as socio-demographic characteristic were found to be moderators, as the perceived usefulness effect on behavioural intentions was stronger among doctors under 50 years of age and GPs. The effect of the professional norm construct was stronger among women, and the resistance to change construct had more influence among GPs. The authors pointed out the need to develop strategies that are tailored to the individual characteristics of potential EHR users with respect to age, gender, specialty, and experience. However, this study had a very low response rate of 2.6%, and the authors did not know how many respondents actually received the invitation email.

Razeghi and Nasiripour (2014) examined the factors affecting EHR acceptance in hospitals and healthcare centres in Lorestan, Iran. A questionnaire based on UTAUT and task-technology fit model was distributed to 30 doctors and non-medical staff selected using a stratified random sampling method. Socio-demographic factors such as gender, education, and work experience were also assessed. The data were analysed with descriptive statistics and inferential statistics (*t*-test, ANOVA, and Friedman test). The ranking of the factors affecting EHR acceptance indicated that the facilitating conditions construct was in first place, followed by social influence in second, performance expectancy in third, effort expectancy in fourth, and task appropriateness in fifth place. There was a significant difference between the means of task appropriateness based on the respondent’s educational level and intentions to use the system. However, there was no significant relation between other socio-demographic factors or intentions. Considering that facilitating conditions is the main factor affecting EHR acceptance, the authors proposed taking into consideration information technology infrastructures and facilities to improve the proper attitude of users to the system. However, the sample selected for this study was very small and limited to one area, meaning that the results cannot be generalised to the whole population. Table 2.4 presents synthesis of technology acceptance models on EHR systems research.

Table 2.4: Synthesis of technology acceptance models and EHR research

| Study | Objective | Institution  /Country | Participants | Model/ technology acceptance  Constructs | Findings | Implications | Limitations |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Menechemi et al. (2007) | Examines the extent of use of crucial parts of EHR | Florida, USA | All primary care doctors + 25% of other doctors in ambulatory care | TAM/mail survey, questions asking doctors to identify the extent of EHR key functionalities commonly used in their practices. Logistic regression used | Greater technological complexity reduces doctors willingness to adopt the functionality | Functionalities not adopted have great potential to improve safety. Continuous incomplete EHR adoption raises concerns about potential benefits | This study identifies only the extent of key functionality’ usage, while perceived usefulness, perceived ease of use and other constructs were not tested.  Suboptimal response rate. Focus on only one state in the USA |
| Wilkins  (2009) | To examine factors which influence health information managers in adoption of EHR | Arkansas hospitals,  Arkansas, USA | 94 health information managers | TAM/Internet based survey, 7 -demographic questions + questions to measure perceived usefulness, perceived ease of use, and intention as factors influencing health information managers implementing EHR. Likert scale used. | Perceived usefulness perceived ease of use, and intention have influence on health information managers who already adopted EHR | If health information managers understand EHR, its usefulness, ease of use and impact on their job, they will play a role in implementation | Focused on only one state. Doctors and other health staff are not included |
| Morton and Wiendenbeck (2009).  First paper of two-part study | Determination of individual characteristics, social, and technical factors related to EHR adoption | University of Mississippi Medical Centre, Mississippi, USA | 802 faculty, fellow and resident doctors | Modified TAM/self-reporting and diffusion of innovations theory, online questionnaire. Five-point Likert scale used. Structural equation modelling used. | Perceived usefulness highly correlated with attitude to EHR usage. Perceived ease of use had indirect (through perceived usefulness) effect on attitude to EHR | EHR system must provide clear benefit to doctors. Addressing doctors’ immediate needs rather than emphasising future benefits. EHR should be flexible and customisable | Conducted in one academic healthcare system, and may not be relevant to other doctors. Unequal distribution between fellow and resident doctors (younger age), low response rate |
| Hyun et al. (2009) | To explore nurses’ perceptions of functional requirements for EHR | Columbia University Medical Centre, New York, USA | 7 nurses | TAM, task-technology fit and user-centred methods. Questionnaire assessed on 5-point Likert scale | Perceived usefulness and perceived ease of use related to nurses perceptions of functional requirement | This method may serve as a guide for future user-cantered theoretical foundation for developing EHR | Small sample from academic hospital, nurses only, may not be relevant to other settings |
| Morton and Wiendenbeck (2010).  Second paper of the  two-part study | Examines EHR acceptance factors in academic based healthcare system | University of Mississippi Medical Centre, Mississippi, USA | 802 faculty, fellow and resident doctors | Extended TAM and diffusion of innovation theory, self-reporting online questionnaire. 5-point Likert scale used | The individual user characteristic is not accurate predictor of attitude | Need for strong project management techniques to ensure successful implementation of EHR. Social and behavioural factors should be addressed during EHR planning phase | Conducted in one large academic healthcare system, and may not be relevant to other doctors. Unequal distribution between fellow and resident doctors. Low response rate |
| Devane et al. (2010) | To assess attitudes to e-prescribing adoption in the context of EHR | Everett Clinic, Washington USA | 188 doctors and staff | Modified TAM, 38 questions survey, covered perceived usefulness, perceived ease of use, finesse, and intention. 5-point Likert scale and 7-point visual attitude scale used. Hierarchical linear regression used | Perceived usefulness, perceived ease of use, intention, finesse, self-assessment of computer use at home, and computer knowledge predicted attitudes | Proposed survey instrument can predict adoption acceptance in a parsimonious fashion | Covered primary care staff in one clinic and may not represent entire population |
| Spil et al. (2010) | To examine EHR implementation at national level | Netherlands | 73 doctors, from 18 hospitals | Interviews based on TAM, USE-IT model, Delone and Mclean model, and 4E model. Facilitating conditions, subjective norm, and managerial interventions effect on intentions assessed | Subjective norm key determinant for success. It was too low in this study to create incentives | Only increasing in all three constructs would have a positive effect | Did not test the relationship between the proposed dimensions/  models |
| Egea and Gonzalez (2011) | To examine doctors’ acceptance of EHR in terms of usage intentions | Andalusia, Spain | 1500 doctors in private medical practices | Postal mail, demographic questions, extended TAM (perceived usefulness, perceived ease of use, attitude to use, and intention) extended with trust- and risk- related factors. 5-point Likert scale used | Established relationship between perceived usefulness, perceived ease of use, attitude to use, and usage intention. Additional predictive value of trust and risk factors | Need to develop positive attitude among doctors to improve acceptance and future use of EHR | Included doctors from only one region. Other healthcare professionals not included, low response rate |
| Archer and Cocosila  (2011) | To compare perceptions of doctors using and not using EHR | Canada | 220 doctors in Canada | TRA, TAM, TAM2, UTAUT, + other technology acceptance constructs. Job relevance, innovativeness and perceived overall risk. Outsourced online cross-sectional survey. Two versions of the survey for EHR users and non- users. 7-point Likert scale used. Structural equation modelling used | Performance expectancy and effort expectancy key determinants Job relevance, social influence, and perceived overall risk stronger effect on non-users. Effort expectancy and performance expectancy stronger effect on EHR users | Showed differences in factor influences on perceptions between EHR users and non-users | Small sample size for such study. Research instrument did not differentiate. It was  improperly distributed between healthcare professionals with various levels of EHR experience |
| Harle and Dewar (2012) | Preparedness to use EHR among academic doctors | USA | 256 academic doctors | TAM, TAM2, UTAUT. Effort expectancy, performance expectancy, and other constructs (job role, computer self-efficacy, openness to changes in practice and personality). 7-point Likert scale used. Multivariate regressions used. | Effort expectancy and performance expectancy found to be strong predictors. Age and gender differences founded | Assessment of doctors’ beliefs about EHR prior to implementation | Only academic doctors included |
| Gagnon et al. (2014) | To identify main determinants of doctors’ acceptance of EHR | Quebec, Canada | 6000 doctors (GPs and specialists) | TAM, extended-TAM, psychosocial model, and integrated model. Perceived usefulness, perceived ease of use, subjective norm, computer self-efficacy, personal identity, professional norm, and resistance to change used. Multivariate linear regression used. | Perceived usefulness, perceived ease of use, subjective norm, professional norm, and demonstrability of results found as strong predictors | Need to develop tailor-made strategies with respect to age, gender, speciality, and experience | Very low response rate (2.6%) |
| Razeghi and Nasiripour (2014) | To examine factors affecting EHR acceptance in hospitals and healthcare centres | Lorestan, Iran | 30 doctors and non- medical staff | UTAUT and task-technology fit models. Performance expectancy, effort expectancy, facilitating conditions, and social influence tested | Facilitating conditions, social influence, performance expectancy, and effort expectancy found as predictors of intentions | IT infrastructure and facilities should be taken into consideration | Very small sample, limited to one area in the country |

The in-depth literature review of peer-reviewed empirical studies of technology acceptance models of EHR indicated that there is limited research in this area. In developing countries in SEE there have been no studies at all. The available studies on technology acceptance of EHR in the Table 2.4 suggest the following:

* almost all of the studies adopted a quantitative approach using a structured questionnaire;
* the original and extended versions of TAM have been applied by researchers studying technology acceptance of EHR, and have been shown to be efficient tools;
* the UTAUT model has been used in a limited number of studies (Spil et al. 2010; Archer and Cocosila 2011; Harle and Dewar 2012; Razeghi and Nasiripour 2014), and in almost all studies it was used in combination with TAM;
* perceived usefulness (TAM and TAM2) and performance expectancy (UTAUT) are similar constructs and are the strongest predictors of intentions across studies of technology acceptance concerning EHR (Hyun et al. 2009; Morton and Wiedenback 2009; Wilkins 2009; Devane et al. 2010; Archer and Cocosila 2011; Egea and Gonzales 2011; Harle and Devar 2012; Gagnon et al. 2014; Razeghi and Nasiripour 2014);
* perceived ease of use (TAM) and effort expectancy (UTAUT) are similar constructs and were predictors of intention of technology acceptance of EHR only in a limited number of studies (Hyun et al. 2009; Wilkins 2009; Devane et al. 2010; Egea and Gonzalez 2011; Archer and Cocosila 2011; Harle and Devar 2012, Gagnon et al. 2014; Razeghi and Nasiripour 2014). The perceived ease of use construct had an indirect effect through perceived usefulness in Morton and Wiedenback’s (2009) study;
* social influence (UTAUT) and subjective norm (TAM and TAM2) are similar constructs and were tested and proved to be predictors in several studies (Spil et al. 2010; Archer and Cocosila 2011; Gagnon et al. 2014; Razeghi and Nasiripour 2014);
* the facilitating conditions construct was tested and proved to be a predictor only in Razeghi and Nasiripour’s (2014) study;
* attitude was tested and proved to be a predictor in Morton and Wiedenback’s (2009) study;
* other technology acceptance constructs were used in a few studies, some of which predicted intention to use: finesse (Devane et al. 2010); self-assessment of computer use at home (Devane et al. 2010); computer knowledge (Devane et al. 2010); job relevance (Archer and Cocosila 2011); perceived overall risk (Archer and Cocosila 2011); professional norm (Gagnon et al. 2014); demonstrability of results (Archer and Cocosila 2011); task appropriateness (Razeghi and Nasiripour 2014). However, each study that has been using modified technology acceptance models included only a few additional variables;
* hierarchical, linear or multivariate regressions were used by Devane et al. (2010); Egea and Gonzalez (2011); Harle and Devar (2012); and Gagnon et al. (2014); and
* structural equation modelling was used by Morton and Wiedenbeck (2009) and Archer and Cocosila (2011) studies.

Most of the studies on technology acceptance on EHR systems till 2010 were applying TAM or TAM2. UTAUT was first used in the assessment of EHR in 2011 (Archer and Cocosila 2011; Harle end Devar 2012). Other technology acceptance models that were used (although rarely) are: task-technology fit, and user cantered methods (Hyun et al. 2009); diffusion of innovation theories (Morton and Wiendenbeck (2009); the Delone and Mclean model, USE-IT, and the 4E model (Spil et al. 2010); and a psychosocial model and integrated model (Gagnon 2014). However, the majority of studies used TAM, TAM2 or UTAUT, either in the original form or in modified versions. Table 2.4 suggests that a wide range of researchers have used the modified or extended TAM, or a combination with other technology acceptance tools such as UTAUT and TAM2. Yarbrough and Smith (2007) developed a new enhanced TAM incorporating barriers to technology acceptance in healthcare, such as financial and time costs, organisational issues, such as physician reimbursement, status, and doctors’ perceptions of the utility of new technology.

Holden’s (2010) work in EMR settings, which are closely related to EHR, stressed the need to have a contextualised TAM approach for healthcare professionals, as they are not like software company employees. There are differences between the two contexts, and there is a need to have a health-specific model of technology acceptance. Egea and Gonzalez (2011) recommended future research to determine the influence of external variables such as socio-demographics in technology acceptance of EHR. Harle and Devar (2012) stressed that effort expectancy and performance expectancy were important constructs when assessing technology acceptance in healthcare. Finally, models that will be used in healthcare settings should be sensitive to the needs of the profession.

### Gaps in knowledge in technology acceptance on e-Health/EHR systems in the literature (prior to the research in this Thesis)

The literature review has shown that many scientific papers have dealt with EHR. However, there is a lack of studies of EHRs in Europe, especially in SEE developing countries. There is limited research on the capabilities of the EHR systems and their actual use. EHR systems have the ability to increase the quality in healthcare (Ambinder 2005; Miller 2005; Sidorov 2006; Chen et al. 2009), but this will happen if healthcare professionals use them regularly. Simon et al. (2007) proposed future work to emphasise the factors that affect the actual use of EHR functions.

Although there has been quite considerable research in this field, many questions need to be addressed. Furthermore, studies are needed to explain the extent to which EHR is changing healthcare delivery, and to what extent it is improving the quality of healthcare. This would give a clear picture to management and policy makers about the level of preparedness of healthcare professionals to use the system. The outcomes of this research will enable management and policy makers to consider measures and implement policies on how to improve the effectiveness of EHR.

Technology acceptance in healthcare is different from other domains, and there is a need for a new contextualised model of technology acceptance. Basic technology acceptance models developed for the general public do not apply in the healthcare environment (Holden and Karsh 2010). There is a need for a model applicable to healthcare settings to measure the barriers to adoption, effectiveness, and actual use of EHR by end users (Walter and Lopez 2008; Romano and Stafford 2011).

The differences between EMR and EHR described in Section 2.4.1 of the literature review resonate with the planned Macedonian integrated health system described in the introduction to this Thesis (Section 1.4). In the Macedonian e-Health system, EHR and EMR will have differences, similar to the NHS plan described by Burns (1998). The EMR part will be created by the Ministry of Health of the Republic of Macedonia as a large database supported by IT staff from the Ministry, and doctors as end users will have interactions only with the EHR. Therefore, for the purpose of this Thesis, main research will focus on technology acceptance of EHR in the Republic of Macedonia.

The foregoing comprehensive review of literature on EHR shows that many challenges remain to be addressed before achieving a fully functional system. There is a need for government policies that will support the further development of national EHR systems. The interoperability of EHR at the international level is one of the major challenges. Security issues are still a major concern among healthcare providers, patients, and policy makers. In a few years from now, the expansion of the Web 3.0 semantic web might further change applications and enable more ‘smart’ EHR systems**.**

The literature review on EHR has indicated that this system is a complex one with many components (Walsh 2004). There is still a long road ahead in the journey from paperless health care to fully operational EHR systems. Although the paperless component of the EHR system is an essential part, there are still many other components. The EHR is not merely a computer application, but should be considered as a set of highly integrated sets of systems (Amatayakul 2007), which should be incorporated with the aim of achieving fully operational systems.

As Menachemi et al. (2007) wrote that EHRs are comprised of several distinct technologies, or functionalities, which have to be used in an integrated manner if their full potential is to be realised. It is possible for doctors to partly adopt an EHR system by using only a few selected functionalities from the system. EHR functionalities such as clinical decision support systems and electronic prescribing tools are among the most complex to use, and contribute primarily to patient safety. The increased technological complexity of EHR systems reduces end-users willingness to fully exploit them. Widespread partial EHR adoption may occur, without achieving the targeted gains in clinical outcomes, patient safety and cost control. These issues remain major challenges for the future.

If the EHR system is implemented, and if the user is using one or few components of the system, this does not mean that s/he will be using the system to full extent. These issues should be explored in the future with the aim of achieving a complete fully operable EHR system. As it is, at the moment, it seems that there is still long way ahead to reach the full implementation of an EHR system.

Although technology acceptance models were generally used in healthcare settings, the synthesis of the literature reviewed in this section identified the limited application of empirical studies of technology acceptance models to EHR acceptance among healthcare professionals, before the commencement of the two studies of this research. The following section presents the results of the revised literature search/review following the completion of the two studies of this research to re-examine the issues proposed and explored in the Thesis.

## Studies published since the commencement of the research

Technology acceptance on e-Health and EHR systems are fast changing areas. After the completion of the two studies of this research there was a need to update the literature review in these areas with the aim of reassessing and comparing the findings. Therefore, this section focuses on study reports on technology acceptance on e-health and EHR systems.

Ben-Assuli (2015, p. 287) wrote: “the implementation of these systems has not gone smoothly, and still faces some considerable barriers.” Asan et al. (2016) highlighted the effect of training and orientation on the adoption patterns of new technologies in healthcare. De Pietro and Francetic (2017) reported on slow implementation of EHRs and issues related to technical implementation and management of these systems as a major drawback. Beglaryan et al. (2017, p. 102) indicated: “EHRs implementation can face numerous barriers to acceptance including attitudes and perceptions of potential users, required effort attributed to their implementation and usage, and resistance to change.” Tubaishat (2017) suggested that more and more EHR systems are implemented in health settings: however, relatively little research was been conducted to assess the degree of acceptance of those systems. However, despite the advance in ICT in the last decades, there are still studies on failures of these systems in healthcare, and technology acceptance remains an important challenge.

A systematic review study by Garavand et al. (2016) indicated that the TAM and UTAUT are the most widely-used models in the research literature. They conducted their systematic review by searching the major databases (e.g., Google Schoolar, Emerald, Science Direct, Web of Science, Pubmed, and Scopus) and identified the factors influencing the adoption of health information technology. In their study they concluded that:

“the technology acceptance model (TAM) is the most important model used to identify the factors influencing the adoption of information technologies in health system; also, the unified theory of acceptance and use of technology (UTAUT) model has had a lot of applications in recent years in the health system. Ease of use, usefulness, social impact, facilitating conditions, attitudes and behaviour of users are effective in the adoption of health information technologies.” (Garavand et al. 2016, p. 2714)

Strudwick et al. (2016) reported that the theory of reasoned action, the theory of planned behaviour and TAM were developed to explain the behaviour of end users. In their study, they stressed that nurses play an important role in electronic health record implementation. Variations in nurses’ electronic health record utilization may influence the degree to which benefits are realised. The authors concluded that the technology acceptance may assist organisations implementing electronic health records to facilitate a deeper-level adoption of this e-Health technology.

De Moraes et al. (2016) indicated that methodology on openEHRarchetypes implementation presents significant investment of many years in the legacy systems developments. This allows to developers to add new features to those systems, providing proactive assistance to the end-users. However, the authors’ claims were not tested empirically on healthcare professionals. Alsyouf and Ishak (2017, p. 419) indicated:

“unfortunately, the under-utilisation of the EHRs has become of concern to researchers and industry practitioners, since the acceptance and actual usage of the EHRs depend majorly on the technological personality of the nurses.”

Alsyouf and Ishak (2017) proposed the UTAUT2 as a model to understand technology acceptance in health care settings. In their study, they aimed to increase the technology acceptance among nurses. However, this proposal was not tested empirically on health care professionals.

It is evident that technology acceptance is still an important issue after the completion of the research in this Thesis. Healthcare professionals may avoid using, or use workarounds, to avoid using systems, even when they are mandatory (Section 1.4). Therefore, the following two Sections (2.7.1 and 2.7.2) present the latest developments in the area of empirically testing of technology acceptance in e-Health and EHR systems.

### Technology acceptance and e-Health, empirically studies since commencement of the research

This section focuses on empirically testing of technology acceptance studies on e-Health systems. Studies published after the completion of the research in this Thesis were selected and presented in this section according to their relevance to the topic and number of citations.

Abdekhoda et al. (2015) applied a descriptive analytical study on 330 hospital doctors in Teheran University. Regression analyses and structural equation modelling were used for the data analyses. Doctors’ attitudes toward EMR adoption were influenced by basic TAM constructs (perceived usefulness and perceived ease of use). However, other technology acceptance constructs such as: management support, involvement, autonomy, and doctor-patient relationship were established as behavioural predictors. This research was limited to one university hospital. The authors proposed that future research explore security factors and the effect of doctors’ personality characteristics on intentions.

Holden et al. (2016) used an extended TAM to assess nurses’ attitudes toward novel in-room paediatric technology. Their technology acceptance model extended the concept of: perceived ease of use, perceived usefulness, social influence, satisfaction, intention to use, nature of health IT use, and various barriers and facilitators such as training and technical support. The authors applied a standardized survey on 167 nurses in one hospital in the USA. Stepwise linear regression was used for the analyses. Holden et al. (2016) reported that the ICT used in the hospital did not lead to the expected outcomes. However, the findings from this study were limited to single paediatric hospital.

Khaneghah et al. (2016) used three constructs from different theories of usability and technology acceptance with the aim to assess the attitude of 54 patients with Type II diabetes and nine clinicians towards using a PHR system. The authors used perceived usefulness from TAM, relative advantage from the diffusion of innovations theory and job fit from the model of personal computer utilisation. Finally, the authors concluded that although the attitude of patients towards PHR system was positive, the PHR may not have any relative advantage compared to other traditional methods for self-managed care (pencil and paper log books).

Kim et al. (2016) performed an online survey on user acceptance of mobile EMR system based on the UTAUT and TAM. They assessed attitudes of 942 healthcare professionals in a tertiary hospital in Seoul, Korea. They performed structural equation modelling analyses to identify the intention to use the system.

Tavares and Oliveira (2016) conducted a study at three institutions that provide educational services for patients in Lisbon, Portugal. They used the extended UTAUT in a consumer context as a starting point for the questionnaire, and added few more variables such as self-perception, habit, with the aim of assessing the attitudes towards EHR portals by patients. The research instrument was administered on 1618 people and there were 350 valid answers. The data were analysed using a causal modelling approach. This technology acceptance model has explained 49.7% of the variation for intention to use the system and 26.8% of the variance in their actual use of it. Performance expectancy, effort expectancy, self-perception, and habit were found to have the most significant effect on intentions. Age was shown to have had a significant influence on technology acceptance among the older participants in the study. Finally, the authors concluded that the adoption of EHR portal was low and most users were using the system infrequently. However, this research was not conducted on health care professionals.

TAM was applied in Kivekas et al.’s (2016) study which was conducted in two primary health organisations in Finland with the aim of explaining first users’ use of e-prescribing technology. The research instrument was administered online to 269 GPs and the response rate was 26%. The perceived usefulness of e-prescribing could lead to more widespread adoption of technology. Most of the participants agreed that the e-prescribing system was easy to use. Training was considered by doctors as an efficient tool for further development and they wanted more detailed guidance on e-prescribing. Further training was identified as a method for supporting doctors in familiarizing themselves with the e-prescribing system and e-prescription centre. They also concluded that numerous existing systems that had insufficient standardisation had left healthcare organisations in Finland uncertain how to approach systems procurement.

TAM and diffusion of innovations theory were used by Abdekhoda et al. (2016) in their survey in Iran with aim to recognize doctors’ attitudes towards EMR systems’ use and application. They have proposed that doctors’ acceptance of EMR systems will have influence on other users in healthcare such ad administrative staff, nurses, and information managers. The authors developed a model that will assess how different factors influence doctors’ acceptance of EMR. The final model was tested using structural equation modelling. Findings of this research confirmed the effects of perceived usefulness and perceived ease of use on users’ intentions. Other technology acceptance extensions such as: advantage, trainability, compatibility, and complicatedness were also established as behavioural predictors.

Malik Bader Allazam et al. (2016) proposed that trust in e-Health is of vital importance for the effective acceptance and use of EHR systems. They suggested a research model based on the modified UTAUT2 with a new construct such as: trust in the data storage. However, the authors proposed only a theoretical model that would be tested in the future with the aim to increase the intention for use of the EHR system by medical staff. Finally, the authors indicated that this will be a starting point for future research study on the acceptance of EHR systems by medical staff.

TAM, UTAUT and protection motivation theory were used by Hseih et al. (2017) in survey conducted in Taiwan with the aim to explore factors that affect adopting of PHR system. Their survey included structured questionnaire confirmed that the TAM, UTAUT and protection motivation theory were effective at predicting PHR usage behaviour among healthcare primary care practitioners. All ten proposed hypotheses were measuring various technology acceptance items with behavioural intentions. Exploratory factor analyses, confirmatory factor analyses and structural equation modelling were used to test the hypotheses. Perceived usefulness, perceived ease of use, self efficacy, subjective norm, and response efficacy were identified as technology acceptance constructs that which have significant effect on PHR acceptance. There was a significant positive correlation between behavioural intention for PHR and usage behaviour among the respondents. Finally, the authors proposed promotion of health management to increase public acceptance of the PHR systems. This study tested the correlation between behavioural intention and usage behaviour.

TAM was used by Handyani et al.’ (2017) model of hospital information system acceptance focusing on organisational, technical and human characteristics. The study used qualitative and quantitative approaches assessing the attitudes of hospital management officers, doctors, nurses and administrative staff. The data were analysed using structural equation modelling. The authors recommended that the hospital management and IT developers should have more understanding on the non-technical factors (i.e. technology acceptance) to better plan the hospital information system implementation and they have concluded:

“hospital management can provide benefits perceived by the user so that they accept the health information system even though the application is not necessarily suited to their needs.” (Handyani et al. 2017, p. 21)

Bartholomew (2017) reported that although the ‘Affordable Care Act’ in the United States was passed in 2010 there was still a digital divide in medical practices and some patients did not have access to their health information. In this study he examined the effect of perceived usefulness, social norms, and social influence on intentions through a qualitative study. He also reported that nine (three doctors and six other staff) healthcare providers were interviewed and expressed frustration with government requirement for meaningful use of the PHR which has placed an undue burden for record keeping. However, this may lead to a decrease in the effectiveness and efficiency of the system.

Chen et al. (2017, p. 478) introduced a new model called e-Health readiness with the aim to understand and explain the relationship between: “user habits, perceived healthiness and beliefs towards, sensing technologies (mobile health monitoring technologies).” They proposed that readiness will be significantly impacted by perceptions of healthiness, technology satisfaction and usefulness of such technology. The authors used confirmatory factor analyses and structural equation modelling to analyse their data.

Macdonald et al. (2018) conducted an interview study on 12 hospital healthcare professionals. They found that participants in their study were not using the system to its full extent focusing mainly on health information. However, they have also concluded that more experienced participants may ask for additional issues in e-Health use. Finally, they proposed better professional education specific to e-Health and better equipping of healthcare professionals to adopt e-Health technologies. Finally, it is evident that the technology acceptance on e-Health systems was still current after the completion of this Thesis.

### Technology acceptance and EHRs, empirical studies published since the commencement of this research

This section focuses on technology acceptance empirical studies on EHR systems among health care professionals. Studies published after the completion of the research in this Thesis’ were selected for this section.

Al-Adwan and Berger (2015) applied modified TAM to examine EHR acceptance and utilisation by doctors in Jordan. The sample frame for this study was 396 doctors from three hospitals and three medical centres which had EHR implemented when the study was conducted. The data were collected through a paper-based questionnaire distributed to doctors and had a high response rate of 66.6%. The study assessed perceived usefulness, perceived ease of use, social influence, and perceived threat constructs on a 4-point Likert scale. Additionally, the participants were asked to provide information about their gender, age, computer experience, number of years in practice, and number of patients seen per week. Structural equation modelling, moderation, and mediation analyses were used for the analyses. Perceived usefulness, perceived ease of use, and social influence were found to be major factors in the doctors’ decisions to use the EHR. The perceived threat was found as a barrier to EHR adoption, as the introduction of the EHRs was perceived as a radical change in their long-established style of work. All the relationships specified in the research model of this study were found to be significant, i.e., the direct and indirect effects of perceived usefulness, perceived ease of use, social influence and perceived threat explained 64% of the variance in the doctors’ intention to use the EHR system. The perceived threat construct had an indirect negative effect on intentions through perceived usefulness and perceived ease of use. Additionally, perceived threat had an indirect negative effect on perceived usefulness through perceived ease of use. However, the study did not differentiate doctors with respect to their speciality, and it is possible that there is a difference in the functionality level (basic/advanced) of EHRs used in the country.

Steininger and Stiglbauer (2015) examined the extent to which factors influenced acceptance of the EHR system among Austrian doctors. A modified TAM paper-based questionnaire was distributed to 2000 randomly chosen private practice doctors. Socio-demographic parameters such as gender, age, speciality (GP or specialist), and size of town were also included in the research instrument. Basic technology acceptance constructs (perceived usefulness, social influence, attitude, and intention) were tested alongside other extensions, such as privacy concerns and e-Health experience. The reliability of the research instrument was tested using Cronbach’s α coefficient. Structural equation modelling was used for the data analyses. Perceived usefulness had a significant positive effect on the intention to use the EHR system. Attitude, social influence, e-Health experience, and privacy concerns also had a significant effect on users’ intentions in the study. The overall model explained 69% of the variance in intention to use the EHR system. The authors proposed raising users’ awareness in terms of the potential value effects from EHR use in order to realise the full potential of the EHR system. However, this study had a low response rate (only 15.2%), and the sample could not be considered as representative of the Austrian population of doctors.

Bahadori et al. (2017) investigated the attitudes of 169 doctors towards the EHR at a university-affiliated hospital in Teheran, Iran. They used a standardised questionnaire with 42 modified TAM items. The data were analysed using structural equation modelling. Perceived usefulness and perceived ease of use were identified as major technology acceptance predictors. Moreover, perceived ease of use had a significant effect on perceived usefulness. The authors concluded that the most important barriers to the implementation of EHRs were people’s attitudinal behavioural limitations and organizational changes. Finally, they proposed that system users should be familiarised with the features, objective, benefits, and positive impacts of the EHRs (beside data privacy and security standards) with the aim to reduce the resistance to change and increase their readiness. However, this study was limited to one University affiliated hospital in Teheran, Iran.

Tubaishat (2017) used the modified TAM to assess the attitudes of 1539 nurses towards an EHR system. Data were collected through self-administered questionnaire from 15 randomly selected hospitals in Jordan. Correlation and multiple regressions were used for analyses of the data. The respondents showed significant positive perception of perceived usefulness and perceived ease of use. Other technology acceptance constructs such as: rank, experience, and gender were identified as behavioural predictors. The perceived ease of use was affected by EHR experience and computer skills. The author stressed that little attention has been paid to the acceptance and actual use of EHR systems. However, this study is limited to nurses in a few hospitals.

Table 2.5 presents a summary of the latest developments in empirical testing of technology acceptance on EHR systems.

Table 2.5: Synthesis of technology acceptance models and EHR, following the research in this Thesis

| Study | Objective | Institution  /Country | Participants | Model/ technology acceptance  Constructs | Findings | Implications | Limitations |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Al-Adwan and Berger  (2015) | To examine EHR acceptance and utilisation by doctors | Jordan, 3 hospitals | 396 doctors | Modified TAM. Perceived usefulness, perceived ease of use, social influence and perceived treat tested. 4-point Likert scale used | Perceived usefulness, perceived ease of use, and social influence found to be major factors for EHR use. Perceived threat a barrier to EHR adoption | Over-reliance on perceived influence and perceived ease of use for better EHR adoption | Doctors were not differentiated by speciality. Different levels of EHR functionality implemented in the country not assessed |
| Steinninger and Stiglbauer (2015) | To examine the extent to which factors influence acceptance of the EHR system among doctors | Austria | 2000 private doctors | Modified TAM. Perceived usefulness, social influence, attitude, intention, and other constructs (privacy concerns and e-Health experience) used | Perceived usefulness, social influence, attitude, privacy concerns, and e-Health experience significant effect on intentions | Raise of awareness needed in terms of potential values of EHR | Low response rate 15.2% |
| Bahadori et al.  (2017) | To examine the barriers to the implantation of EHRs | University-affiliated hospital, Teheran, Iran | 169 doctors | Modified TAM, standardised questionnaire with 42 items.  Structural equation modelling used | Perceived usefulness and perceived ease of use were predictors. Perceived ease of use had effect on perceived usefulness | End users should be familiarised with the features, objectives, benefits and positive impacts of the EHRs | Limited to one university-affiliated hospital |
| Tubaishat  (2017) | To asses nurses’  perceptions of usefulness and ease of use of EHRs | Jordan | 1539 nurses | Modified TAM.  Perceived usefulness and perceived ease of use tested | Gender, professional rank, EHR experience and computer skills predicted perceived usefulness.  EHR experience and computer skills predicted perceived ease of use | EHR systems being implemented, but little attention paid to the degree end-users will accept and subsequently use these systems | Focused only on nurses. No other healthcare professionals |

The in-depth literature review of peer-reviewed empirical studies of technology acceptance models of EHR after the completion of the research in this Thesis indicated that:

* perceived usefulness (TAM and TAM2) and performance expectancy (UTAUT) as similar constructs are the strongest predictors of intentions across latest studies of technology acceptance concerning EHR systems (Al-Adwan and Berger 2015; Steinninger and Stiglbauer 2015; Bahadori et al. 2017; Tubaishat 2017);
* perceived ease of use (TAM) and effort expectancy (UTAUT) as similar constructs were established as predictors of intention of technology acceptance of EHRs (Al-Adwan and Berger 2015; Bahadori et al. 2017; Tubaishat 2017). However, the perceived ease of use construct did not have effect in Steinninger and Stiglbauer’s (2015) study;
* social influence (UTAUT) and subjective norm (TAM and TAM2) as similar constructs proved to be predictors in studies by Al-Adwan and Berger (2015); and Steinninger and Stiglbauer (2015);
* attitude was tested and shown to be a predictor in Steinninger and Stiglbauer’s (2015) study;
* other technology acceptance constructs were used in a few studies, some of which predicted intention to use. Privacy concerns and e-Health experience (Steinninger and Stiglbauer 2015); perceived threat (Al-Adwan and Berger 2015); professional rank, EHR experience, and computer skills (Tubaishat 2017) were identified as technology acceptance predictors in the recent literature included in this part of the review. However, each technology acceptance model used was modified by two to three items;
* the following methods of data analyses were used by the researchers: moderation and mediation analyses (Al-Adwan and Berger 2015); structural equation modelling (Al-Adwan and Berger 2015; Steininger and Stiglbauer 2015; Bahadori et al. 2017); correlations and regression analyses (Tubaishat 2017); and
* the latest empirical studies Al-Adwan and Berger (2015); Steinninger and Stiglbauer (2015); Bahadori et al. 2017; and Tubaishat (2017) used the modified TAM.

### What has changed during the time of this Thesis

Many studies have been published with respect to technology acceptance on e-Health and EHR systems after the completion of the research in this Thesis. It can be concluded that issues related to technology acceptance on e-Health/EHR systems were still current even after the completion of this Thesis. Technology acceptance through the TAM and UTAUT models remained a major issue among researchers (Abdekhoda et al. 2015; Al-Adwan and Berger 2015; Steininger and Stiglbauer 2015; Abdekhoda et al. 2016; Holden et al. 2016; Hseih et al. 2016; Khaneghah et al. 2016; Kim et al. 2016; Kivekas et al. 2016; Malik Bader Allazam et al. 2016; Strudwick et al. 2016; Tavares and Oliveira 2016; Bahadori et al. 2017; Handyani et al. 2017; Tubaishat et al. 2017).

Literature reviews conducted by Garavand et al. (2016) and Alsyouf and Ishak (2017) have confirmed that TAM and UTAUT respectively have remained as leading theoretical frameworks for assessing the attitudes among the healthcare professionals. However, most of the authors were using modified technology acceptance models, adding only a few new variables to the basic model (Abdekhoda et al. 2015; Al-Adwan and Berger 2015; Steininger and Stiglbauer 2015; Abdekhoda et al. 2016; Holden et al. 2016; Hseih et al. 2016; Khaneghah et al. 2016; Malik Bader Allazam et al. 2016; Tavares and Oliveira 2016; Tubaishat et al. 2017). Almost all of the studies were using a quantitative approach.

There were few studies that were using combination of TAM and other technology acceptance assessment tools such as: Abdekhoda et al. (2016) using diffusion of innovations theory; Khaneghah et al. (2016) using three constructs from different theories of usability; and Hseih et al. (2016) using protection motivation theory.

A qualitative approach was applied in smaller samples studies. Bartholomew (2017) conducted a study on nine respondents. However, larger samples of respondents were assessed in studies through quantitative studies such as Tavares and Oliveira (2016) on 1618 people, and Kivekas et al. (2016) on 269 GPs.

Regression analyses were used in Jimoh et al. (2012); Heart and Kalderon (2013); Abdekhoda et al. (2015); Holden et al. (2016); and Tubaishat (2017) studies. However, there were many researchers who used other data analysis techniques, such as confirmatory factor analyses (Chen et al. 2017; Hseih et al. 2017), and structural equation modelling (Abdekhoda 2015; Steininger and Stiglbauer 2015; Abdekhoda et al. 2016; Kim et al.2016; Bahadori et al. 2017; Chen et al. 2017; Handyani et al. 2017; Hseih et al. 2017).

New technology acceptance predictors such as: physicians’ involvement, physicians’ autonomy, doctor-patient relationship (Abdekhoda et al. 2015); privacy concerns (Steininger and Stiglbauer 2015); compatibility, complicatedness, trainability (Abdekhoda et al. 2016); and trust (Malik Bader Allazam 2016) were used in the new studies published after the research in this Thesis was completed.

## Conclusions

This chapter presented an in-depth literature review of the most recent research of technology acceptance, particularly in healthcare settings. Technology acceptance models research related to EHR were synthesised in Section 2.6, and updated in Section 2.7. Almost all of the studies described in Tables 2.4 and 2.5 suggested that technology acceptance plays a key role in assessing end users’ attitudes to e-Health/EHR systems. Harle and Dewar’s (2012) study of doctors’ EHR acceptance prior to the implementation of a system resonates with the current situation in Republic of Macedonia. As there have been no studies on technology acceptance in SEE, and none specifically in the Republic of Macedonia, there is a need to assess the acceptance of e-Health applications in order to understand health professional’s general understanding and acceptance of e-Health and EHR systems. The Macedonian government plans to introduce these systems in the future (Section 1.4.7).

The updated literature review (Section 2.7) confirmed that the issues discussed before the commencement of the two studies of this research were still current after the completion of the research in this Thesis. The next chapter presents the methodology adopted for this research. Different contemporary methodological approaches will be examined to identify the most appropriate one for this Thesis and to pose the research questions.

# Methodology

## Introduction

The literature review in Chapter 2 revealed the need for research in the field of technology acceptance of new e-Health/EHR systems among healthcare professionals. There are still unanswered questions concerning their attitudes to new technologies, particularly in countries that are developing their healthcare systems, such as in SEE. This research aims to develop knowledge in the field of technology acceptance among healthcare professionals in one SEE country, i.e. the Republic of Macedonia. This chapter outlines the methodological part of that research.

A sound methodology should be the basis for all research projects, and every research project should have its own methodology (Grix 2002). The author stressed that: “methodology is the study of methods and assumptions about the ways in which knowledge is produced.” (Grix 2002, p. 179) According to Ishak and Alias (2005), methodology is the systematic theoretical analysis of the methods applied to specific research. Methodology provides the theoretical underpinning for understanding which method can be best applied to a specific research study. The diversity of research questions needs to be addressed through different types of methodological approaches.

This chapter gives an overview of the general methodological paradigms and research instruments published in the peer-reviewed literature (Section 3.2). Different approaches and techniques published in the relevant literature were studied, and their advantages and disadvantages were assessed in detail, in order to develop an appropriate research design for this study and to develop an appropriate research instrument. Research questions relevant to this Thesis will be posed in this section. Qualitative and quantitative methodological approaches will be explored in Section 3.3. The appropriate approach for this research is identified in Section 3.4. Different sampling techniques are discussed in Section 3.5. Research ethics are explored in Section 3.6. Section 3.7 presents methods which assess quality of the research. Section 3.8 introduces both studies of this Thesis. Finally, Section 3.9 concludes this chapter.

## Research paradigm

This section explores different research paradigms in order to identify the most appropriate paradigm for the research instrument of this study. A research paradigm is a set of assumptions for exploring the social world and applications of appropriate techniques for inquiry (Myers 1997). The adoption of a research paradigm is necessary for the development of a sound methodology. Patton (1990) described a paradigm as a tool for breaking down the complexities of the real world. Ontology and epistemology are two philosophical concepts of a paradigm.

According to Hudson and Ozanne (1988), ontology is the nature of reality. Ontology refers to things existing in the world and reality (Punch 2000). Carson et al. (2001) defined epistemology as relationship between the scientist and reality, or how reality can be assessed. Epistemology is associated with the methods of enquiry that are used to develop knowledge (Mingers 2001).

The core epistemological consideration is whether the same principles can be applied, and therefore studied, in both the social world and within natural sciences. Positivism and interpretivism are the two predominant approaches to acquiring knowledge in social sciences (Hudson and Ozanne 1988). Other paradigms, such as post-positivism and critical theory, are also discussed in the literature (Denzin and Lincoln 2000; Punch 2000; Creswell 2003). However, positivist and interpretive perspectives are the most dominant paradigms that have influenced social sciences research and so will be discussed in depth here.

According to Punch (2000), positivism, the oldest theory in the social sciences, is related to the philosophical work of A. Comte (1798 – 1857) and E. Durkheim (1858 – 1917). Comte assumed that knowledge is founded on the experience of senses and can be acquired by observation and experiments (Punch 2000). Punch (2000) proposed that observation and reason can be used as a means for studying human behaviour. Positivist theory understands reality as everything that can be perceived through the senses. Reality is objective, placed in order, governed by strict laws, independent of human consciousness. Myers (1997) confirmed that positivist researchers generally assume that reality is objective and can be explored by measurable means that are independent of the scientist, and their tools. Researchers such as Bagozzi (1980) and Morgan and Smircich (1980) perceived that reality is divisible and fragmentable, which means that precise, accurate measurements and observations of the world are possible. Hudson and Ozanne, (1998, p. 509) described the positivist approach as:

“the positivists tend to take a realist position and assume that a single, objective reality exists independently of what individuals perceive. The social world, like the physical world, also exists independently of the individual’s perceptions as a real, concrete and unchanging structure.”

Reality is seen objectively in the positivist approach. This approach may test hypotheses and measure properties (Myers 1977). Research that takes a positivist approach is conducted through scientific protocols (Hudson and Ozanne 1998). The scientific protocol for the positivist research process is well established (Campbell and Stanley 1963). Bryman (2004, p. 28) defined positivism as: “an epistemological position that advocates the application of the methods of the natural sciences to the study of social reality.” The fixed structure of positivist research allows only accurate answers to each question. Positivist researchers strive to remain detached from the subjects of the research. Scientists using the positivist approach remain emotionally neutral in order to achieve a distinction between reason and feeling. Positivism as a theory is very influential as the basis for methodology, and the positivist approach is used mainly in quantitative research. Positivism is the main philosophical approach in medical research.

In contrast, interpretivism reflects the views of researchers who have been critical of applying the methods of the natural sciences to the study of the social world (Bryman 2004). The author argued that, in the social sciences, people are not the same, and cannot be treated the same, as subjects compared to the natural sciences. The research of the social world needs a different approach. Punch (2000) indicated that interpretive theory is associated with the work of Vico (1668 – 1744) and Dilthey (1833 – 1911). According to the interpretive theory, reality is in the mind and is internally experienced**.** Myers (1997) argued that interpretive researchers consider that reality can be assessed through social constructs, such as language and consciousness. Researchers using the interpretivist approach seek to describe many perceived realities that may not be known in advance (Hudson and Ozanne, 1998). Questions and data collection in interpretivist approach are co-operatively developed. Interpretivist researchers create more personal and flexible research structures than when adopting the positivist paradigm. Researchers remain more receptive to meanings in interactions with subjects, and can make more sense of what is perceived as multiple realities. When collecting data, the researcher and the research participant are not completely separated from each other. However, the researcher remains open to new ideas.

Friedman and Wyatt (2006) wrote that objectivist and subjectivist assumptions are the two main perspectives used in the evaluation of medical information systems. According to them, the objective assumption is associated with quantitative research by developing instruments for data collection. The subjective assumption is associated with qualitative research. In qualitative studies, researchers may develop hypothesis through the progress of the study, rather than setting them out beforehand (Friedman and Wyatt 2006). Myers (1997) argued that positivist and interpretivist (or constructivist) paradigms are most appropriate for conducting research in the field of information systems.

Creswell (2003) indicated that researchers adopting the constructivist paradigm tend to study reality based on the individual’s experience. Researchers with subjective assumptions use qualitative methods, such as interviews, to show individual perceptions of a particular condition (Friedman and Wyatt 2006). Psychology has for a long time been associated with quantitative research methods (Mason 2002). Quantitative methodology is based on positivist or neo-positivist theories. Through the positivist approach, researchers can remain detached from respondents, and they can remain emotionally neutral in order to achieve a distinction between reason and emotion. Positivist research has a fixed structure, which allows accurate answers to each question. Clark (1998) proposed using a quantitative approach in order to adopt new knowledge, as reality may be measured objectively and independently by the researcher. Quantitative methods rely on the quality of mathematics as a precise scientific tool (Sayer 1992).

Objectivity is the most significant element of quantitative research. Sarantakos (1993) argued that objectivity can avoid researchers’ personal prejudice and present the reality in its original form. Through objectivity, the researcher remains distant from, and neutral towards, the research subjects, the respondents, and the methods of data collection and analysis.

### Research problem

The literature review of this study presented in Chapter 2 revealed a lack of knowledge in the field of technology acceptance among healthcare professionals in SEE. The review of the literature showed that there had been no studies in the field of technology acceptance among healthcare professionals in the Republic of Macedonia. As discussed in Chapter 1 (Section 1.2), this SEE country has its own characteristics, and has gone through a transition from one political system to another. The Republic of Macedonia is developing new healthcare systems and new information systems to support these. These circumstances rise to the idea of studying technology acceptance among healthcare professionals in this region. There might be differences between other states in Europe and the USA, countries in which technology acceptance has previously been studied (Section 2.6). Republic of Macedonia is developing its economy and healthcare system respectively (Section 1.4). e-Health is not being introduced in well-established mature healthcare system, but in developing country. The healthcare system in the Republic of Macedonia is more recent, and the issues they face, and how these might affect the acceptance of technology, might be different.

Technology acceptance research has been developed in different settings, such as information technology and psychology, different from healthcare. Healthcare professionals have specific needs that are different from the other professionals who are usually studied with technology acceptance. This highlighted the need for the development of new models of technology acceptance in healthcare (Schaper and Pervan 2007; Yarbrough and Smith 2007; Kijsanayotin et al. 2009). With the new technology acceptance model, it will be possible to assess the attitudes of healthcare professionals in countries in SEE, like Republic of Macedonia which are implementing national e-Health systems. To date, little is known about the attitudes of healthcare professionals in SEE to new ICT technologies. No research or knowledge is available for us to fully understand and assess the behaviour of healthcare professionals in this part of Europe which later can be related and compared to existing research and knowledge (Section 2.6).

### Research questions

Specifying the research question in both natural and social sciences is a methodological milestone in research. Posing the research question is the methodological point of departure in both quantitative and qualitative research. Research questions should be constructed accurately and clearly. Answering the research question will address the research problem. A research question is a clear and precise statement, written in the form of a question that will address the researcher’s needs (Bryman 2004). A hypothesis, however, may address a research question, although it is not written as an actual question. The literature review in Section 2.6 identified the TAM2 introduced by Venkatesh and Davis (2000) and used in original or modified versions as an effective tool for this research (Menechemi et al. 2007; Hyun et al. 2009; Morton & Wiendenbeck 2009; Wilkins 2009; Devane et al. 2010; Morton and Wiendenbeck 2010; Spil et al. 2010; Egea & Gonzalez 2011). The UTAUT model created by Venkatesh et al. (2003) and used in healthcare settings as the most recently developed technology acceptance model (Archer and Cocosila 2011; Harle and Devar 2012; Razeghi & Nasiripour 2014) was also considered for this research.

According to the literature review, no studies of technology acceptance of e-Health in Republic of Macedonia or other developing countries in the SEE region have been carried out. As indicated in this chapter, technology acceptance models were developed in settings outside healthcare (Holden and Karsh 2010). The cultural differences which exist between different countries stressed the value of more cross-cultural research (Cash et al. 1992; Straub et al. 1997; Zakour 2004; Srite 2006; Bandyopathyay and Fracastro 2007; McCoy et al. 2007; Oshlyanski et al. 2007; Venkatesh and Zhang 2010; Im et al. 2011). Based on this research, there is reason to believe that there are associations between culture and the actual use of certain ICT. While considerable research has been applied to the understanding and adoption of ICT, only a handful of studies have specifically examined the possible cultural effects on the adoption and diffusion of new ICT (Straub et al. 1997). Therefore, it is imperative to assess general views of e-Health applications and then build on that model and assess the technology acceptance of EHR, and given the development of EHRs in the Republic of Macedonia. This new contextualised model has to be derived from the existing research synthesis of technology acceptance reported in Table 2.4 and should also address culture-specific features (e.g., the current state of e-Health and EHR systems in Republic of Macedonia).

There is a need to assess the national readiness in Republic of Macedonia to accept new e-Health/EHR technologies prior to implementation, as indicated by Amatayakul (2005). A formal readiness assessment can have many benefits and reduce the time and money needed to implement such systems. The future study should assess the effectiveness of basic constructs from original technology acceptance models (TAM2 and UTAUT). However, other technology acceptance constructs introduced by Devane et al. (2010) and Morton and Wiedenback (2010) may be assessed, and their effectiveness should be checked in healthcare settings in a SEE country. The author of this research has a good access to healthcare setting in the Republic of Macedonia. The literature review in Chapter 2 of this Thesis that identifies some gaps in the knowledge led to the following research questions:

**Research question 1:** Which factors influence and what is the level of national readiness for acceptance of new information and communication technologies in healthcare settings in SEE country?

**Research question 2:** Which technology acceptance variables and moderators described in the TAM2, UTAUT, and other technology acceptance models have a significant influence on healthcare professionals’ acceptance of new information and communication technologies in healthcare?

**Research question 3:** What is the effectiveness of TAM2, UTAUT, and other technology acceptance models in studying healthcare professionals’ acceptance of new information and communication technologies in healthcare?

Addressing these questions in sufficient detail will contribute to new knowledge of healthcare professional’s behaviour regarding technology acceptance. Answering these research questions will serve as a basis for creating future management and government policies in this area, specifically in the Republic of Macedonia. Furthermore, the findings of this study might also be applicable to other developing countries in SEE.

## Research approaches

The aim of this section is to investigate the appropriate paradigm and selection of the right approach for this research. This can be used to address the research questions presented in the previous section. The review of research methodologies was conducted to identify the advantages and disadvantages of different research paradigms. Saunders (1997) has discussed deductive and inductive approaches. A researcher uses a deductive approach to develop a theory, and designs a strategy to test the hypotheses which is arising from this theory (Saunders 1997), i.e., it adopts the positivist paradigm described in Section 3.2. With an inductive approach, the data are collected first, and a theory is developed based on data analyses (Saunders 1997), i.e., it is more interpretive in nature and emerges from the data.

Research approaches can apply quantitative, qualitative or mixed methods, i.e., a combination of quantitative and qualitative methods. A deductive approach is closely associated with quantitative methods, and an inductive approach is closer to qualitative research. Methodology in social sciences can be divided into two approaches: quantitative and qualitative (Fox 2001). However, these two approaches may be applied in combination, the so-called mixed methodology. Eisenhardt (1989) observed that too complex and detailed theory presents difficulties for studying important relations between variables.

### Quantitative approach

The quantitative approach is a widely accepted research method and has been applied by researchers for many years (Creswell 2003). Quantitative methodology is based on positivist or neopositivist theories. Sayer (1992, p. 175) defined those researchers who use quantitative methods as: “usually appeal to the qualities of mathematics as a precise, unambiguous language which can extend our power of deductive reasoning.”

Many quantitative researchers consider objectivity as the most significant element. Sarantakos (1993) argued that in quantitative research objectivity is regarded as a virtue that every quantitative researcher strives to achieve. Sarantakos (1993, p. 18) also stressed that:

“objectivity is generally employed to minimise personal prejudice and bias, and to guarantee that social reality will be presented as it is, rather than as it is interpreted or imagined by the investigator.”

An objective technique requires that the researcher remains distant and neutral with respect to the subject of research, the respondents, and methods of data collection and analysis. In quantitative research, the recruitment of a sample that reflects the attributes of the target population is one of the most important qualities. In order to study a population of interest in quantitative research, a sample is taken which needs to reflect the representativeness of the population. Achieving representativeness in quantitative research allows generalisation and findings from the research that can be deemed applicable to the whole population. Quantitative research is undertaken through deduction, wherein a researcher develops a theory. This is used to develop hypotheses, which are tested through collecting data and analyses (Bowling 1997).

Quantitative research is often conducted through questionnaires or surveys designed to establish how people see themselves (Silverman 1993). As the main research instrument in quantitative studies, questionnaires should be designed and developed to yield high-quality data that enables proper analyses that will answer research questions, and test hypotheses properly.

Burkle et al. (2001) indicated that the survey is the most common method of data collection in quantitative studies relating to the use of ICTs. Fink (1995) and Patten (2007) proposed quantitative research (for example, using surveys) assesses attitudes and behaviour of the participants. Punch (1998) stressed that the results obtained from quantitative research can be generalised to the whole population, assuming that the sample is representative of the population from which it comes. A quantitative approach can express how strongly the variables being tested are associated with each other.

### Design of the research instrument in quantitative approaches

Bourque and Feilder (1995) proposed the development of questionnaires through a relevant literature search. However, the authors also proposed the use of standardised questionnaires. The application of standardised questionnaires has some advantages, as they have been already tested, and data can be compared across studies. Bourque and Feilder also proposed the development of questionnaires through the adoption and adaptation of questionnaires from previous studies. Questionnaires can be translated into other languages, and the order of items may be changed according to the needs of the survey (Bourque and Feilder 1995; Hambleton 2001).

The proper design and development of the questionnaire as the main research instrument in survey studies is very important for yielding high-quality data which enable proper analyses and answers the research questions properly. Recommendations from Bland (1995), who argued that a greater number of variables makes it more difficult to interpret the results of the regression model, were also taken into consideration when designing the research instrument for the study in this Thesis.

Questions in a quantitative study survey can be closed or open-ended (Patton 1990). With closed questions, the respondent has to choose between pre-defined options. Data collected through closed questions are unified and may be easily compared (Denscombe 2007). In contrast, with open-ended questions, respondents need to write their answers; this is a time-consuming process, and the data collected are not unified as in surveys with closed questions (Oppenheim 1992).

Quantitative research using questionnaire surveys can assess respondents' attitudes to specified subjects with an attitude scale (May 1997). Questions on the attitude scale are phrased in such a way that the participant can agree or disagree with them. Additionally, beliefs and behaviour intentions can be measured and predicted by attitude scales (Oppenheim 1992).

The Thurstone, Guttman, and Likert scales are among the most commonly used methods of attitude scaling (Oppenheim 1992; Bowling 2002). The Thurstone scale is a complex measuring instrument developed on statements about a particular question, and each statement has a numerical value indicating how favourable or unfavourable it is. Attitudes are measured on a continuum ranging from positive to negative, and respondents choose a statement with which they agree, and a mean score is computed, indicating their attitude. The Guttman scale measures attitudes that are easy or not easy to accept.

The Likert scale is the most commonly used uni-dimensional scale that measures all constructs in the same way. It was developed in 1932 as five-point bipolar response scale. Respondents rank quality from high to low or best to worst using scales ranging from two to ten. However, 5- or 7-point Likert scales are the most commonly used. The Likert scale contains a number of constructs about a particular subject, and the participant can rate his/her attitude by indicating ‘strongly agree’ to ‘strongly disagree’. The middle response in the scale is often a neutral option, and even-numbered Likert-scales force the respondent to make a choice and not give a ‘neutral’ response. The Likert scale can obtain an in-depth understanding of the users’ attitudes (Bowling 2002). However, the Likert scale has some disadvantages, such as similar responses to questions, as respondents can tick the same responses to a series of questions without really thinking about them (Oppenheim 1992).

The quantitative approach with questionnaire surveys has several advantages, as they are cheaper, less time-consuming, and can be used to cover a wide geographical area, and applied to larger sample sizes (Oppenheim 1992). New knowledge can be obtained by using the quantitative approach, as reality may be measured objectively and independently by the researcher (Clark 1998). However, questionnaire surveys have disadvantages, such as low response rates (postal surveys often have low response rates of 30% or less, which can reduce the representativeness of the sample), respondents may return incomplete questionnaires with poor or inappropriate responses, and the validity of the responses in a survey often cannot be checked.

### Qualitative approach

The qualitative approach emerged primarily during the last three or four decades (Creswell 2003). According to Cahill (1996), qualitative research can be used both for preliminary research, before a quantitative study or after the quantitative study, to determine the credibility of the study. Qualitative research is undertaken through induction, in which the researcher first collects the data and uses them to generate ideas and theories. Denzin and Lincoln (2000) defined qualitative research as a set of material and interpretative practices, such as interviews, field notes, conversations, photographs, recordings, and memos, that make the world visible. The authors stressed the fact that qualitative researchers study things in their natural settings. Interviewing is the most commonly used research method, enabling researchers to have close interaction with participants (Mason 2002). Qualitative research has diverse theoretical frameworks. Sarantakos (1993) defined three, i.e., phenomenology, hermeneutics, and symbolic interactionism, which contribute most to this kind of social research. Because these approaches were not adopted for the study in this Thesis, they will not be discussed further here.

Ritchie and Lewis (2003) recognised that there is no single accepted way to do qualitative research. Researchers base their study on a range of factors, such as personal beliefs about the social world and what can be learned about it (ontology), the nature of knowledge and how it can be obtained (epistemology) and the goals of their research. According to Ritchie and Lewis, researchers should take into consideration the audience for the research, the characteristics of the participants, and the position and environment of the researchers themselves. The researcher’s aim is to develop new knowledge (epistemology) and to present the nature of reality (ontology) accurately as indicated by Hudson and Ozanne (1988) and Punch (1988). The researcher creates relationships between reality and the new knowledge based on it (Carson et al. 2001; Mingers 2001).

In qualitative research, the size of the sample can be small, and many researchers consider representativeness as not essential, in the way that it is in quantitative research, where the findings can be generalised to the whole population. In qualitative research, transferability is achieved through theoretical sampling with the recruitment of essential, typical and theoretically important units. The most common method in qualitative research is the interview, but data can be collected through other forms, such as group discussions, observation, various texts, pictures, and other material (Savin-Baden and Major 2013). Silverman (1993) argued that interviews can be used to generate data which give authentic insights into people's experiences. However, Silverman (1997) also acknowledged that interviewees sometimes fail to provide meaningful insights and they respond to interviewers with personal narrative constructs.

Quantitative and qualitative methodologies can be combined, and this approach is referred to as a mixed method (Creswell 2003). It is used within the post-positivist paradigm. Mixed method approaches are relatively new and still developing in form and substance. Bryman (2006) favoured conducting quantitative and qualitative studies in tandem, as this combination can lead to multiple unanticipated outcomes. Punch (1998) pointed out that in mixed approaches both approaches compensate for the weaknesses of each other, enhancing the overall strength of the study.

### Differences between quantitative and qualitative approaches

In the quantitative approach, data are gathered through a predetermined methodological structure, with strictly defined questionnaires, whereas in the qualitative approach, conducted through unstructured or semi-structured interviews, the structure of the data will emerge through data analysis. The quantitative approach tends to select larger samples, with the aim of generalising the findings to the wider population. In the qualitative approach, smaller samples are selected in order to make the research more profound. Generalising the findings is not the main purpose of the qualitative approach. Patten (2007) discussed how designing and administering a questionnaire to a large sample in quantitative studies may take less time compared to one-to-one interviews in qualitative studies. However, composing a questionnaire, selecting a larger sample and collecting data in quantitative studies is not easy, and is a time- and effort-consuming task. Quantitative researchers aim for hard, replicable, and reliable data, while qualitative researchers attempt to obtain rich, real, deep, and valid data (Shih 1998). In quantitative approaches, the results are presented mainly numerically, while a textual format is the most common way of presenting the results of qualitative studies (Patten 2007). Hypothesis testing is the main approach in quantitative studies, whereas the qualitative approach creates hypotheses through an inductive approach.

Quantitative research provides quantified answers to research questions, whereas qualitative research develops concepts that help to understand social phenomena (Pope and Mays 1995). These authors proposed the use of a qualitative approach for in-depth analysis, such as understanding how educational messages on stopping smoking can be accessed by teenagers.

Neither approach is better than the other, both have strengths and weakness and can be combined (Punch 2000). The author also proposed a focus on what the researcher is trying to find (questions), before s/he focuses on how the research can be conducted (methods). Begley (1996) discussed that the quantitative approach is used in cases where something is known about the topic, and the qualitative approach can be applied in exploratory studies in order to conduct a more in-depth investigation. Pope and Mays (1995) favoured the use of qualitative research in health services research as a way to access areas that are not amenable to quantitative research.

Hudson and Ozanne (1988) indicated that the interpretivist approach is focused on understanding and interpreting human behaviour rather than predicting it. According to Friedman and Wyatt (2006), with the subjectivist assumption, end users who use ICT systems may have different views about what is good. Therefore, the interpretivist assumption explores types of diversity, rather than showing the user’s belief.

### Data collection

There are different approaches for data collection in quantitative and qualitative research. Direct interaction with participants, individually or in group settings is used for data collection in qualitative research. Therefore, this type of data collection is time consuming. The data are collected from smaller samples. However, the qualitative research provides richer data which provides better explanation of the phenomenon for the researcher. Data collection in qualitative research can be achieved using: focus group, interview, observation, and action research (solving immediate problem or reflective process of progressive problem solving).

However, data collection in quantitative research sometimes is more expensive and includes: surveys; experiments; clinical trials; observing and recording events; and providing data from information systems. Data collected through quantitative approach are collected from larger samples, and findings can be generalised to the wider population (Punch 2000).

### Triangulation

The term triangulation is derived from geometry to describe the process of determining the location of a point by measuring angles to it from other known points. Triangulation in social sciences emerged in the late 1950s with the core argument that more than one method should be used in the validation process (Jick 1979). The newly fixed point can then be used in a ‘triangle’ with one known side and two known angles (Given 2008). Denzin (1970) indicated that triangulation is a combination of methodologies. Triangulation can combine theories, methods, data sources or investigators in the study of the same subject (Kimchi et al. 1991). The use of different research methods in a study of the same phenomenon is considered as a triangulation method (Nolan and Behi 1995).

The combination of the above-mentioned triangulation techniques (methods and investigators, for example) is called multiple triangulation (Thurmond 2001). The purpose of triangulation in social research is to increase the credibility and validity of results. Numerous researchers have proposed the use of triangulation (Altrichter et al. 1993; Cohen et al. 2007). Triangulation can be used in quantitative as well as qualitative studies. According to O’Donoghue and Punch (2003), triangulation is a tool for cross-checking data from multiple sources and to search for the accuracy of the research data.

There are two main types of methodological triangulation: between-methods and within-methods triangulation. A combination of quantitative and qualitative approaches is most commonly used in between-methods triangulation (Begley 1996; Patten 2007). A combination of questionnaires and interviews can be used in the same research project (Thurmond 2001). Combinations of different techniques for collecting data (interviews and observation for example) within the same research approach are considered as within-methods triangulation.

### Data analyses

Collected data may be analysed with different data analyses techniques. However, data analyses tools proposed for data gathered in this research are presented in Chapter 4 (Section 4.2.11).

## Quantitative versus qualitative methods, identifying the right approach for the Thesis

The literature review in Chapter 2 identified the need to investigate healthcare professionals’ attitudes to e-Health systems in a SEE country, i.e., in the Republic of Macedonia. Furthermore, the Introduction Chapter 1 and Literature review Chapter 2 of this Thesis demonstrated that there was a need to explore the readiness of healthcare professionals to accept new ICT in healthcare in SEE. Thus far, nothing has been published in the scientific literature on doctors’ behaviour regarding acceptance of new ICT in this country in SEE. This environment has its own specific characteristics, such as the changes in the political system and other changes in the last few decades, as explained in Section 1.2. It is possible that healthcare settings are in some way different from those studied in other parts of Europe. It was established in Section 2.6.3 that the effectiveness of technology acceptance models should be assessed in healthcare settings in SEE. This research is intended to develop knowledge about healthcare professionals’ intentions. There is a need to capture the actual situation and draw conclusions about their expectations of e-Health/EHR systems.

Creswell’s (2003) ideas on the positivist approach with the application of multiple methods and multiple perspectives of participants were considered for this research in order to capture ‘much of the reality’. A review of the methodological approaches (Section 3.3) has confirmed that reality is objective and can be explored by measurable means that are independent of the scientist (Myers 1997). A positivist approach will permit the researcher to remain detached from the participants in this study. Through the positivist approach, the researcher will remain emotionally neutral. The established scientific protocol for this study may be used according to Campbell and Stanley’s (1963) recommendations for positivist research.The fixed structure of the positivist research instrument allows only precise answers to each question, and it can be used to assess healthcare professional’s attitudes to new ICT. Therefore, a positivist paradigm was identified as the most appropriate tool for assessing of intentions of Macedonian healthcare professionals in this Thesis.

Quantitative methods, based on a positivist approach (Myers 1977; Sayer 1992; Sarantakos 1993; Silverman 1993), were considered for this research in order to answer the research questions in Section 3.2.2, and to test the study hypotheses that were developed (presented in Sections 4.2.3 and 5.2.3). The research questions in this study may be addressed only with precise, accurate measurements and observations of reality (Bagozzi 1980; Morgan and Smircich 1980). Quantitative research provides quantified answers to research questions, whereas qualitative research develops concepts that help us to understand social phenomena (Pope and Mays 1995). Myers’ (1997) recommendations that this approach may test hypotheses and measure properties were also taken into consideration. May’s (2001) recommendations that a quantitative approach shows the strength of the statistical association between variables were applied for the creation of the research instrument. The quantitative approach enabled the collection of hard, replicable and reliable data for this Thesis, according to Shih’s (1998) recommendations. Oppenheim’s (1992) and Punch’s (1998) recommendations that quantitative approaches are more suitable for generalising the results from a sample to the whole target population were considered. Eisenhardt’s (1989) recommendations on the appropriate complexity of the study were taken into consideration in order to provide accurate relations between the variables tested in the technology acceptance models in this research.

Quantitative research through deduction was used to develop hypotheses, which were tested through data collection and data analysis according to Bowling’s (1997) recommendations. A theory and hypotheses were developed and tested for both studies, according to Saunders’s (1997) recommendations for a deductive approach. Burkle et al. (2001) proposed that a survey is one of the most common methods of collecting data in quantitative studies in ICT. Bourque and Fielder (1995) proposed the development of questionnaires through relevant literature research. The authors proposed the development of questionnaires through the adoption and adaptation of questionnaires from previous studies. Questionnaires can be translated into other languages, and the order of items may be changed according to the needs of the survey (Bourque and Feilder 1995; Hambleton 2001). Therefore, it was decided that data collection for this research should be conducted through questionnaire surveys. The questionnaires were designed to establish how people see themselves (Silverman 1993) and to assess participants’ attitudes and beliefs (Fink 1995; Patten 2007).

The review of methodologies in this chapter has shown that the interpretivist approach is based mainly on the researcher’s attitudes (Denscombe 2007). This approach can be less representative of a wider population data interpretation. The interpretivist approach may be also influenced by researcher’s background and personal beliefs. Through qualitative data analysis, the interpretivist approach is used to provide rich data that can provide alternative explanations to research questions when needed. Qualitative data analysis may be used for in-depth meaningful explanations of research questions. This research may be performed at a later stage to provide more in-depth answers about healthcare professionals’ preferences. The data may later be triangulated, as discussed in Section 3.3.6. Denzin and Lincoln (2000) stressed the fact that qualitative researchers study things in their natural settingsin order to interpret phenomena in terms of the meanings people attach to them.

Qualitative methods have their own advantages over quantitative approaches. They can provide a more meaningful explanation on phenomena and more precise description on people’s behaviour. With these approaches the researcher is more open and responsive to the reality. For instance, using open-ended questions in an interview and provide wider perspectives for the researcher.

This Thesis aims to explore a wider group of healthcare professionals at a national level. However, the qualitative approach is mainly focused on smaller groups of respondents and wider national samples cannot be examined. Therefore, a quantitative approach was selected for this Thesis with the aim to examine end users attitudes at a national level. However, the avoidance of a qualitative approach is a potential limitation of this research, discussed in Section 6.3.1.

The current research was conducted by means of two quantitative studies of Macedonian healthcare professionals. The first study involved hospital healthcare professionals, while the second assessed GPs’ views on e-Health. The two technology acceptance models (modified TAM2 and modified UAUT) most commonly used in the literature review studies (Section 2.6) were selected to be applied to the different populations in healthcare settings in the country with the aim of predicting future intentions and gauging the country’s readiness for e-Health acceptance. However, because the study was intended to be a quantitative study, open-ended questions were not included in the questionnaire of this study. Although these questions could have provide further explanations on users’ attitudes and behaviours towards the new ICT in healthcare, the researcher did not want to put participants off completing the questionnaire by making it too long. This limitation is discussed in Section 6.3.1.

## Population and sampling

The aim of this section is to discuss the importance of using proper sampling techniques. Different sampling techniques will be discussed prior to the selection of the most appropriate sampling method for this Thesis. When researchers aim to achieve the objectives of a scientific project, they must determine the group or groups of people in whom they are interested, the so-called ‘population’ of interest. The meaning of this term should be differentiated from the same term meaning all the inhabitants of a given area. The population in which a researcher is interested is specific and usually much smaller. For a proper methodology, it is important to identify the exact population or group of people in which s/he is interested. However, collecting data from the whole population is often not possible.

Therefore, the researcher must identify a suitable number of individuals to represent the targeted population and study them as a group. This group is referred to as the sample for the study. Scientists should be able to assume that the sample is a good representation of the population they aim to understand (Howard 1985). A representative sample reflects characteristics among its participantsthat are proportional to the characteristics of members of the population, i.e., the sample is not in any important way different from the population. The researcher may claim that the knowledge gained from a representative sample is also true for a whole population. This is called generalisation of the findings (Altman and Bland 1998). On the other hand, a biased sample that does not represent the population that the researcher wishes to generalise can lead to erroneous conclusions (Howard 1985). The selection of an appropriate sample permits the transfer of quantitative study results to the study population (Morris 1989).

Morris (1989) suggested that choosing a sample from the population and the results that the researcher can obtain from the chosen sample should not be too different from those applying to the rest of population. Morris (1989) and Saunders (1997) described different ways of sampling: simple random sample, stratified sample, multi-stage sample, quota sample, and systematic sample.

Morris (1989) compared the random sample to an old-fashioned paper-and-hat procedure, in which we can write down names or numbers from the identified population on a piece of paper, put them in a hat, shake it well and pull out as many as we need for our sample. The important point is that all the individuals have an equal chance of being in the sample. Today, computers with Microsoft ExcelTM programs or IBM SPSSTM do the random sampling in a very precise way. Saunders (1997) reported that random numbers allow the selection of a sample without bias.

The origin of the word ‘stratified’ comes from the Latin word ’stratum’, which means layer. Morris (1989) describes stratified sampling as a fair representation of all ‘layers’ of sub-groups within a population. For instance, within one company with part- and full-time workers we should choose a fair sample from both ‘layers’. Saunders, (1997) explained that if a stratum is represented proportionally within the sample, it is more likely that the overall sample will be representative.

Cluster sampling is similar to stratified sampling (Saunders 1997). He has proposed that cluster sampling can be considered as a complete list of clusters, rather than just a list of separate cases. As soon as the clusters are defined, random sampling techniques are applied to select a few clusters. Finally, data from the whole population within selected clusters are collected. For instance, with this technique, data can be grouped according to the type of manufacturer or geographical area.

In research conducted over a wide geographical area, multi-stage sampling is needed. With this method, described by Morris (1989), a country or a population is first divided into a small number of large areas, and two or three of these are chosen at random in the usual way. Random sampling is then used within the two or three selected areas. With the application of multi-stage random sampling, participants selected in the last stage are located geographically in a few areas and still represent the overall population. Saunders (1997) defined multi-stage cluster sampling as a further development of cluster sampling. The author proposed this method for addressing sampling problems associated with geographically dispersed populations. However, this method can be also used for groups that are not geographically based. Saunders’s (1997) recommendations for multi-stage cluster sampling mean that this could be applied in this Thesis for studying healthcare professionals’ attitudes at the national level.

A quota sample is applied when accuracy is not required in the final results. This sampling is usually applied in qualitative research, when interviewers are instructed to choose the sample. For instance, unemployed males aged between 20 and 30, or housewives aged between 18 and 35. Morris (1989) stated that this sampling method is usually confused with random sampling, meaning that although this sampling is not haphazard, it is not statistically random, and does not give everyone an equal opportunity to be selected.

The simplest non-random sample is a systematic sample, when the researcher chooses a sample by means of a defined sample frame, such as selecting every tenth person in the whole population (Morris 1989). Saunders (1997, p. 162) defined systematic sampling as: “selecting the sample at regular intervals”. Usually, a random number is chosen as a starting point for this type of sampling. Finally, Morris (1989) concluded that data obtained from such a sample definitely would not give accurate information about a population in a way that a complete census would. Final quantitative statements are needed to show how much the sample could be in error.

Denscombe (2007) proposed that non-probability sampling does not rely on statistical calculations of the sample size, but uses good judgment based on experience, taking into consideration the circumstances. This author proposed a minimum sample size that is feasible with respect to the available resources and a level of accuracy related to the need of the findings. Denscombe (2007) also proposed a comparison with other similar surveys conducted in comparable conditions. A sample size in such surveys may be used as a starting point. The researcher needs to know the sample size to attain the statistical power of a significance test. For statistical analyses involving two or more groups, the sample size is defined as the necessary number of participants for each group. If the research population is not sampled sufficiently, i.e., there is not an adequate sample size for a specific statistical test, and Type 2 (statistical) errors can occur (Cohen 1992), i.e., the sample is not large enough for the test to detect a difference, even if there is a difference in the underlying population.

Choosing an effective sampling technique, however, does not guarantee that the sample will be representative of the population. Even when a representative sample is selected, certain things can occur during the research that reduce the efficiency of the final sample (e.g., the number and proportion of the people who respond), which can affect the overall final sample size, and introduce the possibility of Type 2 errors. However, non-response bias, e.g., people within certain groups within the sample not responding, may also reduce the representativeness of the sample as well.

A sampling cumulative approach was described by Denscombe (2007), in which the researcher cannot state the sample size with certainty at the start of the investigation. In these studies, sample sizes grow during the investigation until the researcher acquires sufficient information for the project.

Researchers studying healthcare should consider all aspects in sample size estimates. It is essential that the procedure is established on a solid evidence base and clinically proven differences. If researchers employ inappropriate sampling techniques, they will misinterpret findings due to the resulting inappropriate and biased samples (Devane et al. 2004).

The recruitment of a sample that reflects the attributes of the target population is one of the most important qualities of quantitative research. Achieving representativeness in quantitative research allows for the transfer of the results of quantitative studies to the study population (generalisation), and findings from the research can be deemed applicable to the whole population (Morris 1989). Therefore, the sample for this research should be representative of the population from which it is drawn, with the aim of generalising the findings to the whole population. The response rate is the percentage of respondents that actually took part in the study, and is an important factor influencing the representativeness of a sample. Cook’s (2009) analysis on 350 studies in data collection in health services research reported that response rate among doctors was 57.5% (average).

The sampling techniques applied in this research instrument are discussed and explained in detail in Chapter 4 (Section 4.2.8) and Chapter 5 (Section 5.2.11).

## Research ethics

Research ethics issues will be discussed in this section in order to stress the importance of ethical procedures for research involving human participants and data about them (University of Sheffield 2016). Ethical issues need to be considered before developing a research strategy. The basic principles of research ethics are recognised in international treaties and national laws. Flick (2006) wrote that, recently, ethical principles have been formulated in many countries and many ethics committees founded with the aim of authorising research with human participants. The researcher should be aware that neglecting these principles may be a civil or criminal offence. The research instrument should not embarrass the research population or impose any material disadvantage (Saunders 1997). Conducting research with ethical standards means respecting the principles of honesty, integrity and openness. For example, the researcher should conduct research with integrity, honesty, cultural sensitivity, and avoid any risk to participants. The researcher has an obligation to examine the study’s ethical appropriateness (Howard 1985).

Research ethics ensure that the rights and dignity of participants is respected and that there is no harm to participants during their interaction with the research (Denscombe 2007). The main responsibility of the researcher is the safety and well-being of the participants in the research, as well as his/her owns safety and that of co-researchers and collaborators.

Israel and Hay (2006) stressed that ethical behaviour helps to protect individuals, communities, and environments within research projects. Ethical research does not mean avoiding potentially high-risk research. The researcher should recognise and prepare for risks and risk management before commencing a project. Therefore, proper research is risk aware, and seeks to manage risks appropriately, but is not risk averse.

Ethical issues are an important part of research, and an ethics review by an appropriate committee must be undertaken (Department of Health 2005). Certain ethical principles and good practice should be addressed. Monitoring research and reporting adverse effects are important aspects of this framework.

### The University of Sheffield Research Ethics Policy

The University of Sheffield Research Ethics Policy (University of Sheffield 2016) recommends that prior to any research study involving human participants, the researcher should obtain the person’s informed consent to participate in the study. Wherever possible, for interview research, the participant’s consent should be obtained in writing. However, when this is not possible, oral consent is an alternative. Preferably, for interview research, interviews should be recorded or conducted in the presence of at least one witness. For questionnaire surveys, the implicit consent of the respondents is required. Therefore, consent must be given freely and voluntarily, without any kind of pressure or coercion. The University’s approach to research ethics is clear, and demands a review of procedures involving human participants, personal data or human tissue. Research ethics approval should be obtained before data collection begins.

The University of Sheffield’s Research Ethics Policy (2016) applies to research involving human participants, personal data and human tissue. This policy is complementary to the NHS ethics review system (University of Sheffield 2016). Collecting identifiable personal information should be reduced as much as possible. The researcher should carefully plan whether it is necessary to collect identifiable personal information. However, if the use of identifiable personal information is necessary, it should be done only with consent. If the research is carried out in the UK, the researcher must comply with the requirements of the Data Protection Act (1998) or, in other countries, in accordance with their laws. The processing of personal information data should be transparent and justifiable at all times.

Participants in a research project should not be exposed to higher levels of danger than that they face in their normal life. However, if any discomfort or harm is expected during the study, the researcher should explain this during the ethics approval process and discuss it with prospective participants (University of Sheffield Research Ethics Policy 2016). All personal information must be kept secure at all times. The researcher should provide a level of security appropriate to the nature of the data. The data should not be retained for longer than necessary. The disclosure of identifiable personal information should be avoided. However, in research projects where the disclosure of personal identifiable information is necessary, this should be done only with consent of the participants.

### Informed consent of participants in research projects

The process of informed consent should provide participants with sufficiently detailed information on the study (Flick 2006). The aim of consent is for participants to make a voluntary and rational decision about whether to participate in the research. Informed consent should comprise information on the purpose of the study, expected duration, procedures of the study, right to decline or withdraw from the study, potential risk, discomfort or adverse effects, benefits of the research, and incentives. The amount of information included in informed consent varies, depending on the complexity and risk involved in the research.

The process of obtaining informed consent depends on the research setting, the methodology and the sample of participants (Israel and Hay 2006). Informed consent must be obtained from participants before their participation in the study begins. Informed consent should be documented by written consent or by oral consent from the participants. A written consent form for participants to sign and date is most widely used. However, written consent should not involve the creation of a code designating the participant’s identity. When a written consent form is collected, it has to be separated from the data collected from participants.

Explicit consent provides sufficient information about the research and ensures that future participants may decide about their possible involvement without undue pressure or coercion. All the information that is necessary for an informed decision should be normally supplied in written form. Sufficient time needs to be allowed for participants to decide whether they want to take part. Implicit consent differs from explicit consent in that it is not obtained through formal methods such as written or verbal approval: when participants in a study and complete a questionnaire, in effect they imply that they are giving their consent to participate.

### Anonymity and confidentiality in research projects

The anonymity of information collected (from participants) means that the researcher does not collect identifying information from individuals and the project cannot link individual responses to participants’ identities. Full anonymity is achieved when no one, including the researcher, knows which response came from which participant. Pseudonymity is achieved when participants name and other personal information are replaced with another identity with the aim of making the identification of the person impossible. Every researcher is interested in obtaining accurate and honest opinions from participants. Participants might be hesitant to share personal information or believe that participation could affect their daily routine or even jeopardise their job, benefits or social status. Collecting anonymous data from participants ensures that their responses are accurate. Participants should be assured that their names or identifying information and any responses they provide will not be shared publically.

Confidentiality differs from anonymity, and means that participants and the information they share cannot be identified, but their identity is protected. Under conditions of confidentiality, the researcher knows which participant said what, but they do not identify participants’ comments in order to protect participants’ identity. Therefore, confidentiality is the process of protecting an individual’s privacy.

The research ethics procedure and process for obtaining consent from the University of Sheffield Research Ethics Committee for this research are explained in detail in Chapter 5 (Section 5.2.8).

## Quality of research

This section provides an in-depth explanation of techniques for assessing the quality of the research project. The main aim of this section is to identify the appropriate tools for controlling the quality of this research. The quality of the research study may be questioned for several reasons, such as theory generation and lack of researcher independence.

Confirmability, dependability, transferability and credibility are used in qualitative studies to assess the reliability and validity of research (Seale 1999). Small qualitative studies are not generalised in the way that quantitative studies aim to do (Myers 2000). Checking for generalisability, reliability and validity are important both in qualitative and quantitative studies. The concepts of generalisability, reliability, and validity are easier to establish in quantitative research than in qualitative research (Riege 2003). External validity or generalisability, internal validity, external reliability, and internal reliability are addressed in quantitative studies.

### Generalisability

Generalisability is the degree to which the results of a study based on a specific sample can be said to represent results that would be obtained from the whole population from which a sample is taken. If the theory is too narrow and idiosyncratic, the findings cannot be generalised (Eisenhardt 1989). According to Morris (1989), the selection of an appropriate sample and comparison of the study population with the sample are also important, and applied correctly, they permit the transfer of quantitative study results to the study population, as described above in the sampling (Section 3.5) and descriptive statistics (Section 4.2.11). The results obtained from a representative sample also apply to the whole population, i.e., the findings may be generalised (Altman and Bland 1998). If the sample studied is representative, then the findings may be generalised to the whole population (Patten 2007).

### Internal consistency reliability

Internal consistency reliability refers to the consistency of a research study or measuring instrument. Therefore, the internal consistency reliability in quantitative studies is associated with the characteristics of the research instrument and consistency of measurement (Oppenheim 1992). If research findings are replicated consistently, they can be considered reliable. Internal consistency reliability can be assessed with a correlation coefficient. A high positive correlation proves that the test is reliable, meaning that all constructs measure what they should in the expected direction. Reliability can be internal and external. Internal reliability measures the consistency of results across items within a scale; external reliability assesses the extent to which a measure varies from one use to another.

Internal consistency reliability can be calculated from pairwise correlations between items and is expressed through Cronbach’s alpha (*α*) coefficient (Fink 1995; Straub et al. 2004). Internal consistency reliability ranges between infinite negative values and one. Cronbach’s α is negative whenever there is greater within-subject variability. However, in statistics the most widely used range is from 0 to 1 (Tavakol and Dannick 2011).

Tests which measure narrow constructs have necessarily higher Cronbach’s α, and vice versa, lower values when more broad constructs are measured. However, very high Cronbach’s α values (.95 or higher) indicate that some measuring items may be redundant (Tavakol and Dannick 2011). Internal consistency reliability is an effective instrument for measuring if similar items are related (i.e., they are internally consistent), but also contribute unique information.

Internal consistency reliability in this Thesis can be expressed as the consistency of the questionnaire as a research instrument, based on the correlations between different items within the questionnaire. The internal consistency required for an effective instrument measures whether items are related (internally consistent) and also contribute to unique information. Therefore, the reliability test assesses whether the proposed items measure the same general construct and produce similar scores. This can be calculated with pairwise correlations between items and can be expressed through Cronbach’s alpha (*α*) coefficient (Fink 1995).

### Validity

Validity permits the researcher to assess whether the developed measuring instrument measures what it claims to measure. Validity should identify the appropriate research instrument, and ensures that the proposed method measures the identified constructs. It is also ensures that the final results of the study will be applicable to real- world settings. This tool should confirm that the research instrument is measuring what it was designed to measure and not something else (Kramer et al. 2009). In quantitative research, validity can be addressed through content validity, face validity, criterion validity, and construct validity.

Content validity is a non-statistical type of validity assessment. It is a systematic exploration of the tested content to determine whether it is a representative item of the targeted behaviour which will be measured. Content validity can be achieved through an in-depth literature review and the creation of a research instrument that measures items appropriately (Carmines and Zeler 1994). A measurement instrument will achieve content validity only with a careful selection of the items included in the study. Content validity may also be assessed through the knowledge of experts familiar with the measured constructs. Their feedback on proposed items will ensure the effectiveness of each question.

Face validity describes the degree to which an assessment item measures what it appears to measure. It reveals how the measurement instrument is subjectively viewed, and whether it covers the concept it is intended to measure. Face validity is associated with the language, question format and structure of the questionnaire (Fink 1995). It also refers to the relevance and transparency of the measurement instrument among participants. Face validity is a subjective measurement, explaining the extent to which selected items appear to be reasonable. It can be achieved by examination of the proposed items by experts.

The criterion validity measure calibrates the research instrument against known standards or against itself. It compares findings with similar outcomes in other related, well-established research (Carmines and Zeler 1994). Comparing the measurement instrument with an established measure and outcome at the same time is known as concurrent validity. On the other hand, comparing the measured instrument or an outcome at a later time is known as predictive validity.

Construct validity assesses the degree to which the measured instrument measures what it claims to measure. It reflects how operational items actually reflect the true theoretical meaning. Construct validity is measured through the extent a particular measure is associated with other measures consistent with theory (Carmines and Zeler 1994). However, a single study may not assess construct validity, rather it is a process of evaluation, refinement, and development. Proper construct validity may be achieved through the accumulation of correlations from numerous studies using the evaluated research instrument (Peter 1981). Researchers may test the construct validity before the main research by conducting a pilot study. This is small-scale preliminary study which can establish the strength of the research instrument. Necessary changes and adjustments can be made based on the feedback from the pilot study. The data collected for this research were tested with respect to reliability and validity. These analyses are explained in detail in Chapters 4 and 5.

## The research in this Thesis

Two empirical studies on healthcare professionals were conducted for this research in this Thesis: The study of hospital healthcare professionals and the study of General Practitioners.

### The study of hospital healthcare professionals

A modified version of the TAM2 was used for the first time among healthcare professionals in SEE in the Republic of Macedonia. The aim of this study was to assess the general effectiveness of technology acceptance in SEE healthcare settings. This part of the research, given the name of hospital healthcare professionals, was conducted to assess the general attitudes of Macedonian hospital healthcare professionals to e-Health. It involved healthcare professionals, in relation to the system that was proposed at the time in three hospitals in the Republic of Macedonia. The research design, methodology and findings of the study are described in detail in Chapter 4.

### The study of General Practitioners

Following the study of hospital healthcare professionals, which provided useful insights about the acceptance and intentions to use e-Health systems among healthcare professionals in the Republic of Macedonia, a second study was undertaken. The study of hospital healthcare professionals was intended to assess the effectiveness of the technology acceptance model generally, and has served as a basis for using a more advanced research instrument to examine acceptance and intentions to use health IT among General Practitioners. The aim of the second study, a study of General Practitioners was to assess the preparedness of these healthcare professionals for future EHR implementation at a national level in the Republic of Macedonia. A modified version of the UTAUT, as the most up-to-date technology acceptance model, was applied in the study. It was conducted at a national level, as GPs will be the first healthcare professionals to use the future EHR system (Section 1.4.2). Chapter 5 explains in detail the research design, methodology and findings of the study of General Practitioners.

## Conclusions

The aim of this chapter was to establish the appropriate research instrument for the Thesis. This chapter has presented an in-depth review of the two main research paradigms, such as positivism and interpretivism, to provide an understanding of the research instrument used in this Thesis. A number of research approaches were presented, such as qualitative, quantitative and mixed methods, with their advantages and disadvantages. Methods for data collection and data analyses were discussed in detail.

The previous Chapter 2, the literature review, identified the lack of knowledge in the field of technology acceptance among healthcare professionals in SEE as a major research challenge of this study. A positivist quantitative research approach with a structured questionnaire was deemed the most appropriate tool for assessing users’ behaviour in the country. Research questions were discussed and posed (Section 3.2.2). Two quantitative studies were identified as research instruments to meet the aims and objectives of this Thesis, outlined in Section 1.6.

The study of hospital healthcare professionals was envisaged to generally assess hospital healthcare professionals' attitudes to e-Health. However, these findings cannot be generalised to the wider population in the country. Research approaches from the study of hospital healthcare professionals will be used as the basis for creating a more advanced research instrument. This will be tested on GPs in the country, and the findings from the second study may be generalised to the wider population.

The next chapter, Chapter 4, presents the study of hospital healthcare professionals. It is the first part of the research project that generally assesses Macedonian healthcare professionals’ attitudes to new ICT in healthcare.

# The study of hospital healthcare professionals

## Introduction

The in-depth literature review in Chapter 2 showed that there was no previous research on technology acceptance in healthcare settings in the developing countries of SEE. In order to facilitate the transition to digitalised healthcare services and encourage the use of innovations in healthcare in these countries, it is important to empirically assess healthcare professionals’ attitudes to future e-Health system.

The latest developments in technology acceptance in healthcare were investigated in order to create a research instrument to study hospital healthcare professionals’ intentions. The findings from the literature review (Sections 2.6) dealing with technology acceptance and e-Health system will be tested in this study. These findings suggested that there is a need for a contextualised technology acceptance approach in healthcare settings (Walter and Lopez 2008; Holden and Karsh 2010; Romano and Stafford 2011).

The study described in this chapter was conducted to generally assess the acceptance of ICT which would be implemented in the future in healthcare in the country. Preparedness for the future implementation of e-Health system was explored. Finally, after the data analyses and results discussion, a set of specific measures for further and improved research were proposed. Section 4.2 presents the methods used in this study. A data analyses and results are presented in Section 4.3. Section 4.4 initiates discussion of the major findings of the study (the whole research and assessment of the hypotheses are discussed in detail in the Discussion Chapter 6). Section 4.5 concludes this chapter. However, this study has some limitations which are presented in Sections 4.4.1 and 6.3.

## Methods

The literature review in Chapter 2 assessed the latest developments in the fields of technology acceptance and health informatics. A gap in knowledge in the field of technology acceptance of new ICTs in healthcare settings was identified (Section 2.6.3). For this reason, there is a need for an initial general assessment of technology acceptance models in healthcare settings in SEE. The Methodology Chapter (Chapter 3) discusses two major different approaches in the research literature, positivist and interpretivist. The next section summarises which of the two proposed approaches was best suited to studying technology acceptance in healthcare settings for the study, and describes the design of the initial research instrument.

### Design of the research instrument

The findings from previous research on technology acceptance discussed in the literature review (Chapter 2) were assessed in this study. As discussed in the synthesis of the literature review (Section 2.6), there is a need for a contextualised technology acceptance approach in healthcare settings (Walter and Lopez 2008; Holden 2010; Romano and Stafford 2011). Further, Amatayakul (2005) recommended assessing ICT acceptance by healthcare professionals prior to implementation. A positivist quantitative study through a questionnaire survey (Section 3.4) was identified as the most appropriate method for this study. Almost all of the relevant studies identified in Table 2.4 used a quantitative approach and data were collected using questionnaires.

The implementation of the e-Health system in the country was mandatory, but it is expected to be difficult to enforce its use by hospital healthcare professionals. It is important to study and understand the factors that may affect people’s willingness to use new technology, even if the systems are implemented as mandatory. This is especially the case when it was not possible to measure the actual use (because it had not yet been implemented). The present study used a conceptual and methodological framework based on the recommendations of Mun et al. (2006) and Holden and Karsh (2010) for technology acceptance use in healthcare settings. An integrative technology acceptance model was used as a basis for assessing technology acceptance-related variables. Specifically, the technology acceptance model of the present study included Venkatesh and Davis’s (2000) TAM2 variables such as perceived usefulness, perceived ease of use, job relevance, and subjective norm, which were empirically tested on healthcare professionals in the country.

Additional technology acceptance variables were also included in the research model for this study. The computer anxiety construct, proposed by Venkatesh and Balla (2008) from TAM3, was also included in the study. Taking into consideration Venkatesh and Davis (2000) and Mun et al.’s (2006) approach to the importance of social influences in technology acceptance, measures of social norms were expanded with the result to include the concept of descriptive norm (Rivis and Sheeran 2003). The authors reported that descriptive norm reflects the perceived prevalence of behaviour in other people. Descriptive norm in healthcare settings can be regarded as a measure of the potential use of health ICTs by colleagues. These additionally added variables were included with the aim to capture possible differences between the targeted population and previous research described in the literature. It was planned that these changes would represent the modified TAM2 (i.e., a more country-oriented) model.

However, there are other technology acceptance models such as: task-technology fit, and user-centred methods (Hyun et al. 2009); diffusion of innovation theories (Morton and Wiendenbeck 2009); Delone and Mclean model, USE-IT, and 4E model (Spil et al. 2010) that were presented in the literature review (Section 2.6.2). In order to focus the study on one particular model, these models were not applied in this Thesis. This limitation is discussed in Section 6.3.1.

### Aims and objectives

The aim of this study was to assess the intentions of hospital healthcare professionals in the Republic of Macedonia to use a prospective e-Health system. More specifically, the study assessed the preparedness of healthcare professionals in the Republic of Macedonia for the future implementation of e-Health system.

The objectives of this study were as follows:

to assess readiness for e-Health system use in the country;

to identify variables associated with intentions to use the e-Health system, and to identify possible cultural differences;

to contribute to new knowledge about technology acceptance in healthcare settings in SEE;

to propose specific measures for the faster and more efficient implementation of e-Health system in Republic of Macedonia for healthcare management and government officials; and

lessons learned from this study of hospital healthcare professionals to serve as a cornerstone for the subsequent development of a more precise research instrument for the second study of this Thesis.

### Development of research hypotheses

The gaps in the research knowledge identified in the literature review in the field of technology acceptance on e-Health in SEE needed to be addressed through an empirical study. In line with Bowling’s (1997), Saunders’ (1997), and Preacher et al.’s (2006) recommendations discussed in the Methodology (Chapter 3), two hypotheses were developed to answer the research questions. Walter and Lopez (2008) and Holden and Karsh (2010) stressed the need for a conceptualised model of technology acceptance in healthcare, because this setting is different from the original one, in which TAM and TAM2 were developed and used. Therefore, the following hypotheses were developed regarding the findings discussed in Section 2.6:

**H1:** Perceived usefulness and perceived ease of use will significantly predict healthcare professionals’ intentions to use the e-Health system (Hypothesis derived from the TAM2 and the literature review) (Venkatesh and Davis 2000; Hyun et al. 2009; Morton and Wiedenbeck 2009; Wilkins 2009; Devane et al. 2010).

**H2:** Subjective norm, descriptive norm, job relevance, and computer anxiety will predict healthcare professionals’ intentions to use the e-Health system indirectly, through the effects of perceived usefulness (Hypothesis derived from the TAM2 and the literature review) (Venkatesh and Davis 2000; Rivis and Sheeran 2003; Venkatesh and Balla 2008).

### Development of the questionnaire

The questionnaire for the study was created on the basis of findings from the literature review in Chapter 2. Items that were thought to be potential predictors of behaviour were included in the final version of the study questionnaire. A traditional ‘paper and pencil survey’ was used, as data obtained in this way may be accurately analysed and easily compared. The questionnaire survey is an inexpensive procedure and may cover a wider area of the country.

A structured questionnaire in English for the study was initially developed using Microsoft Word™. The translation back-translation method (Hambleton 2001) was used to translate the research instrument into the Macedonian language. This was achieved as the questionnaire previously translated into Macedonian was translated back into the original language by an independent translator. At the beginning of the questionnaire, a brief description of e-Health was used to provide some context for the questions:

“Generally, by e-Health we mean the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of healthcare information, data, and knowledge for communication and decision-making.”

### Questionnaire design, technology acceptance in healthcare

General demographic questions such as age, gender, clinic (place of employment), and occupation in the health sector were assessed in the first part of the questionnaire. These data were obtained in order to be able to describe the sample, and to explore possible differences between different groups of healthcare professionals in the Republic of Macedonia.

The main outcome variable from the TAM2 model (Venkatesh and Davis 2000), i.e., intention to use the future e-Health system, was used in the study to determine the participants’ acceptance of technology and their readiness to accept the new technologies in healthcare. The e-Health systems are complex structures not just simple computer applications (Section 2.4) and there is a need to assess the end users’ intentions towards these systems. As proposed in H1 Hypothesis, the participants’ intentions in the study were supposed to be predicted mainly by the two TAM2 core constructs, i.e., perceived usefulness and perceived ease of use. These two variables have been consistently found to be strong predictors of intentions to use ICT across studies assessed in the literature review (Chapter 2) (Hyun et al. 2009; Morton and Wiedenbeck 2009; Wilkins 2009; Devane et al. 2010). Perceived usefulness denotes participants’ expected utility of the e-Health system (i.e., the extent to which their performance will be improved by using the technology in question). The perceived ease of use construct assessed the degree to which participants in the study believed that the e-Health system would be effortless. Therefore, perceived usefulness and perceived ease of use were expected to measure participants’ attitudes to using the new e-Health technology (i.e., how favourably or unfavourably participants evaluate the new e-Health technology). Venkatesh and Davis (2000) noted that a better knowledge on perceived usefulness may serve as a basis for prospective managerial policies. The authors concluded that the perceived ease of use has a less significant influence on the end users’ intentions. However, they also proposed that if the system is easier to use, people will use it more and job performance will improve.

The subjective norm construct from the original TAM2 was included with the aim of capturing the importance of social influences on Macedonian healthcare professionals. As an indicator of social influences, this variable assesses the opinions of important others in healthcare settings. More specifically, it measures the participants’ perceived acceptance of the new e-Health technology by others and how it can be related to the individual’s use of technology (Venkatesh and Davis 2000; Mun et al. 2006; Venkatesh and Balla 2008). This variable has measured the extent to which colleagues will accept and use new e-Health technology and how it can be related to individuals’ intentions. A meta-analysis by Schepers and Weltzes (2007) revealed that the subjective norm exerts a strong influence on TAM2 variables and intentions to use the new technology. Job relevance, as the original TAM2 construct, was included in the study to assess participants’ perception of the degree to which the e-Health system would be applicable and pertinent to their daily routine (Venkatesh and Davis 2000). The following variables from the original TAM2 were included in the questionnaire:

* perceived usefulness was measured with the mean of four items reflecting several aspects of usefulness when using e-Health system. This construct was derived from Venkatesh and Davis’ (2000) original TAM2; Venkatesh and Balla’s (2008); Hyun et al.’s (2009); Morton and Wiedenbeck’s (2009); and Wilkins’ (2009) studies. Higher respondent scores denote healthcare professionals’ higher perceived usefulness of e-Health system;
* perceived ease of use was assessed as the mean score of seven items derived from Venkatesh and Davis’ (2000) original TAM2; Mun et al. (2006); Venkatesh and Balla’s (2008); Hyun et al.’s (2009; Morton and Wiedenbeck’s (2009); and Wilkins’ (2009) studies. The perceived ease of use measure was developed as technology-specific ease of use and general beliefs about self-efficacy in using e-Health applications. Higher mean scores reflected a higher perceived ease of use of e-Health system;
* usage intentions were measured with the mean of three items derived from Venkatesh and Davis’ (2000) original TAM2; Mun et al.’s (2006); and Venkatesh and Balla’s (2008) work. This measure reflected the behavioural tendency and willingness to use e-Health applications; higher scores reflected stronger intentions to use health ICT. This variable was used as a dependent variable with the aim to test the possible effect of other technology acceptance variables on intentions to use the e-Health system. However, the updated literature review in Section 2.7 indicated that, even after the completion of the research in this Thesis, the intention variable was still playing the most important role in the technology acceptance assessment research;
* computer anxiety was assessed through four items derived from Venkatesh and Balla’s (2008) original TAM3 that measure different feelings of anxiety and nervousness associated with computer use in medical practice. Higher scores denote greater anxiety about working with computers;
* job relevance of e-Health system to the job routine was assessed through two items derived from Venkatesh and Davis’ (2000) original TAM2. Participants choosing higher scores perceived that e-Health had a greater job relevance to their job tasks;
* subjective norm was measured with two items firstly used by Venkatesh and Davis’ (2000) original TAM2; Mun et al.’s (2006); and Venkatesh and Balla’s (2008) studies. This measurement was associated with the perceived acceptability and endorsement of e-Health system by participants’ colleagues and important others, as described in the original TAM2. Higher scores denoted a participant’s greater perceived social approval and endorsement of e-Health system;
* descriptive norm was measured through one item derived from Rivis and Sheeran’s (2003) study. Participants were asked to estimate on a 5-point scale (1=none of them, 5=all of them) how many of their colleagues would use e-Health system if it was implemented. Higher scores reflected greater perceived potential use of e-Health system by colleagues, if it was implemented; and
* computer use measurement was assessed through three items based on Teo et al.’s (2008); Devane et al.’s (2010); and Morton and Wiedenback’s (2010) studies. In the first item, participants were asked to answer yes or no to whether they had access to a PC at home or work. Another two open-ended questions asked participants to report the average number of years and amount of time per day they used a PC.

Descriptive norm, computer use, and computer use are new technology acceptance variables that were added to the basic TAM2. However, variables such as image, output quality, and result demonstrability from the original TAM2 model were not assessed in this study; this was to avoid making the questionnaire too complex and long and to be able to analyse relationships between the measured constructs and included variables (Eisenhardt 1989). Experience and voluntariness of use moderators were not assessed as well because the current and future use of e-Health system in the Republic of Macedonia will be mandatory. These changes to the original TAM2 represent a modified research model for this study and enabled the appropriate complexity of the research instrument. Tables 4.1 and 4.2 present the questions used in this study.

Table 4.1: Technology acceptance constructs used in the questionnaire

|  |  |
| --- | --- |
| **Construct (model)** | **Question** |
| Perceived usefulness (TAM2) | 1. Using e-Health system at work would improve my job performance |
| 1. Using e-Health system at work will improve my job productivity |
| 1. Using e-Health system at work would enhance my effectiveness |
| 1. Overall, I would find e-Health system useful for my work |
| Perceived ease of use (TAM2) | 1. I would find e-Health system easy to use |
| 1. Interacting with e-Health system would be easy and understandable |
| 1. I would find it easy to get e-Health system to do what I it to do |
| 1. Interacting with e-Health system would not require a lot of mental effort |
| 1. I will able to use e-Health system effectively |
| 1. Using e-Health system will be an easy task for me |
| 1. I will easily work with e-Health system |
| Subjective norm (TAM2) | 1. In general, e-Health system will be well approved and supported by most of my colleagues |
| 1. The colleagues that I respect most would accept the e-Health system |
| Intention (TAM2) | 1. I plan to use e-Health system if it is implemented |
| 1. I expect to use e-Health system if it is implemented |
| 1. I intend to use e-Health system if it is implemented |
| Job relevance (TAM2) | 1. In my job, the use of e-Health system would be important |
| 1. In my job, the use of e-Health system would be relevant |
| Computer anxiety (TAM3) | 1. Computers make me feel uncomfortable |
| 1. Working with a computer makes me nervous |
| 1. Computers do not scare me at all |
| 1. Computers make me feel uneasy |

Note: Items were assessed on a 7-point Likert scale (strongly disagree to strongly agree).

Table 4.2: Other technology acceptance constructs used in the questionnaire

|  |  |  |
| --- | --- | --- |
| **Construct** | **Question** | **Assessment scale** |
| Descriptive norm | How many of your colleagues do you think will use e-Health system if it is implemented? | **5-point predefined answering option:**  1-none of them,  2-few of them,  3-some of them,  4-most of them,  5-all of them |
| Computer use | Do you have access to a personal computer at work or home? | Yes/No |
| Computer use  (years) | On average, how long have you been using computers? | Years (Please fill in) |
| Computer use  (hours) | On average, how many hours a day do you use a computer? | Hours (please fill in) |

This research aimed to assess attitudes of healthcare professionals and to identify the main predictors of intentions. This can be achieved with predefined questions with a precise measuring scale. The option of adding open-ended components (e.g. a ‘further comments’ text box) was considered for this study’s measuring instrument. However, open-ended questions were not included in the measuring instrument, so that the instrument was not too long for participants and focused on the most important aspects. It was also important to achieve an appropriate level of complexity for the study, and to maintain precise measuring instrument that would identify exact predictors of intentions among healthcare professionals. However, not having open-ended questions did limit the scope of answers provided by respondents, and this limitation is discussed in Section 6.3.1.

Importantly, since the conclusion of this study, a systematic review study conducted by Garavand et al. (2016) has identified that TAM is the most important model used to identify the factors influencing the adoption of information technologies in healthcare. This finding supports the idea of using the TAM2 in this research. An original, final English version of the questionnaire is included in Appendix A2.

### Questionnaire measurement, the Likert scale

Thurstone, Gutman, and Likert attitude scales were considered for the research instrument of the study, following Openheim’s (1992) and Bowling’s (2002) recommendations. The 7-point Likert scale was proposed for the assessment of TAM2 and TAM3 constructs, because it was identified in the methodology (Chapter 3) and literature review (Chapter 2) as the most commonly used method of attitude scaling (Oppenheim 1992; Bowling 2002). May (1997) recommended using an attitude scale for assessing participants’ attitudes to a specified subject.

Participants were asked to give their answers on attitudes to e-Health system in healthcare settings and their intentions to use those systems in future. Response options were coded on a 7-point Likert scale (1=strongly disagree, 2=moderately disagree, 3=somewhat disagree, 4=neutral, 5=somewhat agree, 6=moderately agree, and 7=strongly agree), unless otherwise stated.

Demographic questions were assessed through predefined answering options measuring gender, occupational group, and age (in years). The descriptive norm item was assessed through 5-point predefined answering options (from 1=none of them, to 5=all of them). Participants were asked to fill in numbers (number of years of computer use, number of hours of computer use per day) assessing the items measuring computer use. The item measuring personal computer for home use was assessed using the predefined Yes/No option.

### Research ethics

Because the study was carried out in hospitals, research ethics approval was obtained from the hospitals concerned, rather than from the University of Sheffield, in accordance with the University’s research ethics policy. The researcher ensured that the rights and dignity of participants were respected, and there was no harm to participants during their interaction with the research, according to Denscombe’s (2007) recommendations, and in accordance with the University of Sheffield research ethics policy (University of Sheffield 2016). The research instrument for the study was developed in such a way that it would not embarrass the targeted population or impose any material disadvantage (Saunders 1997) on respondents. During the collection of data, the participants were not exposed to greater danger than they face in their normal life (University of Sheffield Research Ethics Policy 2016). The researcher monitored the research throughout the survey.

The questionnaire was developed so as to avoid the collection of any personal identifiable data from participants. The anonymity of hospital healthcare professionals was ensured, as no one, including the researcher, knew which response came from which participant. This measure was included in the study ethics policy also in order to obtain accurate and honest opinions from the respondents. From a methodological point of view, the researcher was also aware that if the participants were identified, they might be hesitant to share personal information or beliefs, which could affect the outcome of the study. Participants were informed that they could take part in the study voluntarily and anonymously and that they could withdraw from the survey at any time. Confidentiality in the study of hospital healthcare professionals was maintained, as the participants could not be identified.

The research instrument was first presented to the management of the sampled healthcare institutions, and they were asked to discuss and approve the questionnaire through their internal ethical committee (as applicable). There was a limitation in the ethics approval procedures within the hospitals in the study. The management in these hospitals were not familiar with the research ethics approval processes and while verbal approval for the study was given, no written ethics approval forms were available from the sampled hospitals to be included in the study.

The data were kept securely on the researcher’s personal PC, which was protected by a restricted access password. The participants were informed that the data would not be retained for longer than was necessary.

### Population and sampling

Identifying the appropriate population was necessary to achieve the objectives of the study. Howard (1995) indicated that a proper sample should have a good representation of the population that is being studied. A good sample reflects the characteristics of the targeted population.

For the purpose of the study, a two-stage cluster sampling method was applied. Healthcare institutions were sampled in stage one, and healthcare professionals were sampled in stage two. In the first stage, the clusters, which comprised clinics and hospitals, were randomly chosen from a pool of all clinics and hospitals located in Skopje, the capital of the Republic of Macedonia. The list of institutions was provided by the national Health Insurance Fund’s list of healthcare institutions in the country that actually deliver healthcare services. This population was identified as a group that will be using e-Health system in the future. Three hospitals in Skopje were randomly chosen from the provided pool of hospitals. The following hospitals were randomly selected through IBM SPSSTM: Geriatric Hospital, Paediatric Hospital, and City Surgery Hospital. However, hospitals in the capital are almost certainly not representative of all hospitals in the country as a whole. This is a limitation discussed in Sections 4.4.1 and 6.3.1.

In the second stage, the cluster comprised health professionals and staff employed in the selected hospitals. The three randomly-selected hospitals had the following numbers of healthcare professionals employed at the time of the survey: the Geriatric Hospital (employees=251, female=202, male=49), Paediatric Hospital (employees=205, female=178, male=27), and City Surgery Hospital (employees=367, female=248, male=119).

Based on sample size calculations for the proposed multiple linear regression (for α=.05, and β=.80; and a medium effect size), it was estimated that 107 respondents would be required to complete the questionnaire (Cohen 1992). Assuming an approximate 50% response rate, it was decided that 200 questionnaires would be sent out. Overall, 200 questionnaires were administered to healthcare professionals (nurses and doctors) by the management in the three hospitals with the aim of providing substantial data for future analyses. Therefore, the sample of doctors was comprised of surgeons (City Surgery Hospital), paediatricians (Paediatric Hospital), and geriatricians (Geriatric Hospital). These employees were invited to participate in the study voluntarily and anonymously. However, the second stage of the sampling procedure had limitations (including the total number of 200 questionnaires distributed), which are discussed in Sections 4.4.1 and 6.3.1.

### Questionnaire construct validity, the pilot study

Carmines and Zeler (1994) proposed assessing the research instrument’s construct validity through a pilot study prior to the main research. Therefore, a pilot version of the questionnaire was distributed to a small sample of five doctors and medical nurses to assess the understanding of items, completion instructions, and comprehensiveness of language. This sample for the pilot survey was randomly selected from the national Health Insurance Fund’s mailing list. The participants in the pilot study were informed that their contact details had been provided through a random selection procedure from this list. The participants were asked to report to the researcher through evaluation questionnaire whether the questions included in the research instrument were comprehensive, understandable and relevant to the study’s scope. They were also informed that this was scientific research. An email containing the above explanation, the attachment with the proposed questionnaire in a Microsoft Word™ version and evaluation questionnaire was sent to the pilot study participants’ contact addresses. The pilot study was conducted from 28th of March to 1st of April 2011. The proposed version of the questionnaire for the pilot study, the invitation email and evaluation questionnaire are included in Appendix A1 of the Thesis.

All respondents responded through email that all the items in the questionnaire measured what was intended. They also reported that the questionnaire was comprehensive and understandable. However, some participants in the pilot study commented that several of the questions seemed to measure the same, or similar, constructs. This issue was addressed with the following statement included in the introduction to the questionnaire: “Note: Even if some questions appear to be irrelevant or very similar to each other, please complete them as appropriate.” One of the characteristics of the technology acceptance model is that the measuring items are often very similar. Although the final answers of the anonymous questionnaire are at the respondents’ discretion, the “Note” added to the questionnaire was intended to explain to the respondents the similarity of the measuring items, and make things easier for them. Finally, as there were minor changes in the research instrument of this study, the responses of the pilot study were not included in the research dataset for the analyses.

### Study procedure

Finally, the printed version of the questionnaire was provided in sealed envelopes. These envelopes were distributed through the management to participants of the three randomly chosen hospitals. The questionnaire was distributed on the 11th of April 2011. No time limits were imposed for the completion of the study, and it was estimated that each participant would spend approximately about seven minutes completing the questionnaire. Respondents were asked to return the completed questionnaires in the sealed envelopes provided for the purpose. The participants’ completed questionnaires that were received until 29th of April 2011 in sealed envelopes were collected from the management of the three selected hospitals.

### Quantitative data analyses

This section explores different data analysis techniques that were used for analyses of data gathered in this study. However, those analyses were used as well in the next study of General Practitioners (Chapter 5). The development of IT in the last few decades has made computer software the leading statistical tool for data analyses. Data analysis software, the Statistical Package for the Social SciencesTM (SPSSTM), was released in 1968, and at first it was used mainly by social science researchers. As the company was acquired by IBMTM in 2009, the newer versions are officially named IBM SPSS StatisticsTM or Predictive Analytics SoftwareTM (PASWTM). The basic IBM SPSSTM software can be used to perform many analyses, such as descriptive statistics, t-test, ANOVA, correlations, hierarchical linear regression, stepwise linear regression, etc. However, IBM SPSSTM Amos software can be used for structural equation modelling analyses.

Quantitative data represents quantity, amounts or range. It takes the form of numerical data. Discrete data are those that can be categorised into a classification (i.e. ordinal or normal). Data expressed within a given range constitute a continuous range, which allows for the greatest precision. Interval data are continuous in a logical order, with standardised differences between values, has a natural zero but not an absolute zero. Ratio data are continuous, ordered, have standardised differences between values, and a natural zero (height, length, weight, age, etc.). However, the accuracy of measurement can influence the type of analysis the researcher can use.

**Descriptive statistics**

Descriptive statistics may be used to describe the characteristics and distribution of data that have been collected, such as the sample characteristics, demographic variables, and the variables of interest. Descriptive statistics summarise data, and can describe frequencies and distribution (Prem 1995). Comparing the sample with the study population through descriptive statistics is also important, and, if applied correctly, permits the transfer of quantitative study results to the study population (Morris 1989).

A normally distributed data has a bell-shaped distribution. The data that follow a normal distribution tend to gather around the mean value. However, data that are normally distributed are also symmetrical around the centre. Skewness as a measure of symmetry measures the symmetric distribution of data set, i.e., if the data look the same to the left and right of the centre point. Normally distributed data display zero skewness, and any symmetric data should have skewness near zero. Data skewed to the left are termed negative skewed, while data skewed to the right are positive skewed. For example, left-skewed data means that the left tail is long relative to the right tail, and vice versa.

Kurtosis measures whether data are heavy-tailed or light-tailed relative to a normal distribution. High kurtosis means that data tend to have heavy tails (outliers), and vice versa, low kurtosis data tend to have light tails (lack of outliers). Therefore, a uniform distribution of data is an extreme case.

Quantitative data derived from a population in which the data are normally distributed can be analysed by means of parametric tests. When the data are not normally distributed, then non-parametric tests should be used. A parametric test relies on a fixed parameter set, and assumes more about the given population than non-parametric tests. When these assumptions are valid, parametric tests will provide more information than non-parametric tests (Corder and Foreman 2011).

Categorical quantitative data (e.g., hair colour) are sometimes called qualitative, and can be analysed quantitatively, which is different from qualitative interview/open-ended question data, which are analysed using for example, thematic analysis (Morris 1989).

Descriptive statistics do not allow the researcher to reach conclusions regarding hypotheses, and cannot be extended to larger populations. Statistical methods that test hypotheses from which inferences can be made are so-called inferential or inductive statistics.

**Inferential statistics**

Inferential statistics can test the research hypothesis and make predictions or inferences about the sample. If the sample studied is representative, then the findings may be generalised to the whole population (Patten 2007). However, there are other computational techniques, e.g., data mining that are indicated in the literature, but will not be used in this research.

Researchers studying health and medicine are often interested in finding out whether the data from a determined sample differ from another data sample, or whether there are differences between different groups within the sample. Parametric tests make assumptions about the distribution of data described by particular parameters, usually the mean and standard deviation (Altman 1991). Non-parametric tests make no assumptions about the probability distributions of the variables being assessed, and tend to analyse median values and the ranked order of values. They are less powerful, i.e., less likely to detect a difference in the underlying population, than parametric tests.

Inferential statistics tests calculate a value for specific statistical tests, and from this tests a probability, or *p* value, is estimated. The *p* value confirms whether or not there is a real difference, or in statistical terms a significant difference, between the tested values. The significance level (cut-off value) of *p* is generally set at less than, or equal to .05. The smaller the *p* value, or probability, the larger the significance, meaning that small *p* values confirm the probability that the difference happened by chance is very small. Therefore, there is a (statistically) significant difference, for example, between the mean values being tested.

***t*-test**

The *t*-test is one of the most commonly applied analyses when the data follow a normal distribution. This test can determine whether the mean values of two sets of data are significantly different from each other, or whether the mean value of a variable for a sample is significantly different from a specific value. When data variables are not normally distributed in both groups, or variances are not the same, the non-parametric equivalent of the *t-*test, known as the **Mann-Whitney test**, should be used as an alternative.

**ANOVA**

Analysis of variance (ANOVA) is a useful test for comparing differences in the mean values in three or more groups or data sets for statistical significance.ANOVAis used as a statistical model to analyse the differences among group means and their associated procedures, such as variations among and between groups, and shows whether or not the means of several groups are equal. ANOVA is a means of hypothesis testing across three or more groups, and can explain whether the variation across the groups is due to real variations among them, or if this is explained by variation in the whole data set. Therefore, ANOVA extends the *t*-test to more than two groups. ANOVA is a parametric test and can be performed if the data in each group are normally distributed, and if the standard deviation in the groups is the same. A non-parametric equivalent of the ANOVA is the **Kruskal-Wallis test**, which can be considered as an extension of the Mann-Whitney test.

**Kolmogorov-Smirnov**

The Kolmogorov-Smirnov test analyses whether a set of observations arise from the same completely specified continuous distribution (Lilliefors 1967). A modified Kolmogorov-Smirnov test can be used as a goodness of fit test to analyse normality of distribution. In this case, samples are standardised and compared with a standard normal distribution.

**Correlations**

In statistical analyses, a correlation expresses the strength of linkage (co-occurrence) between two variables in a single value, test statistic or correlation coefficient, between -1 and +1. This analysis measures the degree of association or correlation between continuous variables. The expressed value that measures the strength of linkage is called the correlation coefficient and is represented by the letter *r*. The **Pearson product moment correlation coefficient** is one of the most commonly used coefficients, and shows the linkage between two continuous variables. If *r* values are positive, then there is a positive relationship between the two variables (i.e. higher values of x are associated with higher values of y). A negative *r* value indicates a negative relationship (higher values of x are correlated with lower values of y). When a correlation coefficient is zero, there is no relationship between the variables.

For the Pearson correlation, at least one variable should be normally distributed. However, if neither variable is normally distributed, the use of the **Spearman rank order correlation coefficient** should be considered (Blank 1995). The Spearman rank order coefficient, referred to as *rs*, is a non-parametric test that determines the level of association between two variables. One of the limitations of the Spearman Rank order correlation coefficient is that it measures the correlation between the ranked scores and cannot indicate the strength of the correlation between the variables.

Correlation analyses can explain the degree of association between two variables, but cannot explain the relationship between them, or how the researcher can use one to predict the other. According to Goodwin (1998), a major strength of correlation research is that predictions about human behaviour can be made when strong correlations exist. Relationships between two variables can be investigated by taking a bi-variate approach, but relationships between more than two variables can be examined using a multivariate approach (Goodwin 1998), e.g., multiple linear regression. Correlation analyses can be extended to making predictions by using this type of regression analysis.

**Regression analyses**

Regression analysis helps the researcher to explain how dependent variable values change when of the independent variables is altered. These analyses can explain which of the independent variables are most closely related to the dependent variable. Regression analyses may be applied in the research for predicting values of the dependent variable given the value for the independent variable.

**Hierarchical linear regression**

Hierarchical linear regression models the data into a hierarchy of regressions (for example: A is regressed on B, and B is regressed on C). Lindenberger and Potter (1998) indicated that hierarchical linear regression is used to determine the extent to which the predictive link of the exogenous variable (the more distal predictor) to the dependent variable is reduced after statistical control of individual differences (mediator variable). Hierarchical linear regression enables an integrated approach to research projects studying correlates of change (Bryk and Raudenbush 1987). This model can also measure psychological change in behavioural sciences. Ozborne (1999) confirmed that hierarchical models are the best way to estimate relationships between predictors and outcomes. The two-stage conceptualisation of the model allows the researcher to model individual change, predict future development, and assess the quality of a measurement instrument.

The **R squared (R2)** value is the coefficient of determination, which indicates how data fit the model (Draper and Smith 1998), or how close the data are to the fitted regression line.  The value varies between 0 and 1 (multiple and hierarchical linear regressions). When R2 is one, the regression line fits the data perfectly; when it is zero, it indicates that the line does not fit the data at all. The R2 is used in models which test hypotheses, mainly for the purpose of predicting a future outcome.

A modified version of R2, i.e. **Adjusted R2** is used in a regression model that has been adjusted for the number of predictors in the model. The Adjusted R2 increases only if the new variable changes the model more than would be expected by chance. Sometimes, the Adjusted R2 decreases when a predictor improves the model by less than would be expected by chance. However, it is always lower than the R2.

The Adjusted R2 expresses the explanatory power of regression models that contain different numbers of predictor constructs. It adjusts for the number of explanatory predictors in a model relative to the number of data points.  It increases only if the new added prediction construct improves the model more than would be expected by chance (Draper and Smith 1998).The Adjusted R2, compared to the traditional R2, provides a more restricted and robust estimate of the predicted variance because it adjusts the value according to the number of the predictors in the model (Aiken et al. 2003, Cohen et al. 2014).

A **confidence interval (CI)** is an interval estimate which is calculated from the observed data. Confidence intervals can be constructed at a confidence level, such as 95%, which can be defined by the researcher. The 95% confidence interval reflects a significance level of .05 (Nakagawa and Cuthill 2007).

**Stepwise linear regression**

Stepwise linear regression is a method for adding multiple variables to the model in multiple linear regression, while simultaneously removing those that are less important. It is a semi-automated process of building a model by successively adding or removing variables. The IBM SPSSTM with stepwise regression performs multiple regressions in a number of times. Stepwise linear regression determines the relative contribution of each variable to the model by adding or removing variables (based on their significance or *p*<.5). This is performed through a sequence of adjusted R2 values, *t*-tests or *F*-tests. There are several different stepwise linear regression models. Forward selection model starts without variables in the model, adds the variable (if any) whose inclusion gives the most statistically significant improvement of the fit, and repeats this process until no variable improves the model to a statistically significant extent. Backward elimination model starts with all candidate variables, tests the deletion of each variable using a chosen model fit criterion, and continues this process until no further variables can be deleted without a statistically significant loss of fit. Stepwise linear regression explains the relative contribution of each separate variable to the measured variable of the overall model. Rather than an overall percentage of the whole measured variance, it provides a break-down of the amount that each variable contributes to the variance in the dependent variable. Those variables that remain at the end are those that best explain the contribution to the variance in the dependent variable.

**Moderated regression**

Moderated models are used to measure how moderators change the relationship between independent and dependent variables. The hierarchical moderated regression method of analysis was introduced by Saunders in 1955 (Russel and Bobko 1992) with the aim of detecting empirically how a variable ‘moderates’ or influences the nature of a relationship between two other variables. According to Russel and Bobko (1992), moderated regression analysis is the preferred statistical procedure for detecting interaction effects among variables. Furthermore, these authors stressed that many theories in psychology and organisational sciences postulate moderator or interactive relationships.

Moderated regression examines how the relationship between a dependent variable and an independent variable depends on the level of another independent variable (Irwin and McClelland 2001). Edwards and Lambert (2007) indicated that a moderation effect occurs when the effect of an independent variable on a dependent variable varies according to the level of a third variable, a so-called a moderator variable. The main effect of a moderated variable is an interaction with the independent variable (Champux and Peters 2011). Therefore, moderated regression is the most appropriate form of analysis for assessing the moderation effect of the moderators (age, gender, previous work experience, and voluntariness of use) included in recent technology acceptance models (TAM2 and UTAUT).

**Assumptions of linear regression**

The effect of the regression model analyses is optimized if predictor variables correlate highly with the dependent variable and correlate minimally with each other. **Multicollinearity** occurs when the effect of predictor variable in a multiple regression model can be linearly predicted from the other variables in the model. Various recommendations for acceptable levels of tolerance between the variables have been published in the literature. However, Fidell and Tabachnick (2003) recommended a value of .10 as the minimum level of tolerance.

The regression model assumes that the data are homoscedastic (have the same standar1d deviation in different groups). **Homoscedasticity** means that the variance around the regression line is the same for all values of the predictor variables. Therefore, the error variance in regression models is constant, and is central in linear regression modelling. The opposite assumption, i.e. heteroscedasticity, means that there is non-constant variance around the regression line (Van Keiligom and Wang 2010).

The outliers represent the data points which are deviating from the natural data variability (Filzmoser 2004). Outliers from data set can be identified through **Mahalanobis distance**, which presents the distance of a data point from the calculated centre of the other cases. The centre is calculated as the intersection of the mean of the variables being assessed. Date sets with values >1.00 are likely to be considered outliers.

**Mediation modelling**

Mediation modelling examines the relation among three or more variables. It is a useful tool for conceptualization among three or more variables with the aim of explaining the nature of their relation (Dudley et al. 2004). Mediation modelling may be used to test the effect on intervention. It can mediate the relation between the level of intervention, such as a treatment, and outcome.

The cause effect relations invoke the idea of mediation, a process in which some variables exert influence on others through intervening or mediator variables (Preacher and Hayes 2008). The mediation in behavioural research may examine how an independent variable (X) affects a dependent variable (Y) through one or more potential intervening variables or mediators (M). In cases when multiple mediators (Ms) are entertained is more precise to include all of them in the model. However, these analyses can be performed only through sophisticated analyses systems such as IBM SPSSTM, more specifically through Macros (Shrout and Bolger 2002). While moderated model measures how moderators (age, gender, experience, and voluntariness) change the relationship between independent and dependent technology acceptance variables, the mediation analyses assesses the relation between the basic technology acceptance variables (performance expectancy, effort expectancy, facilitating conditions, social influence, etc).

**Structural equation modelling**

Structural equation modelling may be used to assess constructs and relations that would otherwise be unobservable. This analysis often involves a measurement model that defines a structural model that imputes relationships between latent, or hidden, variables. The links between constructs of a structural equation model may be estimated through independent regression equations. Hox and Bechger (2007) proposed that researchers using structural equation modelling may specify complex path models in regression analyses. This model may identify theoretical constructs that are represented by latent factors. The relationship between the theoretical constructs is presented through regression or path coefficients between the factors. The use of structural equation modelling is commonly used in the social sciences due to its ability to impute relationships between unobserved constructs (latent variables) from observable variables.

According to Cangur and Ercan (2015, p.14) the **χ2/df**:

“is an index obtained by dividing the test statistic value by the degree of freedom. It is known as parsimony and stand-alone fit index. The value of this ratio gives information on the fit between data and model.”

Cangur and Ercan (2015, p. 15) proposed that: “the Tucker-Lewis index (**TLI**) is an incremental fit index. The bigger TLI value indicated better fit for the model”. According to Bollen (2014, p. 38) the: “root mean square residual (**RMR**) is the square root of the discrepancy between the sample covariance matrix and the model covariance matrix.” Baumgartner (1996, p. 141) proposed that: “the goodness of fit index (**GFI**) is a measure of fit between the hypothesized model and the observed covariance matrix”. Bentler (1990, p. 240) indicated that the:

“comparative fit index (**CFI**) analyzes the model fit by examining the discrepancy between the data and the hypothesized model, while adjusting for the issues of sample size inherent in the chi-squared test of model fit and the normed fit index.”

For the structure equation model, the x2/df score accepted limit is below 5 (Harrison and Rainer 1996). The Goodness of fit index (GFI) score threshold is .9 (Bollen and Long 1993), and the Confirmatory fit index (CFI) score threshold is .9 (Smith and McMillan 2001). The Tucker-Lewis index (TLI) threshold is .9 (Hair et al. 1998) and the Root mean squire residual (RMR) value threshold is .1 (Bollen 2014).

## Results

In total, 200 questionnaires were distributed and 169 were returned, giving a response rate of 84.5%. However, 36 questionnaires were excluded from the study, as some key variables were missing, left blank, or completed by non-health professionals. Finally, 133 questionnaires were found to be eligible for analysis, yielding a final response rate of 66.5% suitable for analysis. The data eligible for analysis were derived from three selected hospitals: the City Surgery Hospital (22.6%, *n*=30), Geriatric Hospital (34.6%, *n*=46), and Paediatric Hospital (42.9%, *n*=57).

### Demographic characteristics

Demographic data were collected in the study to show the basic characteristics of the respondents. These data concerned age, gender, and occupation. The age of participants in the study ranged from 20 to 62 years old (=42.20, *SD*=10.47). Most of the participants (88.7%, *n*=118) were female, while 11.3% (*n*=15) were male. At the time of the study, the Paediatric Hospital had a gender balance: (female=86.83%, n=178; male=13.17%, n=27); Geriatric Hospital gender balance: (female=80.48%, n=202; male=19.52%, n=49); City Surgery Hospital gender balance: (female=67.58%, n=248; male=32.42%, n=119).

Regarding occupation, almost half of the overall sample of the study consisted of nursing staff (48.9%, *n*=65), and 51.1%, *n*=68 were hospital doctors. A higher proportion of males (86.8%, n=59) than females (13.2%; n=9) comprised the hospital doctor group. Doctors had a significantly higher mean age (=44.30, *SD*=10.73) compared to the nursing staff (=40.09, *SD*=9.83).

Almost all participants reported having access to a PC (*n*=118, 92.2%). Nevertheless, 10 participants (7.8%) reported that they did not have access to a PC. The participants who reported not having access to a PC had a mean age =44.80 (SD=8.99), and most were female (9 out of 10).

Descriptive statistics and inferential data analyses were applied to analyse the data. All data analyses were conducted with IBM SPSSTM software. Descriptive statistics, such as the mean, range, standard deviation, skewness and kurtosis, and Kolmogorov-Smirnov tests were used to summarise the data and provide information about the sample size and demographic characteristics.

### Descriptive statistics of technology acceptance variables

Descriptive statistics were performed on the study’s technology acceptance variables to describe the data and present the basic association of the respondents with the constructs. Frequencies from the descriptive statistics analyses were calculated for seven technology acceptance variables (perceived usefulness, perceived ease of use, intention, computer anxiety, job relevance, subjective norm, and descriptive norm) derived from the TAM2 and other technology acceptance models. These are shown in Tables 4.3 – 4.9. However, which technology acceptance variables predict intentions to use the system are assessed through regression analyses (Sections 4.3.8 and 4.3.9), and structural equation modelling (Section 4.3.10).

Table 4.3: Reported perceived usefulness by the respondents

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **VARIABLE:** Perceived usefulness | **Level of agreement or disagreement with statement n (%)** | | | | | | | |
| **Strongly**  **disagree** | **Moderately**  **disagree** | **Somewhat**  **disagree** | **Neutral** | **Somewhat**  **agree** | **Moderately**  **agree** | **Strongly**  **agree** | **Total** |
| Using e-Health system at work will improve my job performance | 17 (12.8) | 4 (3.0) | 4 (3.0) | 11 (8.3) | 11(8.3) | 31 (23.3) | 54 (40.6) | 132 (99.2) |
| Using e-Health system at work will increase my productivity | 15 (11.3) | 4 (3.0) | 6 (4.5) | 10 (7.5) | 20 (15.0) | 31 (23.3) | 47 (35.3) | 133 (100) |
| Using e-Health system at work will enhance my effectiveness | 16 (12.0) | 4 (3.0) | 7 (5.3) | 5 (3.8) | 17 (12.8) | 30 (22.6) | 53 (39.8) | 132 (99.2) |
| Overall , I would find e-Health system useful for my work | 8 (6.0) | 4 (3.0) | 4 (3.0) | 14 (10.5) | 11 (8.3) | 31 (23.3) | 222 (48.5) | 133 (100) |

Table 4.3 shows that participants in the study had a high perceived usefulness of the e-Health system. Over 70% in all four perceived usefulness assessed items reported usefulness (somewhat agree to strongly agree) from the e-Health system that will be implemented in the country, i.e., they agreed with the statements.

Table 4.4: Reported perceived ease of use by the respondents

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **VARIABLE:** Perceived ease of use | **Level of agreement or disagreement with statement n (%)** | | | | | | | |
| **Strongly**  **disagree** | **Moderately**  **disagree** | **Somewhat**  **disagree** | **Neutral** | **Somewhat**  **agree** | **Moderately**  **agree** | **Strongly agree** | **Total** |
| I would find e-Health system easy to use | 8 (6.0) | 2 (1.5) | 4 (3.0) | 13(9.8) | 15 (11.3) | 46 (34.6) | 44 (33.1) | 132 (99.2) |
| Interacting with e-Health system will be easy and understandable | 4 (3.0) | 5 (3.8) | 5 (3.8) | 16 (12.0) | 17 (12.8) | 39 (29.3) | 44 (33.1) | 130 (97.7) |
| I would find it easy to get e-Health system to do what I want it to do | 10 (7.5) | 4 (3.0) | 8 (6.0) | 21 (15.8) | 17 (12.8) | 44 (33.1) | 29 (21.8) | 133 (100) |
| Interacting with e-Health system would not require a lot of mental effort | 15 (11.3) | 2 (2.3) | 5 (3.8) | 21 (15.8) | 12 (12.8) | 32 (21.4) | 40 (30.1) | 133 (100) |
| I will be able to use the e-Health system effectively | 8 (6.0) | 1 (0.8) | 1 (0.8) | 7 (5.3) | 14 (10.5) | 27 (20.3) | 75 (56.4) | 133 (100) |
| Using e-Health system will be easy for me | 6 (4.5) | 4 (3.0) | 3 (2.3) | 10 (7.5) | 11 (8.3) | 41 (30.8) | 58 (43.6) | 133 (100) |
| I will easily work with e-Health system | 7 (5.3) | 4 (3.0) | 5 (3.8) | 8 (6.0) | 10 (7.5) | 33 (24.8) | 66 (49.5) | 133 (100) |

Table 4.4 presents the frequencies of the reported ease of use from the respondents. The frequencies indicate that respondents’ perception of the ease of use of future e-Health system in the country is high, because for all six of the assessed items, more than 50% of respondents reported agreement with the perceived ease of use of the future e-Health system i.e., they agreed with the statements.

Table 4.5: Reported intentions to use the e-Health system by the respondents

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **VARIABLE:** Intention | **Level of agreement or disagreement with statement n (%)** | | | | | | | |
| **Strongly**  **disagree** | **Moderately**  **disagree** | **Somewhat**  **disagree** | **Neutral** | **Somewhat**  **agree** | **Moderately**  **agree** | **Strongly agree** | **Total** |
| I intend to use e-Health system if it is implemented | 8 (6.0) | 2 (1.5) | 2 (1.5) | 10 (7.5) | 6 (4.5) | 24 (18.0) | 80 (60.2) | 132 (99.2) |
| I expect I will use e-Health system if it is implemented | 3 (2.3) | 3 (2.3) | 1 (0.8) | 9 (6.8) | 12 (9.0) | 19 (14.3) | 84 (63.2) | 131 (98.5) |
| I plan to use e-Health system if it is implemented | 7 (5.3) | 1 (0.8) | 1 (0.8) | 11 (8.3) | 8 (6.0) | 12 (9.0) | 90 (67.7) | 130 (97.7) |

Table 4.5 shows that respondents in the study have a very strong intentions to use the future e-Health system. Over 80% of respondents reported that they agree with the statements assessing their intention to use the system.

Table 4.6: Reported computer anxiety by the respondents

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **VARIABLE:**  Computer anxiety | **Level of agreement or disagreement with statement n (%)** | | | | | | | |
| **Strongly**  **disagree** | **Moderately**  **disagree** | **Somewhat**  **disagree** | **Neutral** | **Somewhat**  **agree** | **Moderately**  **agree** | **Strongly agree** | **Total** |
| Computers make me feel uncomfortable | 73 (54.9) | 11 (8.3) | 5 (3.8) | 16 (12.0) | 12 (9.0) | 4 (3.0) | 11 (8.3) | 132 (99.2) |
| Working with a computer makes me nervous | 78 (58.6) | 12 (9.0) | 1 (0.8) | 14 (10.5) | 11 (8.3) | 4 (3.0) | 12 (9.0) | 132 (99.2) |
| Computers make me feel uneasy | 81 (60.9) | 5 (3.8) | 3 (2.3) | 13 (9.8) | 7 (5.3) | 14 (10.5) | 10 (7.5) | 133 (100) |
| Computers do not scare me at all (positive attitude) | 8 (6.0) | 3 (2.3) | 3 (2.3) | 11 (8.3) | 8 (6.0) | 12 (9.0) | 88 (66.2) | 133 (100) |

Table 4.6 presents the computer anxiety descriptive statistics indicating that participants in the study do not have computer anxiety from the future e-Health system. Over 70% of the sample strongly disagreed with the negative statements associated with computer anxiety, and over 80% reported association with the statement ‘Computers do not scare me at all’.

Table 4.7: Reported job relevance by the respondents

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **VARIABLE:** Job relevance | **Level of agreement or disagreement with statement n (%)** | | | | | | | |
| **Strongly**  **disagree** | **Moderately**  **disagree** | **Somewhat**  **disagree** | **Neutral** | **Somewhat**  **agree** | **Moderately**  **agree** | **Strongly agree** | **Total** |
| In my job, use of e-Health system will be important | 8 (6.0) | 2 (1.5) | 0 | 13 (9.8) | 11 (8.3) | 33 (24.8) | 66 (49) | 133 (100) |
| In my job, use of e-Health system will be relevant | 10 (7.5) | 1 (0.8) | 1 (0.8) | 28 (21.1) | 15 (11.3) | 28 (21.1) | 50 (37.6) | 133 (100) |

Table 4.7 presents the job relevance variable statistics, showing that Macedonian healthcare professionals perceived that future the e-Health system would be relevant to their job design. Over 50% (73.8% for the first item and 58.7% for the second item) of respondents expressed a strong association (moderately agree to strongly agree) with the job relevance variable.

Table 4.8: Reported subjective norm by the respondents

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **VARIABLE:** Subjective norm | **Level of agreement or disagreement with statement n (%)** | | | | | | | |
| **Strongly**  **disagree** | **Moderately**  **disagree** | **Somewhat**  **disagree** | **Neutral** | **Somewhat**  **agree** | **Moderately**  **agree** | **Strongly agree** | **Total** |
| In general, e-Health system will be well approved and supported by most of my colleagues | 11 (8.3) | 3 (2.3) | 3 (2.3) | 20 (15) | 12 (9.0) | 40 (30.1) | 40 (30.1) | 129 (97) |
| The colleagues that I respect more would accept e-Health system | 11 (8.3) | 2 (1.5) | 4 (3.0) | 20 (15.0) | 13 (9.8) | 31 (23.3) | 48 (36.1) | 129 (97) |

Table 4.8 shows the reported levels of subjective norm. The table shows a high level of subjective norm among participants in the study. A very high number of respondents (near 70%) agreed with the statements expressing high subjective norm.

Table 4.9: Reported descriptive norm by the respondents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable:** Descriptive norm | **Level of agreement or disagreement with statement N (%)** | | | | |
| Few of them | Some of them | Most of them | All of them | Total |
| The colleagues I respect most would accept e-Health system | 8 (6.0) | 15 (11.3) | 78 (58.6) | 24 (18.0) | 125 (94.0) |

Table 4.9 indicates a high level of descriptive norm reported by participants in the study. A very high number of respondents in the study reported that they expected that most or all of the colleagues (58.6% and 18.0%, respectively) that they respected would accept future e-Health system in the country.

The descriptive statistics applied in this section provided a basic description of the characteristics of the sample and the key variables used in the study. This provides a good basis for understanding the more advanced statistical methods used later in the analyses (Sections 4.3.8 – 4.3.10).

### Skewness and kurtosis

This section presents the levels of skewness and kurtoses of the data in the study of hospital healthcare professionals. Table 4.10 presents skewness and kurtosis.

Table 4.10: Skewness and kurtosis

|  |  |  |
| --- | --- | --- |
| **Assessment item** | **Skewness** | **Kurtosis** |
| Clinic (employment place) | -.377 | -1.284 |
| Age | -.049 | -1.105 |
| Gender | -2.476 | 4.195 |
| Occupation | .046 | -2.029 |
| Computer use | 3.181 | 8.250 |
| Computer use/years | .530 | -.172 |
| Computer use/hours | 1.695 | 3.901 |
| Intention | -1.864 | 3.125 |
| Perceived usefulness | -1.130 | .308 |
| Perceived ease of use | -1.135 | .781 |
| Computer anxiety | .892 | .053 |
| Job relevance | -1.344 | 1.463 |
| Subjective norm | -1.146 | .511 |
| Descriptive norm | -.822 | .999 |

Tests for skewness and kurtosis test analyses were applied to the data and indicated that for the following variables: gender, computer use, computer use/hours, intention, perceived usefulness, perceived ease of use, job relevance, subjective norm, and descriptive norm, the data were skewed (i.e., the value was <-1.00 or >1.00). The data were strongly negatively skewed for the gender variable (more of the participants in the study were females). Computer use data were strongly positively skewed (participants reported high use of PC).

There was a high tail positive kurtosis for the following variables: gender, computer use, computer use/hours, intention, and job relevance (i.e., the value was >1.00). The data had negative kurtosis for clinic (employment place), age, and occupation (i.e., the value was <-1.00)

### Normality of data distribution

This section presents the results of Kolmogorov-Smirnov tests, i.e. whether the data came from a population in which the data were normally distributed. Table 4.11 presents results of Kolmogorov-Smirnov test.

Table 4.11: Results of Kolmogorov-Smirnov test

|  |  |  |
| --- | --- | --- |
| **Assessment item** | **Test statistic** | **Df** |
| Clinic | .314\*\* | 106 |
| Age | .092\* | 106 |
| Gender | .519\*\* | 106 |
| Occupation | .369\*\* | 106 |
| Computer use | .540\*\* | 106 |
| Computer use/years | .105\* | 106 |
| Computer use/hours | .199\*\* | 106 |
| Intention | .288\*\* | 106 |
| Perceived usefulness | .181\*\* | 106 |
| Perceived ease of use | .152\*\* | 106 |
| Subjective norm | .214\*\* | 106 |
| Descriptive norm | .345\*\* | 106 |
| Job relevance | .217\*\* | 106 |
| Computer anxiety | .274\*\* | 106 |

Note: \*\*=*p*<.005; \*=*p*<.05

The Kolmogorov-Smirnov test was significant (*p*<.05) for all of the variables in the study. Thus the null hypothesis that the data were normally distributed was rejected for each of these variables. Therefore, the use of non-parametric tests should be considered for future data analyses.

### Reliability of the study

The study’s reliability can be expressed as the consistency of the questionnaire as a research instrument. Therefore, the reliability test in the study assessed whether the proposed items measure the same general construct and produce similar scores. As explained in Section 3.7.2, internal consistency reliability can be calculated with pairwise correlations between items and is expressed through Cronbach’s alpha (α) coefficient (Fink 1995; Devane et al. 2010; Egea and Gonzalez 2011).

The study questionnaire’s reliability was assessed by computing the internal reliability indicator, Cronbach’s. The reliability coefficients are shown in Table 4.12. There was a high internal reliability (i.e., α**>**.70) in all of the TAM-related measures (Im et al. 2011). Therefore, the internal consistency reliability indicator Cronbach α values in the study had acceptable levels of internal consistency, which means that all items measure the same concept (all constructs used had *α* coefficients that ranged from .71 to .92).

Table 4.12: Reliability coefficients of the study

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Construct:** | **Intention** | **Perceived usefulness** | **Perceived ease of use** | **Computer anxiety** | **Job relevance** | **Subjective norm** | **Descriptive norm** |
| Cronbach’s α | .85 | .91 | .92 | .71 | .73 | .89 | .87 |

### Bi-variate analyses, Spearman rank correlations

Bi-variate correlations using the Spearman rank correlation coefficient are suitable analyses for Likert-scale data (strongly disagree to strongly agree). These analyses were performed before the hierarchical linear regression with the aim of assessing whether the proposed independent variables correlate with the dependent variable, i.e. intention to use the e-Health system (Blank 1995). The major strength of correlation research is that predictions about human behaviour can be made when strong correlations exist (Goodwin 1998). Relationships between two variables can be investigated by taking a bi-variate approach.

The findings from the Spearman rank correlation analyses are presented in Table 4.13, together with the mean scores and standard deviations. The Spearman rank correlations indicated that all TAM2 and other technology acceptance constructs correlated significantly (*p*<.05) with intentions, except with the computer anxiety variable. Furthermore, it was assessed that the correlations between technology acceptance variables (except the computer anxiety) appeared to be logical (e.g., people who felt that the technology would be easy to use had a higher level of intentions to use the technology).

Table 4.13: Analyses of Spearman correlations, mean () and standard deviation (SD) of the study variables

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1.Intention | - | .62\* | .71\* | -.13 | .70\*\*\* | .67\* | .44\* |
| 2. Perceived usefulness |  | - | .67\* | -.11 | .61\* | .60\* | .38\* |
| 3.Perceived ease of use |  |  | - | -.18 | .66\* | .66\* | .40\*\* |
| 4.Computer anxiety |  |  |  | - | -.06 | .01 | -.13 |
| 5.Job relevance |  |  |  |  | - | .63\* | .38\* |
| 6.Subjective norm |  |  |  |  |  | - | 53\* |
| 7.Descriptive norm |  |  |  |  |  |  | - |
|  | 6.11 | 5.38 | 5.55 | 3.39 | 5.63 | 5.86 | 5.34 |
| *SD* | 1.39 | 1.77 | 1.40 | 1.48 | 1.50 | 1.51 | 1.72 |
|  |  |  |  |  |  |  |  |

Note: \*\*\*= *p*<.001; \*\**p*<.005; \*=*p*<.05

Spearman rank correlations confirmed that proposed technology acceptance variables (except computer anxiety) correlated with intentions to use the e-Health system. Perceived ease of use variable strongly correlated with descriptive norm (\*\**p*<.005), and the intention dependent variable had the strongest correlation with job relevance (\*\*\*=*p*<.001). However, intention has showed .71 correlation with perceived ease of use variable. This is only slightly above the .70 threshold, so was retained for the analyses. Two types of multivariate analysis (hierarchical linear regression and stepwise linear regression) and structural equation modelling were then used to test the proposed hypothesis and to assess which technology acceptance variables predict intentions to use e-Health system in the country.

### Gender, occupational and access to PC differences

The gender, occupational, and access to PC differences of the participants in the study were assessed with the Mann-Whitney tests as the data was not normally distributed. These tests can explain some basic differences between the participants. However, healthcare professional’s intentions towards future e-Health system are explained with regression analyses (Sections 4.3.8 and 4.3.9), and structural equation modelling (Section 4.3.10). These analyses have confirmed that demographic variables do not predict intentions. Therefore, the assessment of demographic differences present some initial findings from this research which do not provide final conclusions on the technology acceptance.

**Occupational differences**

Compared to nursing staff, hospital doctors used PCs for significantly more hours per day (*t* (113) = 2.56, *p*<.05) and for more years overall (*t* (121) = 4.63, *p*<.001) computer usage. A non-parametric Mann-Whitney test was applied to assess possible occupational differences (nursing staff=48.9% and hospital doctors=51.1%). However, the Mann-Whitney test found no occupational differences with respect to technology acceptance constructs.

**Gender differences**

When differences between genders were tested, males reported having used a PC for more years than females (*M*males=5.66, *SD*=1.46; *M*females=5.28, *SD*=.50; *t*(121)=2.72, *p*<.05). A Mann-Whitney test found no significant gender differences with respect to technology acceptance constructs.

**Access to PC differences**

In addition, the influence of having access to a PC on several dimensions of technology acceptance, including intentions to use the e-Health system, perceived ease of use, perceived usefulness, computer anxiety, job relevance, subjective norm, and descriptive norm were assessed. The Mann-Whitney test results showed that non-users of PCs differed significantly from users and had lower association with intention (the dependent variable) to use the e-Health system (Mann-Whitney U=286, *z*=-2.91, *p*=.004), lower perceived usefulness (Mann-Whitney U=354, *z*=-2.11, *p*=.035), and lower job relevance (Mann-Whitney U=346, *z*=-2.20, *p*=.027).

**Other demographic comparisons**

Data on hospital healthcare population, the split between city based and less centralised hospitals, male/female ratio, doctors/nurses ratio, and mean years of experience were not available for comparison with the data from this study. This limitation is discussed in Section 6.3.1.

### Hierarchical linear regression, predictors of e-Health acceptance

A hierarchical linear regression used by Devane et al. (2010) and Egea and Gonzalez (2011) was applied to the study data to test the proposed hypotheses and identify predictors of intentions to use the e-Health system. Hierarchical linear regression was used to assess the direct effects of multiple variables towards the usage intentions of participants in the study. The two-stage conceptualisation of the model may predict future developments and can measure individual changes (Bryk and Raudenbush 1987; Lindenberger and Potter 1998; Ozborne 1999). The technology acceptance variables were measured by mean scores (Bryk and Raudenbush 1987; Lindenberger and Potter 1998; Ozborne 1999). However, regression analysis does not require normally distributed dependent or independent variables (Section 4.2.11).   
Hierarchical linear regression could be applied in this study as the intention (dependent variable) had continuous values. Tests for multicollinearity, homoscedasticity, and Mahalanobis distance for outliers were performed before the hierarchical linear regression analyses.

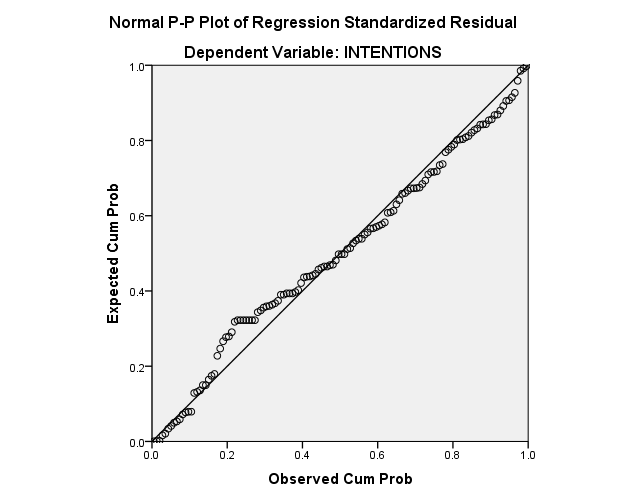
**Multicollinearity**

Multicollinearity analyses were applied with aim to check whether there was multicollinearity between technology acceptance variables used in the model. The following tolerance levels were identified: perceived ease of use (tolerance=.396, variance inflation factor VIF*=*2.525); perceived usefulness (.347, VIF=2.105); subjective norm (tolerance=.516, VIF=1.936); job relevance (tolerance=.431, VIF=2.318); computer anxiety (tolerance=.914, VIF=2.105); and descriptive norm (tolerance=.390, VIF=1.417). Therefore, it could be concluded there was no multicollinearitybetween technology acceptance variables in the study.

**Homoscedasticity**

The assumption of homoscedasticity and normality of residuals was examined with a normal P-P plot of regression standardized residuals was used. As shown in Figure 4.1 homoscedasticity was evidenced as the plotted points approximated to a straight line.

Figure 4.1: Homoscedasticity plot of the study data



**Mahalanobis distance for outliers**

The Mahalanobis distance for outliers was calculated with the aim to detect possible outliers in the data, prior to further regression analyses. No outliers were identified for the study of hospital healthcare professionals. All participants in the study had <1.00 Mahalanobis distance result.

The hierarchical linear regression was completed in two steps. Demographic factors (age, gender, occupation, access to PC, computer use/years, and computer use/hours) were included as independent variables in the first step. The second step included basic TAM2 variables (perceived usefulness, perceived ease of use, subjective norm, job relevance), and other technology acceptance variables, such as computer anxiety and descriptive norm. The results of the hierarchical linear regression are summarised in Table 4.14.

Table 4.14: Predictors of participants’ intentions to use the e-Health system

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Step** | **Predictors** | **95% CI** | **Standardised *β*** | **Adjusted *R*2** | | 1 | Age | .058 – .009 | .033 | 1.4% | | Gender | .387 – 1.193 | .403 | | Occupation | .402 – .756 | .177 | | Computer use/years | .018 – .092 | .037 | | Computer use/hours | .036 – .157 | .061 | | Access to PC | 1.960 - .523 | -.191 | | 2 | Age | .019 – .014 | .002 | 68.1% | | Gender | .276 – .690 | .207 | | Occupation | .182 - .528 | .173 | | Computer use/years | .001 - .072 | .036 | | Computer use/hours | .028 - .090 | .031 | | Access to PC | .819 – .772 | .024 | | Perceived usefulness | .140 – .109 | .015 | | Perceived ease of use | .032 - .335 | .151\*\*\* | | Job relevance | .031 - .296 | .132\* | | Subjective norm | .035 – .339 | .187\*\* | | Descriptive norm | .204 - .313 | .055 | | Computer anxiety | .105 - .153 | .024 | |

Note: \*\*\*= *p*<.001; \*\*= *p*<.005; \*= *p*<.05

In the first step of the analyses, only 1.4% (Adjusted *R*2=.014, R2 Change=.155) of the variance in intentions to use the e-Health system was predicted by the six predictor variables. In the second step of the hierarchical linear regression analyses, the variance in intentions to use the e-Health system explained by the independent variables noticeably increased, by 66.7% (R2 Change=.667). Therefore, the level of variance in intentions to use the e-Health system was significantly explained by the predictor variables, and the overall model explained 68.1% (Adjusted R2=.681) of the variation in intentions to use the e-Health system. In the second step, three technology acceptance variables showed a significant association with intention variable. Perceived ease of use (β=.151, *p*<.001), subjective norm (β=.187, *p*<.005), and job relevance (β=.131, *p*<.05) were found to be strong predictors of intentions to use the e-Health system. However, perceived usefulness as a basic TAM2 variable, was not shown to be a predictor of intentions (*p*=.808). Computer anxiety (*p*=.716) and descriptive norm (*p*=.676) as additionally added technology acceptance variables to the model, and demographic variables were also not shown to be predictors of intentions.

### Stepwise linear regression

Stepwise linear regression (forward selection model) was applied to reassess the findings of the hierarchical linear regression, to test the proposed hypothesis and to identify the most important predictors of intentions of the study participants. The dependent variable was intention to use the future e-Health system. The basic TAM2 variables, i.e., perceived usefulness, perceived ease of use, subjective norm, job relevance and other technology acceptance variables (i.e., descriptive norm and computer anxiety), were tested as independent variables through stepwise linear regression. This regression analyses was used to explain the relative contribution of each separate variable to intentions to use the e-Health system. The results of the stepwise linear regression are presented in Table 4.15.

Table 4.15: Stepwise linear regression model summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Constant/predictor** | **R2** | **R2 Change** | ***p*** |
| **Dependent variable**: Intention to use the e-Health system | | | | |
| 1 | Perceived ease of use | .599 | .599 | .001 |
| 2 | Subjective norm | .682 | .083 | .001 |
| 3 | Job relevance | .697 | .016 | .013 |

The stepwise linear regression determined the most relevant predictor variables, and included three variables in the final model (variations with a probability of < .5 were included in the model). In step one, 59.9% of the variation in intentions to use the e-Health system was explained by perceived ease of use (R2=.599), meaning that almost 60% of the variation in intentions to use the system was explained by the perceived ease of use variable. In step two, the proportion of the variation in intentions to use the e-Health system increased by 8.3% (R2 Change=.083; R2=.682) meaning that an additional 8.3% of the intentions to use was explained by the subjective norm variable. Job relevance was added to the final step of the model, i.e., contributed an additional 1.6% (R2 Change=.016, R2=.697) to the variation in intentions to use the system.

The perceived usefulness, descriptive norm and computer anxiety variables were excluded from the stepwise linear regression model of the study of hospital healthcare professionals. Their association with the intention dependent variable was found to be non-significant (*p*>.05).

### Structural equation modelling

The second level of analyses for the study of the hospital healthcare professionals was performed through structural equation modelling with the aim to reassess the findings from the regression analyses. Structural equation modelling was also used to test the proposed Hypotheses (H1 and H2).

**H1: Perceived usefulness and perceived ease of use will significantly predict healthcare professionals’ intentions to use the e-Health system.** Figure 4.2 presents the structural equation model of the H1.

Figure 4.2: Structural equation model of H1

\* standardized coefficients are presented

.00

.53

.55

.27

.45

.67

Perceived usefulness

Perceived ease of use

Intention to use the e-Health system

Table 4.16 presents the overall model fit for H1.

Table 4.16: Overall model fit, from the structural equation model for H1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Overall model fit, H1** | | | | |
| **χ2/ d.f.** | GFI | CFI | TLI | RMR |
| .651 | 1 | 1 | .985 | .001 |

As can be seen from Table 4.16, the (x2/df) score was within the acceptable limits, i.e. below 5 and the GFI and CFI scores were above the threshold of .9. The TLI was close to the threshold of .9, and the RMR value was below the threshold of .1 (Diamantidis and Chatzoglou 2012). Table 4.17 presents standardized effects of structural equation modelling of H1 model factors.

Table 4.17: Direct and indirect standardized effects of the H1 model factors

|  |  |  |  |
| --- | --- | --- | --- |
|  | | **Perceived ease of use** | **Perceived usefulness** |
| Perceived usefulness | D  I  T | .672  .672 |  |
| Intention | D  I  T | .533  .180  .714 | .269  .269 |
| D=direct effect; I=indirect effect; T=total effect, *p*<.001 | | | |

Perceived ease of use had a direct and total effect on perceived usefulness (.672). Perceived ease of use had a total effect=.714 on intentions (direct=.533, indirect=.180). Perceived usefulness had direct effect=.269 on intentions. Perceived usefulness was predicted by 45% by perceived ease of use. Finally, intentions to use the e-Health system were predicted by perceived ease of use and perceived usefulness by 55%.

Therefore, the H1 could be accepted. Perceived ease of use was identified as the main predictor of intentions among healthcare professionals towards the e-Health system. Perceived usefulness had some effect on intentions to use the system. However, the perceived ease of use had a stronger effect than perceived usefulness on participants’ intentions. Therefore, the crucial role of perceived ease of use in the model can be seen, in contrast to Davis (1993) indication that perceived usefulness had 50% stronger effect than perceived ease of use on intentions (Section 2.5.2). The main findings from the regression analyses (hierarchical and stepwise) were re-confirmed form these analyses as the perceived ease of use had the strongest direct effect (.533) on intentions to use the e-Health system.

**H2:** **Subjective norm, descriptive norm, job relevance, and computer anxiety will predict healthcare professionals’ intentions to use the e-Health system indirectly through the effects of perceived usefulness.** Figure 4.3 presents the structural equation model of the H2.

Figure 4.3: Structural equation model of H2

\* standardized coefficients are presented

.38

.60

.27

.45

.62

.00

.52

.21

.31

.39

.35

.39

Subjective

norm

Job

relevance

Intention to use the e-Health system

Descriptive norm

Perceived usefulness

Table 4.18 presents the overall model fit for H2.

Table 4.18: Overall model fit, from the structural equation model for H2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Overall model fit, H2 | | | | |
| **χ2/ d.f.** | GFI | CFI | TLI | RMR |
| .777 | .993 | 1 | .997 | .032 |

As can be seen from Table 4.18, the (x2/df) score is within the accepted limits, i.e. below 5, the GFI score is close to the threshold of .9, and the CFI score is above the threshold of .9. The TLI is close to the threshold of .9, and the RMR value is below the threshold of .1 (Diamantidis and Chatzoglou 2012). Table 4.19 presents standardized effects of structural equation modelling of the H2 model factors.

Table 4.19: Direct and indirect standardized effects of H2 model factors

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | **Descriptive norm** | **Subjective norm** | **Job relevance** | **Perceived usefulness** |
| Subjective norm | D  I  T | .519  .519 |  |  |  |
| Job relevance | D  I  T | .323  .323 | .623  .623 |  |  |
| Perceived usefulness | D  I  T | .309  .309 | .351  .245  .596 | .394  .394 |  |
| Intention | D  I  T | .347  .347 | .306  .364  .670 | .382  .083  .465 | .211  .211 |
| D=direct effect; I=indirect effect; T=total effect, *p*<.01 | | | | | |

Intention to use the e-Health system was predicated by 60% through this model. However, the effects of subjective norm (direct=.306, indirect=.364, total effect=.670), job relevance (direct=382, indirect=.083, total effect=.465), and indirect effect of descriptive norm (indirect and total effect=.347) on intentions to use the e-Health system were stronger that the direct effect of perceived usefulness (.211). However it can probably be said that a part of the impact of subjective norm, descriptive norm and job relevance on intentions is being channelled through perceived usefulness. The computer anxiety dropped out of this model as statistically insignificant factor.

The effect of descriptive norm on intentions was indirect through the subjective norm construct (direct=.519). New relations from this hypothesized model emerged through the structural equation model. Subjective norm had an effect on job relevance (indirect and total effect=.623), and on perceived usefulness (direct=.351, indirect=.245, total effect=.596). Job relevance had an effect on perceived usefulness (indirect and total effect=.394).

Therefore, the H2 could only be partially accepted, as subjective norm and job relevance were found to be predictors of intentions among the participants, directly or through perceived usefulness, while the effect of descriptive norm was indirect, through subjective norm. Computer anxiety effect on participant’s intentions was not established in this study. However, the readiness to use the e-Health system among the participants in the study is discussed in Section 7.2.

The structural equation modelling of H1 and H2 from the Study of the hospital healthcare professionals confirmed that the intention to use the e-Health system could be predicted through a combination of influences of the technology acceptance constructs and the interactions between them.

## Discussion

This section presents initial discussion on study of hospital healthcare professionals. However, the whole research, and assessment of the hypotheses (both studies) are discussed in detail in the discussion chapter (Chapter 6). This study applied a modified version of TAM2 to the selected sample of healthcare professionals in the Republic of Macedonia. The research instrument was applied for the first time in these settings in healthcare, and the study yielded new and interesting findings, which are discussed in this section.

Although male respondents reported using a PC for more hours per day, and for more years overall than females, no significant gender differences with respect to technology acceptance variables were observed, except for overall usage of PCs. Hospital doctors used PCs for significantly more hours per day and for more years overall compared to nursing stuff, but no occupational differences were observed between nursing staff and hospital doctors with respect to the technology acceptance variables.

Significantly more doctors than nursing staff reported having access to a PC, but there were no gender differences with respect to having access to a PC. The results showed that non-users of PCs differed significantly from users, and had lower association with intentions (the dependent variable) to use the e-Health system, lower perceived usefulness and lower job relevance. However, daily and hourly use of a PC did not correlate significantly with other technology acceptance variables.

It can therefore be concluded that there were no major demographic differences among participants in the study of hospital healthcare professionals. The access to PC variable was associated with participant’s intentions. However, this analysis does not indicate that access to PC variable can predict future intentions of participants in the study.

The core TAM2 variables, i.e., perceived usefulness and perceived ease of use were hypothesised, as the main predictors of healthcare professionals’ intentions to use e-Health (Venkatesh and Davis 2000; Hyun et al. 2009; Morton and Wiedenbeck 2009; Wilkins 2009; Devane et al. 2010). Other basic TAM2 constructs (subjective norm and job relevance), and other technology acceptance constructs, such as computer anxiety and descriptive norm, were tested with the model designed for this study. It was hypothesised that they would be shown to be predictors of healthcare professionals’ attitudes, as indicated in earlier studies by Rivis and Sheeran (2003), Mun et al. (2006), Venkatesh and Balla (2008), and Teo et al. (2008).

The hierarchical linear regression analyses showed that only perceived ease of use, but not perceived usefulness, was a significant predictor of participants’ intentions to use e-Health system. This suggests, therefore, that when implementing ICT within healthcare, it is necessary to focus on providing information to make tasks easier. Reducing healthcare professional’s workload may increase e-Health acceptance. Thus, this study revealed a novel and interesting finding, as perceived usefulness has been reported as a strong predictor in numerous previous TAM and TAM2 studies in healthcare (Hyun et al. 2009; Morton and Wiedenback 2009; Wilkins 2009; Devane et al. 2010; Holden and Karsh 2010; Archer and Cocosila 2011; Egea and Gonzalez 2011). This finding will be discussed in detail and related to the relevant literature in Section 6.4.10.

The stepwise linear regression confirmed the findings of the hierarchical linear regression. These analyses determined the most important predictors of intentions among the participants. Perceived ease of use was identified as the most important predictor, contributing almost 60% of the variance in the three-step prediction model. The second most important predictor was subjective norm, and job relevance was the third most important predictor of intentions.

The structural equation modelling analyses established a direct weak effect of perceived usefulness on intentions to use the e-Health system. The effect of perceived ease of use was much stronger than the effect of perceived usefulness. The structural equation modelling also established indirect effects such as: subjective norm effect on perceived usefulness and job relevance, and indirect effect of job relevance to perceived usefulness. The findings from the study have interesting implications for policy makers and IT managers when implementing such systems. Information about the effective use of e-Health system, the development of user-friendly applications and workshops to improve healthcare professionals’ familiarity and competence with e-Health system could change their perceived ease of the system use, making it more acceptable to them. This will be discussed in detail in Section 7.3.1.

For the purpose of this study, the notion of subjective norm of the TAM2 approach was extended. The influence of subjective norm (i.e. perceived prevalence of e-Health acceptance by others) was considered alongside descriptive norm (i.e. perceived acceptance and approval of health ICT by important others). The results from this study showed that only subjective norm, but not descriptive norm, is a strong predictor of health ICT acceptance among the participants. Subjective norm as a social influence construct was established as a predictor of intentions in Spil et al. (2010), and Archer and Cocosila’s (2011) studies. Expanding the TAM2 notion of social influences was not supported by the data analyses (hierarchical linear regression and stepwise linear regression). However, the effect of descriptive norm was very weak and indirect through the subjective norm when the structural equation modelling analysis was performed.

The descriptive norm question (i.e. ‘Use of e-Health system’) was not established in referent others employees. The question assessing descriptive norm was rather hypothetical, asking participants to estimate the prevalence of how many of their colleagues would potentially use e-Health system. While in this study of hospital healthcare professionals, ‘referent others’ did not actually use e-Health system, in the referent literature mentioned above, this construct was assessed in settings where the system was already implemented.

Job relevance was shown to be of significant importance (as a predictor of intentions to use future e-Health systems) by all three analyses (hierarchical linear regression, stepwise linear regression, and structural equation modelling). Most of the healthcare professionals were aware that if e-Health system were applicable to their daily job routine, they were more likely to accept such systems. This finding also has implications for policy makers, advocating healthcare professionals’ education on the applicability of e-Health systems prior to their implementation.

Based on Venkatesh and Balla’s (2008) theory, computer anxiety, was proposed to influence e-Health acceptance. Taking into consideration the fact that healthcare professionals have a difficult daily routine, they could have difficulties interacting with computers. However, the hierarchical linear regression, stepwise linear regression, and structural equation modelling applied in this study showed that computer anxiety did not influence e-Health acceptance. Over 70% of participants strongly disagreed with the negative statements associated with ‘computer anxiety’, and over 80% reported a strong association with the statement ‘Computers do not scare me at all’ (Table 4.6), suggesting that computer use was not stressful to the participants of this study. However, this finding can be explained in terms of people using computers more and more in their everyday lives, and computer anxiety might be an out-dated concept among certain groups. Future research is needed to verify the results in wider healthcare settings.

### Limitations of the study

This section indicates the initial findings with respect to limitations of the model used in this part of the study with the aim to propose better research instrument for the second study. However, the limitations of the whole Thesis’ research instrument are discussed in Section 6.3.

First of all, the number of 200 questionnaires distributed to the three clinics in Skopje could not be assumed to be representative of the population of healthcare professionals across the Republic of Macedonia and so it did not allow the findings from this study to be generalised to the whole hospital healthcare population.

There were no demographic data (the hospital healthcare population in the country, the split between city based and less centralised hospitals, the male/female ratio, doctors/nurses ratio, mean years of experience) available from the Macedonian Ministry of Health to be compared with this study demographic data. This is another limitation of the study in that it does not allow the sample of participants in this study to be compared with the overall population. The sample of 200 questionnaires has another limitations discussed in Section 6.3.1

The modified technology acceptance model used in this study has proved its effectiveness in assessing healthcare professionals’ intentions. However, this research instrument and the method used have some limitations. The possible moderation effects of age and gender (as demographic variables), and voluntariness and work experience (as TAM2 moderators) were not assessed in this study. In addition, this quantitative study does not provide a profound explanation of user’s attitudes.

The 7-point Likert scale used in this study when translated into Macedonian language created some difficulties for respondents when addressing the technology acceptance constructs. This assessment model was originally created in English, but it is not so effective when translated into Macedonian.

The sample used in this study was limited to hospital healthcare professionals in the capital, Skopje. There is a need to assess the attitudes of healthcare professionals in other parts of the country. Therefore, the results from this study cannot be generalised to the whole hospital healthcare population in the country.

The second stage of the sampling procedure might have been done in a better way. The participants were chosen randomly by the management of the clinics, which is not the most effective way to develop a sample. The management within these hospitals was not familiar with sampling techniques and that did not guarantee effective sampling.

### Lessons learned and recommendations for improvement of the research instrument

This section focuses on the lessons learned from the main findings and research methodology applied in this study and proposes future approaches for the next study of this Thesis. The study of hospital healthcare professionals described in this chapter tested the effectiveness of revised TAM2 in a sample of hospital healthcare professionals in the Republic of Macedonia. As this research instrument was applied for the first time in a healthcare environment in developing country in SEE, there are novel findings that can serve as a basis for future studies in this area.

The findings from this study demonstrate the predictive value of perceived ease of use, subjective norm, and job relevance, and indicate that TAM2 is a more appropriate research tool than the basic TAM in healthcare settings. TAM2 is a more robust model than the basic TAM, and enables the researcher to capture the social norm’s cognitive behaviour of the targeted population. As a behavioural predictor of participants’ intentions, the job relevance variable assesses the level of relevance of e-Health system in healthcare professionals’ daily routine. The use of these two (subjective norm and job relevance) predictor variables alongside the core technology acceptance variables (perceived usefulness and perceived ease of use) is therefore strongly recommended in the next study of this Thesis (Chapter 5).

The effectiveness of perceived ease of use and a weaker effect of perceived usefulness as behavioural predictors from this study require further confirmation though a more robust study. The future reassessment of the perceived usefulness effect on Macedonian healthcare workers’ behaviour will therefore be important in the next phase of the research.

Other technology acceptance constructs, such as access to PC and computer use hours/years were assessed in this study. The results indicated that non-PC users are associated with lower intentions, perceived usefulness, and job relevance. However, the daily and hourly uses of computer constructs were not established as predictors of intentions among the participants of this study. Therefore, the use of other technology acceptance variables to assess the computer and the Internet use variables may be considered in future studies.

The computer anxiety variable did not show an association with users’ intentions and did not predict e-Health usage intentions, and the mean score of this variable was rather low. As the effect of descriptive norm on Macedonian healthcare professionals cannot be fully assessed from this study, there is a need to re-examine the effect of descriptive norm in a context in which health ICT systems will actually be implemented in the country.

Finally, as the TAM2 is a more advanced research instrument than the basic TAM, it suggests that more complex and robust models may have a better effect in healthcare settings. In the literature review (Chapter 2), newer, advanced and more robust technology acceptance models such as the UTAUT were discussed that can be applied in healthcare settings in their original or modified form or in combination. Therefore, the application of a more advanced research instrument may be considered as a future research instrument in this study.

Although in this study, no differences were found on the basis of gender or age, their effect may be assessed indirectly through more sophisticated research models, such as the UTAUT. Other moderation effects, such as voluntariness of use and past work experience, may be assessed through this more advanced research instrument.

Another lesson learned from this study indicates that it is possible that when translated into other languages, in this case Macedonian, the 7-point Likert scale research instrument created some difficulties for respondents. The gradation moderately disagree and somewhat disagree, and moderately agree and somewhat agree, when translated into Macedonian language created confusion among the participants.

A better sampling approach is needed. The research instrument of this study had a rather narrow sampling procedure, focused on hospital healthcare professionals in the city of Skopje, the capital of the Republic of Macedonia. This fact leads to the need for a more robust study at the national level to capture the attitude of a larger population of healthcare professionals.

The structural equation modelling as second level analyses may reconfirm and establish the prediction model tested by the regression analyses. Therefore, these analyses should be undertaken for the second study as well.

## Conclusions

This chapter has assessed the attitudes of specified sample of hospital healthcare professionals in the Republic of Macedonia towards e-Health technology. The study of hospital healthcare professionals confirmed that the modified version of TAM2 is suitable for developing an understanding of healthcare professional’s acceptance of e-Health system. These findings are in accordance with previous reports on technology acceptance in healthcare settings (Section 2.6). The perceived ease of use, subjective norm, job relevance, and perceived usefulness (established effect through structural equation modelling) constructs derived from TAM2 (Venkatesh and Davis 2000) have shown that this model is appropriate for use in healthcare settings. The findings from this study showed the need for healthcare professionals’ education and or the provision of information about the potential applicability of e-Health in their daily routine. The rise of an organisational culture which promotes the use of novel IT applications could have a positive impact on social norm beliefs, and may lead to greater intentions to use the technology.

The findings from this study are relevant to a specific sample of Macedonian healthcare professionals, and further research will show whether these arguments can be extended to a larger sample. In addition, the findings from the study will be used for the contextualisation of the research model for future specific research on the acceptance of EHR system in the country.

# Study of General Practitioners

## Introduction

Chapter 4 presented the initial research study of this Thesis, which was conducted in the Republic of Macedonia. The study assessed the effectiveness of technology acceptance models across healthcare professionals in hospitals, and demonstrated the effectiveness of the modified version of technology acceptance approach, i.e., TAM2 in the assessment of healthcare professionals’ acceptance of e-Health system.

The study revealed new and interesting findings, confirming that the perceived ease of use variable is the strongest predictor of technology acceptance among group of Macedonian healthcare professionals. This is novel findings, taking into consideration that perceived usefulness, as a technology acceptance predictor variable, had previously been confirmed as the strongest predictor of intentions across several studies (Hyun et al. 2009; Morton and Wiedenback 2009; Wilkins 2009; Devane et al. 2010; Holden and Karsh 2010; Archer and Cocosila 2011; Egea and Gonzalez 2011). Other technology acceptance constructs, such as job relevance (Venkatesh and Davis 2000), and subjective norm (Mun et al. 2005; Venkatesh and Balla 2008), were also found to be strong predictors among healthcare professionals in the country. However, the structural equation modelling has established weak prediction effect of descriptive norm (Rivis and Sheeran 2003). The effect of job relevance’ had been used only in one empirical study previously (Archer and Cocosila 2011), while the effect of descriptive norm was not assessed in healthcare settings (Chapter 2).

This chapter presents the next phase of the research for this Thesis, and examines a modified version of the technology approach, based on the UTAUT introduced by Venkatesh et al. (2003), and later used by Spil et al. (2010), Archer and Cocosila (2011), and Harle and Devar (2012) in healthcare settings. In the research described in this chapter, the findings from the study of hospital healthcare professionals were re-assessed in a further group of healthcare professionals in the Republic of Macedonia, using this modified version of technology acceptance model. Jimoh et al. (2012) proposed assessment of healthcare professionals’ attitudes as a mandatory part of any pre-implementation process. Bartholomew’s (2017) study has recently confirmed that technology assessment among healthcare professionals can be conducted even if the use of EHR system is mandatory.

The literature review in Section 2.6.2 (conducted after the first study) showed that the UTAUT model was the latest and most advanced model for studying technology acceptance across studies in healthcare. An online questionnaire survey, based on a modified version of the UTAUT, was created for this study and was used to examine technology acceptance among GPs at a national level in the Republic of Macedonia. GPs are the first doctors who will be using the proposed new EHR system.

Section 5.2 presents the methods used in this study. A data analyses and results are presented in Section 5.3. Section 5.4 initiates discussion of the major findings of the study (the whole research and assessment of the hypotheses are discussed in detail in the Discussion Chapter 6). Section 5.5 concludes this chapter. However, this study has some limitations which are presented in Section 6.3.

## Methods

This section presents the methods, aims and objectives, and the research instrument used in the study of General Practitioners. The progress of the research instrument throughout the Thesis is discussed in detail in Section 6.2.

### Aims and objectives

The aims and objectives of the second study were slightly improved. The main aim of the study described in this chapter was to explore GPs’ intentions to use the future EHR system in the Republic of Macedonia. More specifically, the objectives were:

* to assess the readiness of GPs in the Republic of Macedonia for future acceptance of EHR system on a national level;
* to address the role of the basic predictors of the original UTAUT model such as performance expectancy, effort expectancy, social influence, and facilitating conditions on EHR usage intentions in the country;
* intentions for EHR future use can be also assessed after controlling with other technology acceptance predictors such as job relevance, descriptive norm, and satisfaction with existing health ICT systems, already implemented in the country;
* to assess the moderation effect of basic moderation variables such as age, gender, and previous work experience; and
* to examine the findings from the study of hospital healthcare professionals described in Chapter 4, on a further group of healthcare professionals in the Republic of Macedonia.

Having presented the aim and objectives for this part of the study, and a rationale for these objectives, next section explores the research methods which will be applied in the study of General Practitioners.

### Positivist quantitative approach

Findings from the study of hospital healthcare professionals were applied in the development of the research instrument for the study of General Practitioners described in this chapter. As discussed in Section 3.3 in the Methodology Chapter, researchers, through a positivist approach, may remain detached from the respondents, and they can remain emotionally neutral, with the aim of achieving a distinction between reason and feeling. This approach has a fixed structure, which allows only specific answers to each question and new knowledge can be developed, as reality may be measured objectively and independently by the researcher (Clark 1998). Mason (2002) indicated that the science of psychology has for a long time been associated with quantitative research methods, and technology acceptance models are derived from the science of psychology. May (2001) recommended that a quantitative approach may be used to show the strength of statistical association between variables. If the sample is representative of the population of interest, the findings from a quantitative study may be generalised to the wider study population (Morris 1989).

A positivist paradigm was therefore identified as the most appropriate methodological framework for assessing the attitudes of Macedonian healthcare professionals in the study in this Thesis, and therefore for studying GPs’ attitudes in this chapter. A positivist quantitative methodology approach through a questionnaire survey was decided upon for the research. Quantitative methods based on a positivist approach, recommended by Myers (1977), Sayer (1992), Sarantakos (1993), and Silverman (1993), were used in the current study. Almost all relevant studies identified in Table 2.4 used a quantitative approach through a questionnaire survey. However, assessing larger national samples like the one used in this study would not be feasible using a qualitative approach. Eisenhardt’s (1989), recommendations on appropriate complexity of the study were taken into consideration with the aim of providing accurate relations between the tested variables in the study.

### Development of research hypotheses

According to Saunders’s (1997) and Bowling’s (1997) recommendations discussed in Section 3.3.1, four hypotheses were developed for this study and a research strategy was developed to test them through collection and data analyses. Preacher et al. (2006) recommended the development of hypotheses as a proposed explanation of phenomena involving multiplicative interaction or moderation effects. The findings from Chapter 2 of the literature review indicated that the UTAUT model is the most advanced model for the assessment of the future intentions to use the ICT system in healthcare (Archer and Cocosila 2011; Harle and Dewar 2012; Razeghi & Nasiripour 2014). However, this model has been used in only a limited number of studies until now. In almost all research studies, the UTAUT model is used in combination with other technology acceptance models or variables. Holden (2010) stressed the need to have a contextualized technology acceptance approach for healthcare professionals, as they are not like software company employees. There are differences between the employees in these two contexts and there is a need to have a health-specific model of technology acceptance. Egea and Gonzalez’ (2011) recommendations for future research to determine the influence of external variables, such as socio-demographics, in technology acceptance of EHR were taken into consideration when the hypotheses were developed.

Walter and Lopez (2008) and Romano and Stafford (2011) recommended that there is a need to develop a model applicable to a healthcare settings, to measure the adoption barriers, effectiveness, and actual use of the EHR among end users. Models that will be used within healthcare settings should be sensitive to the needs of this profession. Technology acceptance in healthcare is different from other domains and there is a need for a new contextualized model of technology acceptance. Basic technology acceptance models developed for the general public do not necessarily apply in the healthcare environment.

Findings from the literature review (Chapter 2) were combined with those from Chapter 4, the study of hospital healthcare professionals, where the modified version of TAM2 was found to be suitable for an assessment of intentions of healthcare professionals in the Republic of Macedonia. Main findings from the study of hospital healthcare professionals confirmed that the modified version of the technology acceptance model appeared to be suitable research instrument for prediction of intentions in healthcare. These findings contributed to the creation of the following hypotheses:

**H1:** Performance expectancy, effort expectancy, social influence, and facilitating conditions will directly predict intentions to use the EHR system (Hypothesis derived from the UTAUT studies) (Venkatesh and Davis 2000; Venkatesh et al. 2003; Mun et al. 2006; Venkatesh and Balla 2008).

**H2:** Job relevance, satisfaction (with currently used e-Health systems in the country) and use of ‘Other technology’ will predict intentions to use the EHR system indirectly, through the effects of performance expectancy (Hypothesis derived from the TAM2, the study of hospital healthcare professionals, and the literature review) (Venkatesh and Davis 2000; Teo et al. 2008).

**H3:** The effects of performance expectancy, effort expectancy, social influence, and facilitating conditions will be moderated by the following UTAUT moderators: age, gender, and previous work experience (Hypothesis derived from the UTAUT model) (Venkatesh et al. 2003).

**H4:** Descriptive norm (e.g., how many colleagues will use the system if it is implemented) will predict intentions to use the EHR system, as a distinct/independent social influences indicator (Hypothesis derived from Venkatesh and Davis 2000; and Rivis and Sheeran 2003 studies)

### The questionnaire survey

As discussed in the Methodology Chapter 3, survey studies in quantitative research are conducted through questionnaires. The questionnaire survey as the most common method of data collection in quantitative studies in ICT research was considered (Burkle et al. 2001). The development of the questionnaire is very important for generating high quality data, which will enable proper analyses and testing of the hypotheses tested in Sections 5.3.7 to 5.3.12.

Recommendations from Bland (1991), who argued that a greater number of variables makes the interpretation of the results of the regression model more difficult were also taken into consideration. The questionnaire was designed according to Silverman’s (1993), Fink’s (1995), and Patten’s (2007) suggestions that quantitative surveys are suitable for assessing the attitudes, beliefs and behaviour of the targeted population were also taken into consideration. Bowling (2002) indicated that a questionnaire with an attitude scale is an effective tool for assessing users’ attitudes. Bourque and Feilder’s (1995) recommendations for development of questionnaires through the adoption and adaptation of questionnaires from previous studies were also taken into consideration. The authors proposed that the questionnaire could be developed in one language, and later translated into other languages, if required (Section 3.3.2).

Quantitative study results can be generalized from the sample to the whole target population, assuming that the sample is representative of the population. However, in quantitative studies like this study, there is a risk of a low response rate, and the possibility for poor and incomplete responses in a questionnaire survey.

The research instrument for the study was also created based on the findings from the study of hospital healthcare professionals, and integrating aspects of more recent approaches in the field of technology acceptance research and EHR adoption (De la Torre et al. 2001; Amatayakul 2005; Spil and Katsma 2007; Spil et al. 2010). Specifically, the results from the study of hospital healthcare professionals, together with the latest research articles found in the literature on the UTAUT utilization, were used for development of the research instrument of this study. The original UTAUT model presented by Venkatesh et al. (2003) captures the essential elements of previous technology acceptance models and is the latest developed model for technology acceptance. The model’s effectiveness has been proven in several studies in healthcare settings (Spil et al. 2010; Archer and Cocosila 2011; Harle and Dewar 2012).

Ideally, the same technology acceptance model should have been used throughout the research. However, important and novel findings were revealed in the first study with respect to few technology acceptance variables. The idea of introduction of the UTAUT in the second study of this research was to mainly reassess the findings from the first study through a slightly improved research instrument. Although, it was realised that this may reduce the possibility of merging the data from both studies and analysing them together, it could have an impact on the current knowledge through establishing new important technology acceptance predictors. There was a need to re-confirm the findings from the initial study as they were different from the literature, and they had created interest among the researchers (indicated by the number of citations of the published paper, 112 citations since 2012).

### Questionnaire design

Questionnaire items that have been shown to be strong predictors of intentions in the study of hospital healthcare professionals were included in the questionnaire for the study of General Practitioners. Closed questions, where the respondent has to choose between pre-defined options, were considered for the study according to Oppenheim’s (1992) and Denscombe’s (2007) recommendations. Therefore, a set of closed unified questions for measuring the UTAUT and other technology acceptance constructs were developed for this study. An online questionnaire survey was considered, as this is a less time consuming method, is low cost, and covers a wider geographical area over a larger sample size, in comparison with the traditional ‘paper and pencil survey’.

The findings from the study of hospital healthcare professionals, which indicated that the modified version of the TAM2 is suitable for assessing the attitudes of healthcare professionals in the Republic of Macedonia, were considered as a starting point for the research instrument of the study of General Practitioners. The UTAT model was proposed as the leading research technology acceptance theoretical framework, supported by previous research (Legris et al. 2003; Venkatesh et al. 2003; Ma and Liu 2004; Schepers and Wetzels 2007). However, the difference between the UTAUT and the TAM2 is very small. The literature review showed that the UTAUT model was the latest and most advanced model for studying technology acceptance across studies in healthcare, although it has only been used in a limited number of research studies (Spil et al. 2010; Archer and Cocosila 2011; Harle and Dewar 2012). In all these studies, it was used in combination with other technology acceptance models (as discussed in Section 2.6.2, Table 2.4). However, the progress of the research instrument and the development of the research model (from modified TAM2 to modified UTAUT) throughout the Thesis are discussed in Section 6.2.

The aim of the study was to assess the effect of the UTAUT’s variables on performance expectations and effort expectations (Venkatesh and Davis 2000; Venkatesh et al. 2003; Mun et al. 2006; Venkatesh and Balla 2008) on EHR usage intentions. Social influence, i.e., perceived social approval of EHR use by other colleagues (Venkatesh et al. 2003; Mun et al. 2006; Venkatesh and Balla 2008) and UTAUT other measures such as facilitating conditions (Venkatesh et al. 2003), were also measured in the study. Descriptive norm, i.e., the estimated use of EHR by colleagues in the future (Rivis and Sheeran 2003) and other technology acceptance constructs, such as job relevance (Venkatesh and Davis 2000), use of ‘Other technology’ for professional or leisure purposes (Teo et al. 2008) and satisfaction with existing e-Health systems that are currently in use in the country, were included in the study as well. Satisfaction items were included according to the researcher’s expectations, to assess the user’s experiences with the currently used e-Health systems in the Republic of Macedonia (‘My term’ and ‘Electronic health card’) and the way that they influence the healthcare professionals’ beliefs about future e-Health applications, such as EHRs.

UTAUT’s three moderating variables, i.e., gender, age, and experience, were tested on Macedonian healthcare professionals. The voluntariness of use as UTAUT moderator was excluded as not being relevant for the Macedonian doctors, as the future EHR use will be mandatory for all healthcare professionals in the country. Although it is possible that voluntariness of use has some moderation effect on Macedonian healthcare professionals, this moderator was not included, in order to keep the research instrument efficient and keep the complexity of the study at an appropriate level (Eisenhardt 1989). However, a working area demographic construct was included with the aim of assessing possible working area differences among Macedonian health professionals. The following variables were included in the questionnaire:

* performance expectancy as a leading UTAUT construct was assessed using five items reflecting several aspects of individual beliefs, presuming that using EHR systems will help him or her to attain gains on job performance (e.g., “Using EHR systems will improve my job performance”). The measure was derived from Venkatesh et al.’s (2003) and Venkatesh and Balla’s (2008) studies, and higher scores indicated a higher perceived expectancy of the EHR system;
* effort expectancy was measured using eight items describing several aspects of ease of future use associated with the EHR system (e.g. “I would find EHR systems easy to use”). The measure was derived from studies by Venkatesh and Davis (2000), Venkatesh et al. (2003), Mun et al. (2006), Venkatesh and Balla (2008) and higher scores denoted higher ease of use of the EHR system;
* social influence was measured using three items denoting how an individual perceives what important others believe about whether he or she should use the system. Measures were derived from Venkatesh et al. (2003), Mun et al. (2006), and Venkatesh and Balla (2008), reflecting perceived acceptability and endorsement of EHR system by ‘important others’ colleagues. Higher scores denoted greater perceived social approval of the system by ‘important others’ colleagues;
* descriptive norm was measured through a single item derived from Rivis and Sheeran’s (2003) study on nominative influences. This rather hypothetical question was posed with the aim of assessing end users estimates of how many of their colleagues would use the EHR system if it was implemented;
* facilitating conditions were measured using four items defining the degree to which an individual believes that organizational infrastructure will support the use of the EHR system (e.g., “A specific person or group is available for assistance with system difficulties”). All items were derived from Venkatesh et al. (2003), denoting a person’s beliefs about the existence of an organizational environment designed to remove barriers to use. Higher scores denoted participant beliefs in more developed organizational or technical infrastructure for support of the system;
* usage intentions were assessed using four items assessing behavioural tendency and willingness to use the EHR system (e.g., “I intend to use EHR system if they are implemented”). All items were derived from TAM2 (Venkatesh and Davis 2000), and Mun et al. (2006), and higher scores denoted stronger intentions to use the system. ‘Intention to use’ was used as a dependent variable, as explained in the previous study;
* job relevance of the EHR system to the GP’s job environment was measured using two items derived from Venkatesh and Davis’ (2000) original TAM2 and Archer and Cocosila’s (2011) study (e.g. “In my job, usage of EHR systems will be relevant”). Higher scores reflected greater perceived job relevance of the EHR system to a doctor’s job tasks;
* computer use, the Internet use for professional and personal needs, and use of ‘Other technology’**,** as possible technology acceptance predictors were assessed with five items derived from Teo et al.’s (2008), Devane et al.’s (2010), and Morton and Wiedenback’s (2010) studies. The first item asked participants whether they use ‘Other technology’ such as tablet PC, smartphone, iphone, or laptop to access the Internet (with a yes/no response option). Two further open-ended questions asked participants to report the number of years they had been using a computer and the time per day (hours) they use a computer. The final two items assessed respondents’ use of the Internet for personal needs (entertainment, online banking and social networking) and professional needs (assessing or storing patient information) through 4-item scale (1 = never/rarely, 2 = 1-2 times a month, 3 = 1-2 times a week and 4 = several times a day); and
* satisfaction was assessed through five items measuring GPs’ satisfaction, and their personal beliefs with respect to patients’ satisfaction, with currently used e-Health systems in the country. As noted in the Introduction Chapter (Sections 1.4.3 and 1.4.4), at the time when the study was conducted, only the ‘Electronic health card’ (providing access to basic patient personal data and health insurance), and the ‘My term’ (an online appointment) systems were being implemented in the Republic of Macedonia at that time.

Descriptive norm, use of ‘Other technology’, and satisfaction are three additionally technology acceptance variables that were added to the original UTAUT. The intention for adding these three variables to the research model was to make the instrument more country specific and achieve greater scientific vigour in the Thesis. There are other variables described in the literature, such as trust (Egea and Gonzalez 2011), privacy and data protection (Hoebrst and Ammenwerth 2010), which may be used as potential technology acceptance predictors and could be included in this study research instrument. However, the modification of the basic UTAUT model was limited to the three additionally added variables (descriptive norm, use of ‘Other technology’, and satisfaction), and constructs such as trust, privacy and data protection were not included in order to maintain an appropriate level of complexity of the study. However, the possible technology acceptance effect of these constructs is noted and discussed in the Limitations Section 6.3.1.

Tables 5.1, 5.2, and 5.3 present an overview of technology acceptance constructs used in the study questionnaire.

Table 5.1: UTAUT constructs used in the questionnaire

|  |  |
| --- | --- |
| **Construct** | **Question** |
| Performance expectancy | 1. Using EHR system would improve my job performance |
| 2. Using EHR system would increase my productivity |
| 3. Using EHR system would enhance my effectiveness |
| 4. Using EHR system would help me to accomplish tasks more quickly |
| 5. Overall, I would find EHR system useful for my work |
| Effort expectancy | 1. I would find EHR system easy to use |
| 2. Interacting with EHR system would be easy and understandable |
| 3. I would find it easy to get the EHR system to do what I want it to do |
| 4. Interacting with EHR system would require lot of mental effort |
| 5. It would be easy to me to become skilful at using EHR system |
| 6. I will be able to use EHR system effectively |
| 7. Using EHR system will be an easy task for me |
| 8. I will easily work with the EHR system |
| Social influence | 1. In general, EHR system will be well approved and supported by most of my colleagues |
| 2. The colleagues that I respect most would accept the EHR system |
| 3. People who influence my behaviour think that I should use the EHR system if it is implemented |
| 4. People who are important to me think that I should use the EHR system if it is implemented |
| Facilitating conditions | 1. I have the necessary resources to use the EHR system |
| 2. I have the necessary knowledge to use the EHR system |
| 3. The EHR system is compatible with other systems that I currently use |
| 4. A specific person (or group) will be available for assistance with  EHR system difficulties  EHR |

All items from the Table 5.1 were assessed through a 5-point Likert scale (strongly disagree to strongly agree). According to the original UTAUT moel (Venkatesh et al. 2003), the performance expectancy items could be influenced by gender and age moderators. The effort expectancy and social influence constructs might be moderated by age, gender, and experience moderators, while facilitating conditions might be moderated by age and experience moderators. The voluntariness of use was not assessed in the study, as the future use of the EHR in the country will be mandatory.

Table 5.2: TAM2 constructs used in the questionnaire

|  |  |
| --- | --- |
| **Construct** | **Question** |
| Intention  (TAM2 + UTAUT) | 1. I intend to use EHR system if it is implemented |
| 2. I expect to use EHR system if it is implemented |
| 3. I plan to use EHR system if it is implemented |
| Job relevance | 1. In my job, the use of EHR system would be important |
| 2. In my job, the use of EHR system would be relevant |

All items included in the Table 5.2 were assessed through a 5-point Likert scale (strongly disagree to strongly agree).

Table 5.3: Other technology acceptance constructs used in the questionnaire

|  |  |  |
| --- | --- | --- |
| **Construct** | **Question** | **Response categories** |
| Satisfaction (with existing e-Health systems) | 1. I am satisfied with the ‘Electronic health card’ system that I currently use | 5-point Likert scale  (strongly disagree to strongly agree) |
| 2. I am satisfied with the ‘My term’ system that I currently use |
| 3. The systems I currently use have improved my performance |
| 4. My patients are satisfied with the systems that are currently used |
| 5. Overall, the systems used currently are effective |
| Descriptive norm | 1. How many of your colleagues do you think will use EHR system if it is implemented? | 1=none of them,  2=few of them,  3=some of them,  4=most of them,  5=all of them |
| Computer  use | 1. Approximately for how long have you been using computers? | Years (fill in) |
| 2. On average, how many hours a day do you use a computer? | Hours (fill in) |
| 3. Do you use mobile devices to access the Internet, such as tablet, smartphone, iphone or laptop? | Yes/No |
| 4. Approximately how often do you use the Internet for personal needs such as entertainment, online banking, and social networking? | 1=never/rarely  2=1-2 times a month,  3=1-2 times a week,  4=several times a day |
| 5. Approximately how often do you use the Internet for professional purposes, such as accessing or storing patient information? | 1=never/rarely  2=1-2 times a month,  3=1-2 times a week,  4=several times a day |

### Measuring scale, translation, web platform

Oppenheim’s (1992) and Bowling’s (2002) recommendations for Thurstone, Guttman, and Likert attitude scales were considered for the questions included in the study. Oppenheim (1992) wrote that beliefs and behaviour intentions can be measured and predicted by attitude scales. May’s (1997) recommendations for quantitative research using questionnaire surveys were used in the study in order to assess the respondents' attitudes towards specified subjects with an attitude scale. Questions in the attitude scale were phrased in such a way that respondents could agree or disagree with them. Response options for the UTAUT and other technology acceptance measures were initially coded on a 7-point Likert scale (1=strongly disagree, 2=moderately disagree, 3=somewhat disagree, 4=neutral, 5=somewhat agree, 6=moderately agree, and 7=strongly agree), unless otherwise stated. Demographic questions relating to gender, age, location, and years of working experience were assessed using predefined or open-ended response options. The descriptive norm item was assessed with pre-defined answering options (i.e., none of them, few of them, some of them, most of them, and all of them). Items assessing computer use were assessed through questions with open-ended answering options (i.e., years and hours of use). The ‘Other technology’ use item was assessed with a pre-defined yes/no answering option. The use of the Internet for personal and professional purposes item was assessed with pre-defined answering options (i.e., 1=never/rarely, 2=1-2 times a month, 3=1-2 times a week, and 4=several times a day).

All questions for the study were initially developed in English and the translation-back translation method was used by the researcher to translate them into the Macedonian language according to Bourque and Feilder’s (1995) and Hambleton’s (2001) recommendations. The UTAUT model is robust enough to withstand translation and to be used cross-culturally, outside of the original country and language of origin. The appropriate order of items was defined and a table was created for easier assessment of the measured items (Bourque and Feilder 1995; Hambleton 2001).

The questionnaire initially was created as a Microsoft WordTM document. For the purpose of the study an online web form on a SharePointTM platform was developed. Later, the proposed questionnaire for the study was uploaded onto the web platform. The web form was hosted in the cloud, containing all the predefined questions with the answering options. The web form was designed to enable anonymous participation in the study.

### Questionnaire validity

Content validity is a non-statistical type of validity assessment that can be performed by systematic exploration of the tested items in the study. The aim is to determine whether the question represents a pertinent item of the targeted behaviour that will be measured. Carmines and Zeler (1994) proposed that content validity could be achieved through an in-depth literature review and the creation of a research instrument that measures the items appropriately. Careful selection of the items, based on the literature review (Venkatesh and Davis 2000; Venkatesh et al. 2003; Rivis and Sheeran 2003; Venkatesh et al. 2003; Mun et al. 2006; Teo et al. 2008; Venkatesh and Balla 2008), where included in the study questionnaire to try and ensure the content validity of this research. To improve the content validity of the questionnaire, all of the proposed questions were discussed with supervisors and with experienced researchers who were familiar with the area of technology acceptance.

Construct validity measures the degree to which selected items in the questionnaire measure what they claim. It reflects how the included items actually reflect the true theoretical meaning. Carmines and Zeler (1994) proposed that construct validity is the extent a particular measure is associated with other measures consistent with theory. Researchers may test the construct validity before the main research study through a small-scale preliminary pilot study (Section 5.2.8) (Archer and Cocosila 2011; Harle and Devar 2012), which can establish the strength of the questionnaire.

### Research ethics

The study was carried out in accordance with the University of Sheffield Research Ethics Policy (2014). Although this research was carried out in within the country’s healthcare system, research ethics approval was obtained from the University of Sheffield, because there is no organisation in the country that could deal with a country-wide study of GPs, in accordance with the University’s research ethics policy. All ethical issues were considered before the development of the research strategy for the study. The main aspect of the study research ethics framework was to address principles of good research practice and integrity. The researcher was aware that the research instrument should not embarrass the research population or impose any material disadvantage, according to Saunders (1997) recommendations. The study of General Practitioners was conducted with integrity, honesty, openness, and cultural sensitivity. Any possible risk to participants was minimised. The study’s ethical appropriateness was acknowledged by the researcher according to Howard’s (1985) recommendations. The researcher ensured that all the rights and dignity of participants in the study were respected and that there was no harm to participants during their interaction with the research, according to Denscombe’s (2997) recommendations. The safety and well being of the participants in the study, and his own safety, was one of the main responsibilities of the researcher, according to Israel and Hay’s (2006) recommendations. The study research instrument was designed to avoid collection of identifiable personal information from the participants.

The UK Department of Health (2005) recommended that ethical issues should be an important part of the research and that there should be an independent review by an ethics committee, and these were taken into consideration. The recommendations of the University of Sheffield Research Ethics Policy (2014) involving human participants, personal data and human tissue were fully implemented. This policy complements the National Health Service (NHS) ethics review system (University of Sheffield Research Ethics Policy 2014). The University of Sheffield Research Ethics Policy (2014) requires that research ethics approval must be obtained prior to every research study involving human participants, their data or tissue. The researcher should obtain a person’s consent to participate in the study. The University Research Ethics Policy (2014) recommended that the participant’s consent should be obtained, must be given freely and voluntarily without involving any kind of pressure. Therefore, participants were informed, by an invitation sent by email, that they could take part in the study voluntarily, and completing and submitting the questionnaire would be considered as having obtained consent for participation (implicit consent).

The well-being and rights of the participants were taken into consideration and were not exposed to any danger greater than the ones that they face in their normal life. Therefore, no discomfort or harm were expected for the participants during the study data gathering, and that was reported in the ethics approval process according to the University of Sheffield Research Ethics Policy (2014).

Research ethics approval was obtained before the commencement of data collection, as required under the University of Sheffield Research Ethics Policy (2014). Ethics forms for this research were submitted to Sheffield University Ethics Committee in January 2014. Written consent for the study was obtained from the University of Sheffield’s Research Ethics Coordinator on 24th of February 2014. The application form from the researcher and written approval of the University of Sheffield Research Ethics Coordinator are available in Appendix B.2 of this Thesis. All participants were fully informed in the attachment accompanying the invitation email that their email addresses were obtained from the national Health Insurance Fund mailing list. They were informed that they could take part in the study voluntarily, that they could withdraw from the study at any time. In addition, they were informed of the procedures and aims of the study, and of its impact and benefits. Participants took part in the study anonymously, and they were not asked to reveal their personal contact information at any time.

Data collection was monitored by the researcher at all time during the survey. No adverse effects were reported by participants. The researcher provided a level of security of the data appropriate to the nature of the study research. All data gathered from the study were kept secure at all times in the researcher’s private PC, protected by password. The study gathered data will not be retained for a longer period of time than is necessary. The disclosure of any information to third persons was avoided.

### Pilot study

The pilot study was conducted before the main study with aim to assess the construct validity of the proposed questionnaire. Participants in the pilot study were asked to report to the researcher if the items of the questionnaire were relevant to its scope and aims of the study. The pilot study also assessed the quality and comprehensiveness of the proposed questionnaire. For the scope of the pilot study, ten GP participants were chosen randomly from the national Health Insurance Fund mailing list in the Republic of Macedonia. The pilot study was conducted from 2nd to 16th of June 2014. All participants were invited to take part voluntarily in the pilot study through an invitation sent by email. They were informed that they had been selected randomly from the national Health Insurance Fund mailing list. Participants were invited to comment and evaluate the proposed questionnaire, for the purpose of the future research study, which would be conducted on the national level. They were also informed that this was a scientific research study, which might lead to benefits for the national Health Insurance Fund, healthcare professionals, and for the healthcare system in the future. The validity of the questionnaire was additionally tested through data analyses, when variables measured in the questionnaire were assessed to see whether they correlated with each other in directions predicted by the theory (Section 5.3.5).

An email containing the above-mentioned explanation, the link to the online study questionnaire and an evaluation questionnaire in Microsoft WordTM format was sent to the participants in the pilot study. The invitation email, pilot study questionnaire, and the evaluation questionnaire for the pilot study are included in Appendix B.1.

Five participants in the pilot study responded to the questionnaire. The main remark from participants in the pilot study was that some questions had double negatives. Therefore, those remarks from the participants in the evaluation questionnaire were taken into consideration and necessary changes, such as avoiding the double negative in the above-mentioned questions, were implemented in the final version of the study questionnaire.

With respect to content and construct validity, respondents answered that all items included in the questionnaire measured what they intended. However, some of the participants in the pilot study commented that several of the questions measured the same, or similar, constructs. This remark was made in the pilot study of the hospital healthcare professionals’ research as well (Section 4.2.9). However, the basic structure of the UTAUT model includes several items that sound similar to each other. This issue was therefore addressed by including the following statement in the introduction part of the questionnaire of the study:

“Please select an answer to each question by ticking or circling the answer that best represents your views. Please bear in mind that there are no wrong or right answers, and we are only interested in your personal views. Please respond as honestly as possible.”

The aim of this statement was to explain the specifics of the technology acceptance models to the participants. The research model comprised questions that were similar to each other. It was expected that the participants would address all questions.

Respondents in the pilot study remarked that a 7-point Likert scale degree explanation in the Macedonian language created difficulties in finding the appropriate answer. For that reason, a 5-point Likert scale (1=strongly disagree, 2=moderately disagree, 3=neutral, 4=moderately agree, and 5=strongly agree) was used for the main part of the study. The literature review on methodology, Section 3.3.2 has indicated the usage of five-point Likert scale as well.

All necessary changes and remarks from participants in the pilot study were implemented in the final version of the online questionnaire for the study. As there were only minor changes in the research instrument of this study, the responses of the pilot study were not included in the final research dataset. The final Microsoft WordTM version of the questionnaire is included in Appendix B.3 of the Thesis.

### Questionnaire reliability

The reliability of the study can be expressed as the consistency of the questionnaire as a research instrument (Section 3.6.2). Therefore, the reliability test in the study assesses whether the proposed items measure the same general construct and produce similar scores. Internal consistency reliability can be calculated with pair-wise correlations between items and is expressed through Cronbach’s alpha (α) coefficient (Fink 1995; Devane et al. 2010; Egea and Gonzalez 2011).

The study questionnaire’s reliability was assessed via computation of the internal consistency reliability indicator, Cronbach’s α (Fink 1995; Devane et al. 2010). The reliability analysis in the study with Cronbach’s alpha (α) is presented in Table 5.4, and showed that all constructs used had *α* coefficients that ranged from .69 to .94.

Table 5.4: Reliability coefficients of the study

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable: | Intention | Performance expectancy | Effort expectancy | Facilitating conditions | Social influence | Descriptive norm | Job relevance | Satisfaction |
| Cronbach α: | .94 | .91 | .88 | .74 | .93 | .85 | .69 | .88 |

However, studies like the study of General Practitioners with the multi-item Likert scale which measures more than 4 items, coefficients in the range of .70 or higher indicate high internal consistency reliability (Im et al. 2011). Therefore, the internal consistency reliability indicator Cronbach’s α values in the study had acceptable levels of internal consistency. However, the job relevance items had only average inter-item correlation, although it was just below the level for high reliability, and they were kept for further analyses.

### Sampling

The recruitment of a sample that reflects the attributes of the target population is one of the most important parts of a study. Achieving representativeness in the study allows transference of the results of the study population (generalisation) and findings from the research can be deemed applicable to the whole population (Morris 1989). Quantitative studies, such as this study, are more suitable for generalising the results from a sample to the whole target population according to Punch (1998). Therefore, the sample for the study should be representative of the population from which it is drawn (Cohen 1992).

Conducting a study in larger and more representative settings is necessary for a better understanding of the predictors of technology acceptance of the EHR among healthcare professionals in the Republic of Macedonia. The EHR system in the country is going to be implemented at a national level and for that aim a larger representation from healthcare professionals around the country is needed. Therefore, questionnaires distributed to larger samples were used in the study with the aim of assessing doctors' attitudes across the country.

Once identified, a sampling method was applied in order to determine which healthcare participants would be invited to participate. A two-stage cluster sampling method was used with the aim of sampling participants to meet the inclusion criteria for the study. Representative healthcare institutions/participants were determined in the first stage. GPs in the Republic of Macedonia were proposed as the target group that would use the system first and on a daily basis as part of their daily routine. In the second stage, the number of invited participants for the study was identified. GPs with registered (those who had active contracts with the national Health Insurance Fund) e-mail addresses were selected in the second stage. However, the sampling strategy of the study has limitations, which are discussed in Section 6.3.2. The sampling strategy of the study is presented in Table 5.5.

Table 5.5: The sampling strategy for the study

|  |  |
| --- | --- |
| **Two-stage cluster sampling for the study** | |
| Stage 1 | Identifying healthcare settings, determination of the representative sample/representative healthcare institutions identified |
| Stage 2 | Sample size: defining the number of participants |

### Study procedure

The personal contact details of participants for the study were obtained from the national Health Insurance Fund mailing list. The list of active e-mail address of GPs registered (those who had active contracts with the national Health Insurance Fund) in the Republic of Macedonia for the year 2014 consisted of 1174 addresses. At this time, there were 1631 registered GPs in the country. The online survey was conducted during the period from 1st of July to 31st of August 2014. An invitation email with a link to the study was sent to all of the identified participants for the study.

All participants were informed that they were invited to take part voluntarily in the study. They were also informed of the reasons for the research from the study, the potential benefits for them, the health insurance system and the Republic of Macedonia, and that it would contribute to new knowledge in the area of technology acceptance.

An attachment with information on the survey for potential participants, accompanied the invitation email. The invitation email, its attachment, and final version of the study questionnaire are included in Appendix B.3. General information on EHR was included in a short introduction to the questionnaire. Participants were informed that EHRs are a store of the required information relating to the patient’s status. This information may be stored and exchanged among multiple health care professionals and users. The primary purpose of the EHR was explained as providing support for continuing, efficient and quality integrated healthcare. Further, participants were informed about e-Health systems such as ‘Electronic health card’ and ‘My term’, which had been implemented at that time in the Republic of Macedonia. They were also informed that only a few components of e-Health had been implemented at that time and other major parts of the EHR would be introduced in the near future. However, in 2017 these parts of the EHR were not implemented in the country (Section1.4.7).

Participants in the study were also informed that, through the following questions, the researcher would like to learn about their beliefs and opinions about the future use of EHR systems in their everyday work routine. They were informed that understanding the doctor’s expectations of systems could help to develop and implement better systems in the country.

Participants were also informed about the aim and objectives of the survey. In particular, the aim of the study was presented as an assessment of doctors’ attitudes towards the EHR system in the Republic of Macedonia. The objectives of the study were presented as:

* to provide comprehensive information on doctors’ intentions to use the EHR system;
* to examine relationships between technology acceptance variables and doctors’ readiness to use the EHR in the Republic of Macedonia;
* to discover doctors’ views on the possible use of the EHR;
* to explore relationships between various demographic factors;
* to develop an EHR implementation strategy; and
* to examine relationships between demographic factors and doctors’ willingness to use EHR.

The initial emails inviting doctors to participate in the survey were sent on 1st of July and two reminder emails were sent to participants on 15th of July, and 1st of August 2014 with the aim of increasing the response rate for the survey. All data analyses for the study were conducted through IBM SPSSTM software. The latest version of IBM SPSSTM statistics Version 22 provided by University of Sheffield Corporate Information and Computing Services (CICS) were used, with the aim of providing the most accurate and contemporary data analyses.

### Analyses

The gathered data were entered manually in the IBM SPSSTM statistics Version 22. Descriptive statistics were applied to the study to summarize and describe the data that had been collected. Descriptive statistics enabled the subsequent inferential statistics to be more robust. The study research instrument provided lot of data with good quality, and it was possible to visualize it. Therefore, descriptive statistics methods such as range, mean, standard deviation, Kolmogorov-Smirnov, and skewness and kurtoses (Altman 1991) were applied to describe the data gathered in the study. Tables summarising the UTAUT and other technology acceptance variables were created with the aim of highlighting the important information on technology acceptance variables.

Mann-Whitney tests were used to assess gender and location differences (Harle and Devar 2012; Razeghi and Nasiripour 2014). Kruskal Wallis test was applied to assess the differences across the three ‘age groups’ and three ‘years in service’ groups. Spearman rank correlation was used to assess correlations between UTAUT variables and intention (dependent) variable to use the EHR system (Harle and Devar 2012). According to Goodwin (1998), a major strength of correlation research is that predictions about human behaviour can be made when strong correlations exist. Relationships between two variables can be investigated by taking a bi-variate approach.

To test the proposed hypotheses, hierarchical linear regression (Egea and Gonzalez 2011; Harle and Devar 2012; Gagnon et al. 2014), stepwise linear regression, structural equation modelling (Morton and Wiedenbeck 2009; Archer and Cocosila 2011), moderated multiple regression, and mediation analyses were used. These analyses were applied according to Goodwin (1998) recommendations, where relationships between more than two variables can be examined using a multivariate approach, e.g., multiple linear regression. However, regression analyses do not require normal distributions of the dependent or independent variables (Section 4.2.11).

Hierarchical linear regression was identified as a useful inferential statistics tool for assessing the effectiveness of the UTAUT and other technology acceptance variables. The two-step conceptualization of the model allows identification of constructs that predict behaviour. The hierarchical linear regression can measure association of multiple technology acceptance constructs proposed in the study with intentions for future use of the EHR.

Stepwise linear regression (forward model) was applied in the study with aim to identify the most important variables from the list of proposed technology acceptance constructs. Stepwise linear regression in the study explained the relative contribution of each separate technology acceptance construct to the overall prediction model. Following each step of the model, the weakest predictor variables (i.e., that were not statistically significant) were removed from the model. Therefore, variables that stayed in the end of the model were identified as being the strongest behaviour predictors of the GPs’ behaviour in the study.

Structural equation modelling was performed as a second level of analyses to reassess the findings from the regression analyses. This analysis was also used to test the proposed hypotheses.

A moderated regression analysis (Venkatesh et al. 2003) applied in the study’s UTAUT constructs allowed the researcher to assess whether the observed significant effects of predictors (performance expectancy, effort expectancy, facilitating conditions, and social influence) become stronger or weaker depending on the influence of hypothesized moderators (age, gender, and working experience). Multiple mediation methodology (Preacher and Hayes 2008) was used to assess the indirect effect of job relevance as TAM2 distal predictor on usage intentions, after controlling for the potential mediation effects of basic UTAUT variables.

## Results

This section presents the core findings of this Thesis. In the first part, the response rate (Section 5.3.1) and descriptive statistics (Sections 5.3.2 and 5.3.3) of the sample characteristics are presented. The second part presents the inferential statistics (Section 5.3.4) through Spearman rank correlation (Section 5.3.5), Mann-Whitney and Kruskal Wallis tests (Section 5.3.6), which assess basic demographic differences. Assessment of predictors of intentions and hypotheses testing through hierarchical linear regression, stepwise linear regression, structural equation modelling, moderated regression, and mediation analyses are presented in Sections 5.3.7 to 5.3.12. However, this study had some limitations which are discussed in Section 6.3.

### Response rate

An invitation email was sent to 1174 GPs from all over the country to take part in the online study. Of these, the invitation email reached 1139 GPs, because 35 emails were returned as they did not reach valid email addresses. Overall, 458 respondents participated and completed the online questionnaire, giving a response rate of 40.2%. All respondents answered the online questionnaire fully, and the data from these were eligible for analyses. Overall, the study generated sufficient data for the statistical tests.

### Descriptive statistics

**Demographic characteristics**

Demographic data were collected to show the characteristics of the respondents. These data were related to age, gender, working area, and working experience of the participants. The age of the respondents ranged from 24 to 65 years, (=44.15; SD=11.41). In the study, 66.2% (n=303) of the participants were female, and 33.8% (n=155) were male. However, the national Health Insurance Fund does not have detailed demographic data of GPs in the country, which can be compared with this study sample. This limitation is discussed in Section 6.3.1.

The work experience of the respondents ranged from relative newcomers to the profession (i.e., <1 year), to health professionals with 38 years of working experience (=15.45 years of working experience, SD=10.40). Most of the participants 72.9%, (n=334) had their practices in urban areas, while 27.1% came from rural areas (n=124).

### Technology acceptance constructs

The following section presents a description of how participants in the study answered on technology acceptance constructs. Next Tables (5.6 to 5.16) present reported technology acceptance constructs by respondents in the study.

Table 5.6: Reported computer use by the respondents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **VARIABLE: Computer use** | **N** | **Minimum** | **Maximum** |  | **SD** |
| Approximately for how long have you been using computers (years)? | 458 | 1.00 | 30.00 | 12.3 | 4.96 |
| On average, how many hours a day do you use a computer (hours per day)? | 458 | 1.00 | 13.00 | 7.5 | 2.64 |

Table 5.6 shows the descriptive statistics for use of computers by respondents. The respondents reported having used computers from between 1 to 30 years in their life (=12.3, SD=4.96). They reported using a computer from between 1 and 13 hours per day (=7.5 hours, SD=2.64). A large proportion of respondents (n=378; 82.5%) were using mobile devices to access the Internet, such as a tablet, smartphones, Iphones and/or laptops.

Table 5.7: Reported the Internet use by the respondents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable:**  **The Internet use** | **Reported use of the Internet by respondents**  **N (%)** | | | | |
| **Never/rarely** | **1-2 times month** | **1-2 times week** | **Several times a day** | **Total** |
| Approximately how often do you use the Internet for personal needs, such as entertainment, online banking, and social networking? | 34 (7.4) | 16 (3.5) | 104 (22.7) | 304 (66.4) | 458 (100) |
| Approximately how often do you use the Internet for professional purposes, such as accessing or storing patient information? | 19 (4.1) | 19 (4.1) | 56 (12.2) | 364 (79.5) | 458 (100) |

Table 5.7 shows that a high number of respondents (n=304), or 66.4% were using the Internet for personal/fun use several times per day. An even higher number of participants (n=364) or 79.5% were using the Internet several times per day for professional reasons.

Table 5.8: Reported performance expectancy by the respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable: Performance expectancy** | **Level of agreement or disagreement with statement N (%)** | | | | | |
| **Strongly**  **disagree** | **Moderately**  **disagree** | **Neutral** | **Moderately**  **agree** | **Strongly**  **agree** | **Total** |
| Using EHR system would improve my job performance | 33 (7.2) | 15 (3.3) | 108 (23.6) | 90 (19.7) | 212 (46.3) | 458 (100) |
| Using EHR would increase my productivity | 36 (7.9) | 32 (7.0) | 95 (20.7) | 91 (19.9) | 204 (44.5) | 458 (100) |
| Using EHR would enhance my effectiveness | 36 (7.9) | 21 (4.6) | 99 (21.6) | 83 (18.1) | 219 (47.8) | 458 (100) |
| Using EHR would help me to accomplish tasks more quickly | 37 (8.1) | 27 (5.9) | 88 (19.2) | 84 (18.3) | 222 (48.5) | 458 (100) |
| Overall, I would find EHR useful for my work | 26 (5.7) | 18 (3.9) | 82 (17.9) | 91 (19.9) | 241 (52.6) | 458 (100) |

Table 5.8 shows that Macedonian health professionals have high performance expectancy from the system. Over 50% of the participants in all of five measured items reported positive performance expectancy from the system, i.e., they agreed or strongly agreed with the statement. A consistently small minority (between 9.6-14.9%) appeared to be not in favour. A consistent proportion (between 17.9-23.6%) of participants were neutral with the statements.

Table 5.9: Reported effort expectancy by the respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable: Effort expectancy** | **Level of agreement or disagreement with statement n (%)** | | | | | |
| **Strongly disagree** | **Moderately disagree** | **Neutral** | **Moderately agree** | **Strongly**  **agree** | **Total** |
| I would find EHR easy to use | 28 (6.1) | 17 (3.7) | 110 (24.0) | 17 (15.5) | 232 (50.7) | 458 (100) |
| Interacting with EHR would be clear and understandable | 24 (5.2) | 18 (3.9) | 130 (28.4) | 97 (21.2) | 189 (41.3) | 458 (100) |
| I would find it easy to get the EHR to do what I want it to do | 36 (7.9) | 30 (6.6) | 140 (30.6) | 102 (22.3) | 150 (32.8) | 458 (100) |
| Interacting with EHR would require a lot of mental effort | 95(20.7) | 69 (15.1) | 135 (29.5) | 64 (14.0) | 95 (20.7) | 458 (100) |
| It would be easy to me to become skilled at using the EHR | 13 (2.8) | 20 (4.4) | 104 (22.7) | 109 (23.8) | 212 (46.3) | 458 (100) |
| I will be able to use EHR effectively | 18 (3.9) | 14 (3.1) | 99 (21.6) | 104 (22.7) | 223 (48.7) | 458 (100) |
| Using EHR will be an easy task for me | 19 (4.1) | 21 (4.6) | 121 (26.4) | 103 (22.5) | 194 (42.4) | 458 (100) |
| I will easily work with  EHR | 21 (4.6) | 22 (4.8) | 123 (26.9) | 99 (21.6) | 193 (42.1) | 458 (100) |

From Table 5.9, it can be seen that GPs in the Republic of Macedonia have high effort expectancy from the EHR system. Respondents in all eight items reported more than 50% positive effort expectancy from the EHR system, i.e., they agreed or strongly agreed with the statement. A small minority (between 7–14.5%) appeared to have negative attitude towards effort expectancy, and the neutral responses are higher (between 21.6-30.6%) than previous performance expectancy construct. However, the fourth item is a reverse question which possibly created confusion among respondents and the level answers were little bit different (35.8% disagree, 29.5% neutral, 34.7% agree).

Table 5.10: Reported satisfaction with e-Health systems (currently in use in the country) by the respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable: Satisfaction** | **Level of satisfaction with currently used e-Health systems n (%)** | | | | | |
| **Strongly disagree** | **Moderately disagree** | **Neutral** | **Moderately agree** | **Strongly**  **agree** | **Total** |
| I am satisfied with the “Electronic health card’ system that I currently use | 47 (10.3) | 32 (7.0) | 100 (21.8) | 78 (17.0) | 201 (43.9) | 458 (100) |
| I am satisfied with the ‘My term’ system that I currently use | 62 (13.5) | 45 (9.8) | 129 (28.2) | 90 (19.7) | 132 (28.8) | 458 (100) |
| The systems I currently use have improved my performance | 44 (9.6) | 48 (10.5) | 125 (27.3) | 90 (19.7) | 151 (33.0) | 458 (100) |
| My patients are satisfied with the systems that are currently used | 96 (21.0) | 66 (14.4) | 145 (31.7) | 76 (16.6) | 75 (16.4) | 458 (100) |
| Overall, the systems used currently are effective | 60 (13.1) | 48 (10.5) | 144 (31.4) | 93 (20.3) | 113 (24.7) | 458 (100) |

Table 5.10shows the denoted level of satisfaction of respondents with e-Health systems that are currently in use in the Republic of Macedonia. It can be seen that over 60% of respondents reported satisfaction with the currently used ‘Electronic health card’ system. However, a smaller minority (17.3%) reported that they were not satisfied with the ‘Electronic health card’ system or were neutral (21.8%). There was a relatively lower level of satisfaction with reference to the ‘My term’ online appointment system (48.5%), while 28.2% were neutral, and 23.6% did not agree. A high proportion of respondents reported that systems currently in use in the country had improved their performance (52.7%), while 27.3% were neutral, and 20.1% did not agree. Over 35% of GPs believed that their patients were not satisfied with the currently used e-Health systems in the country (‘Electronic health card’ and ‘My term’), a further 31.7% were neutral and 33% of participants agreed that their patients are satisfied with currently used e-Health systems. However, 45% of the respondents reported that currently used systems are effective, 31.4% were neutral about the effectiveness of the currently used systems, and 23.6% did not agree with the statement.

Table 5.11: Reported social influence by the respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable: Social influence** | **Level of agreement or disagreement with statement n (%)** | | | | | |
| **Strongly disagree** | **Moderately disagree** | **Neutral** | **Moderately agree** | **Strongly**  **agree** | **Total** |
| In general, EHR will be well approved by most of my colleagues | 36 (7.9) | 24 (5.2) | 152 (33.2) | 91 (19.9) | 155 (33.8) | 458 (100) |
| The colleagues I respect most would accept EHR | 33 (7.2) | 18 (3.9) | 137 (29.9) | 89 (19.4) | 181 (39.5) | 458 (100) |
| People who influence my behaviour think that I should use the EHR if it is implemented | 37 (8.1) | 22 (4.8) | 145 (31.7) | 88 (19.2) | 166 (36.2) | 458 (100) |
| People who are important to me think that I should use the EHR if it is implemented | 29 (6.3) | 22 (4.8) | 145 (31.7) | 89 (19.4) | 173 (37.8) | 458 (100) |

Table 5.11 indicates that respondents in the study had high levels of social influence. They have reported over 50% agreement with statements on all measured social influence items. This measure denoted that respondents believe that ‘Important others’ colleagues have high expectations from them when using the system. However, a consistently small minority (between 11.1–13.1%) reported that they did not agree with the statement. A consistent proportion (between 29.9-33.2%) of participants were neutral with the statements.

Table 5.12: Reported facilitating conditions by the respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable: Facilitating conditions** | **Level of agreement or disagreement with statement n (%)** | | | | | |
| **Strongly disagree** | **Moderately disagree** | **Neutral** | **Moderately agree** | **Strongly**  **agree** | **Total** |
| I have the necessary resources to use the EHR | 16 (3.5) | 12 (2.6) | 65 (14.2) | 77 (16.8) | 288 (62.9) | 458 (100) |
| I have the necessary knowledge to use the EHR | 17 (3.7) | 14 (3.1) | 81 (17.7) | 90 (19.7) | 256 (55.9) | 458 (100) |
| The EHR is compatible with other systems I currently use | 26 (5.7) | 17 (3.7) | 116 (25.3) | 91 (19.9) | 208 (45.4) | 458 (100) |
| A specific person (or group) will be available for assistance with EHR difficulties | 47 (10.3) | 33 (7.2) | 112 (24.5) | 87 (19.0) | 179 (39.1) | 458 (100) |

Table 5.12 shows that Macedonian GPs consider that facilitating conditions were important for the future implementation of the EHR system. All four measured items showed high levels of agreement (over 50%) with the statements. A smaller minority of respondents (between 6.1-17.5%) appeared to be not in favour with the statements. However, between 14.2-25.3% of respondents were neutral with the statements.

Table 5.13: Reported intentions to use the EHR system by the respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable: Intention** | **Level of agreement or disagreement with statement n (%)** | | | | | |
| **Strongly disagree** | **Moderately disagree** | **Neutral** | **Moderately agree** | **Strongly**  **agree** | **Total** |
| I intend to use EHR if it is implemented | 13 (2.8) | 6 (1.3) | 62 (13.5) | 73 (15.9) | 304 (66.4) | 458 (100) |
| I expect that I would use EHR if it is implemented | 11 (2.4) | 8 (1.7) | 65 (14.2) | 73 (15.9) | 301 (65.7) | 458 (100) |
| I plan to use EHR if it is implemented | 15 (3.3) | 7 (1.5) | 52 (11.4) | 90 (19.7) | 294 (64.2) | 458 (100) |

Table 5.13 shows that the three measured intention items showed a very high intention of Macedonian GPs to use the EHR system when it will be implemented. All three measured intention items have very high ‘strongly agree’ (more than 60%) preferences. A consistently small minority (between 4.1-4.8%) appeared to have low intentions to use the system. A consistent proportion (11.4-14.2%) of participants were neutral on intentions on future use of the EHR system.

Table 5.14: Reported job relevance by the respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable:**  **Job relevance** | **Level of agreement or disagreement with statement n (%)** | | | | | |
| **Strongly disagree** | **Moderately disagree** | **Neutral** | **Moderately agree** | **Strongly**  **agree** | **Total** |
| In my job, use of EHR would be important | 26 (5.7) | 24 (5.2) | 99 (21.6) | 84 (18.3) | 225 (49.1) | 458 (100) |
| In my job, using EHR will be relevant | 28 (6.1) | 27 (5.9) | 143 (31.2) | 90 (19.7) | 170 (37.1) | 458 (100) |

Table 5.14 shows that respondent GPs reported high job relevance (over 50%) of the EHR system to their daily routine. A consistently small minority (between 10.9-12%) appeared to be not in favour with the statements. A considerably larger proportion (between 21.6-31.2%) of participants were neutral.

Table 5.15: Reported descriptive norm by the respondents

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable: Descriptive norm** | **Category N (%)** | | | | | |
| **None** | **Few** | **Some** | **Most** | **All** | **Total** |
| How many of your colleagues do you think will use EHR if it is implemented? | 5 (1.1) | 30 (6.6) | 65 (14.2) | 242 (52.8) | 116 (25.3) | 458 (100) |

The descriptive norm assessed in the study shows that 78.1% of doctors believed that most or all of their colleagues would use the system if implemented. A small group (7.7%) did not agree with the statement, and 14.2% believed that some of the colleagues will use the system.

Table 5.16 presents the total scores of technology acceptance variables which were used in the subsequent stepwise regression analyses (Section 5.3.8).

Table 5.16: Total technology acceptance variables

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Total scores:** | **Mean**  **total** | **Number of items** | **Mean per item** | **Median** | **SD** | **Minimum** | **Maximum** |
| Performance expectancy | 19.74 | 5 | 3.95 | 21.00 | 5.71 | 5 | 25 |
| Effort expectancy | 30.56 | 8 | 3.82 | 32.00 | 6.74 | 8 | 40 |
| Satisfaction | 17.00 | 5 | 3.40 | 17.00 | 5.46 | 5 | 25 |
| Facilitating conditions | 16.19 | 4 | 4.05 | 17.00 | 3.43 | 4 | 20 |
| Social influence | 14.95 | 4 | 3.74 | 15.00 | 4.42 | 4 | 20 |
| Intention | 13.22 | 3 | 4.41 | 15.00 | 2.74 | 3 | 15 |
| Job relevance | 7.76 | 2 | 3.88 | 8.00 | 2.08 | 2 | 10 |

Table 5.17 presents the results from the Skewness and Kurtosis tests.

Table 5.17: Skewness and Kurtosis test

|  |  |  |
| --- | --- | --- |
|  | **Skewness** | **Kurtoses** |
| Performance expectancy | -.974 | .008 |
| Effort expectancy | -.677 | -.136 |
| Social influence | -.622 | -.251 |
| Facilitating conditions | -.983 | .869 |
| Job relevance | -.752 | -.006 |
| Satisfaction | -.272 | -.727 |
| Intention | -1.85 | 3.29 |

Tables 5.8 to 5.15 indicated that respondents were strongly (mostly positively) affiliated with the technology acceptance statements, and therefore the data were skewed and showed kurtosis. Descriptive statistics found that respondents reported strong intentions for future use of the system (more than 60% strongly agreed). Therefore, the intention variable was strongly negative skewed. All other variables were also negatively skewed (left skewed) but closer to zero. The intention variable was heavy tailed (high kurtosis) relative to a normal distribution. Other variables had lower kurtosis (light tails). Table 5.18 presents the results of the Kolmgorov-Smirnov test for normality of data distribution.

Table 5.18: Test of normality of distribution Kolmogorov-Smirnov

|  |  |  |
| --- | --- | --- |
|  | Test statistic | df |
| Age | .124\*\* | 457 |
| Working experience | .109\*\* | 457 |
| Performance expectancy | .179\*\* | 458 |
| Effort expectancy | .111\*\* | 458 |
| Facilitating conditions | .153\*\* | 458 |
| Job relevance | .162\*\* | 458 |
| Social influence | .140\*\* | 458 |
| Satisfaction | .071\* | 458 |
| Intention | .299\*\* | 458 |
| Descriptive norm | .306\*\* | 458 |
| Computer use/years | .153\*\* | 458 |
| Computer use/hours | .222\* | 458 |
| Use of ‘Other technology’ | .502\*\* | 458 |
| The Internet use/personal | .387\*\* | 458 |
| The Internet use/professional | .466\*\* | 458 |

Note: \*\*=*p*<.005; \*=*p*<.05

The Kolmogorov-Smirnov test showed that there was a statistically significant difference (*p*<.5) between the distribution of each of the study variables and a normal distribution. Non-parametric tests (described in Section 4.2.11) such as Spearman correlations, Mann-Whitney and Kruskal Wallis tests had therefore to be used in the subsequent data analyses.

### Inferential statistics

Inferential statistics were applied on the gathered data of the study with the aim of making inferences about the targeted population. The collected data were also used to test the research hypotheses and make predictions for future EHR use behaviour. The main focus of the inferential analyses in this Thesis was on multivariate statistics tests on technology acceptance as articulated by Davis (1989).

### Spearman rank correlation

Bi-variate correlations using the Spearman correlation coefficient are suitable analyses for study’s Likert-scale data (strongly disagree to strongly agree) before the regression analyses. The results are shown in Table 5.19.

Table 5.19: Analyses of Spearman correlations, mean () and SD of the study variables

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 1. Performance expectancy | - | .71\* | .56\* | .66\* | .65\* | .58\* | | .59\* |
| 2. Effort expectancy |  | - | .68\* | .69\*\*\* | .66\* | .61\* | | .68\*\* |
| 3. Facilitating conditions |  |  |  | .61\* | .59\* | .58\* | | .62\* |
| 4. Job relevance |  |  |  | - | .65\* | .55\* | | .62\*\* |
| 5. Social influence |  |  |  |  | - | .58\*\*\* | | .63\* |
| 6. Satisfaction |  |  |  |  |  | - | | .52\* |
| 7. Intention |  |  |  |  |  |  | | - |
|  |  |  |  |  |  |  |  | |
|  | 3.95 | 3.82 | 4.04 | 3.87 | 3.73 | 3.40 | 4.41 | |
| SD | 1.14 | .87 | .86 | 1.04 | 1.10 | 1.09 | .91 | |
| Note: \*\*\*= *p*<.001; \*\**p*<.005; \*=*p*<.05 | | | | | | | | |

The Spearman correlation showed that usage intention (the main outcome i.e., dependent variable of the study) correlated significantly with all UTAUT and other technology acceptance variables included in the study. All constructs were correlated significantly in the expected direction (the *r* coefficients ranged from .52 to .71).

### Demographic differences

As explained in Section 5.2.4, gender, age, and location differences among participants in the study were assessed with the aim of exploring the influence of these demographic variables. However, these analyses explain only basic differences and cannot be used to infer conclusions on future intentions of the participants, which are assessed through regression analyses in the next sections.

**Gender differences**

The Mann-Whitney test was used to determine if whether there were significant differences between males and females in the study at the construct level. This test was used to test whether the mean scores showed differences between the genders. Table 5.20 presents results of the Mann-Whitney test for gender differences.

Table 5.20: Mann-Whitney test for gender differences

|  |  |  |  |
| --- | --- | --- | --- |
| **Mann-Whitney test for gender differences** | | **Mean ranks** | |
| **Construct:** | *p* | Male | Female |
| Performance expectancy | .063 | 245.26 | 221.44 |
| Effort expectancy | .101 | 243.64 | 222.27 |
| Facilitating conditions | .598 | 234.04 | 227.18 |
| Job relevance | .045 | 246.44 | 220.83 |
| Social influence | .100 | 243.55 | 222.32 |
| Satisfaction | .701 | 232.81 | 227.81 |
| Intention | .721 | 232.30 | 228.07 |
| Descriptive norm | .017 | 248.26 | 219.90 |

It can be seen from the Table 5.20 that there were significant gender differences in the job relevance variable, confirming that male GPs had a higher level of job relevance variable compared to female GPs (Mann-Whitney U=208, *z*=2.00, *p*=.045). However, male participants had higher level than female respondents with respect to the descriptive norm variable (Mann-Whitney U=205, *z*=-2.37, *p*=.017).

**Age differences**

Three age range groups were formed as follows: age group up to 39 years of age; age group 40-49 years; and age group 50+ years. The Kruskal-Wallis test was used in the study for analyzing whether there were significant differences across the three age groups at the construct level.The test was used to analyze the differences among the rankings across the three age groups. Table 5.21 presents the results of the Kruskal-Wallis test for age group differences.

Table 5.21: Kruskal-Wallis test for age group differences

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Kruskal-Wallis test for age group differences** | | | **Mean ranks** | | |
| **Variable** | *p* | ( | >39 years | 40-49 years | 50 + years |
| Performance expectancy | .035 | 3.95 | 215.27 | 261.99 | 232.32 |
| Effort expectancy | .062 | 3.82 | 229.96 | 261.70 | 217.88 |
| Social influence | .004 | 3.74 | 207.77 | 262.68 | 239.49 |
| Facilitating conditions | .026 | 4.04 | 210.11 | 243.03 | 243.99 |
| Job relevance | .002 | 3.87 | 208.41 | 271.59 | 235.77 |
| Satisfaction | .003 | 3.40 | 205.99 | 254.30 | 245.06 |
| Intention | .274 | 4.41 | 228.51 | 250.33 | 223.26 |
| Descriptive norm | .151 | 3.28 | 212.51 | 271.18 | 216.19 |

The Kruskal-Wallis test results indicated that there were statistically significant differences between the 40-49 year-old age group and the other two groups. The 40-49 year-old age group had higher mean rank values compared to other age range groups:

* job relevance (mean rank, 40-49 year-old age group =271.59; mean rank, age group up to 39 years =208.41; mean rank age group 50+ years =235.77; ***H***=12.78; *p*=.002);
* social influence (mean rank, 40-49 year-old age group =262.68; mean rank, age group up to 39 years =207.77; mean rank, age group 50+ years =239.49; ***H***=10.90; *p*=.004);
* satisfaction (mean rank, 40-49 year-old age group =254.30; mean rank, age group up to 39 years =205.09; mean rank, age group 50+ years =245.06;  ***H*** =11.75; *p*=.003).

Post-hoc (pairwise comparisons) further indicated the specific pairs where significant differences were observed:

* performance expectancy: between the 20-39 year-old age group and the 50+ year-old group (*p*=.032);
* social influence: between the 20-39 year-old group and the 50+ year-old group (*p*=.049); between the 20-39 year-old group and the 40-49 year-old group (*p*=.009);
* facilitating conditions: between the 20-39 year-old group and the 50+ year old group (*p*=.033);
* job relevance: between the 20-39 year-old group and the 40-49 year-old group (*p*=.002); and
* satisfaction: between the 20-39 year-old group and the 40-49 year old group (*p*=.025); between the 20-39 year-old group and the 50+ year old group (*p*=.008).

**Location differences**

The Mann-Whitney test showed that there were no differences between the mean ranks among doctors in urban areas compared to rural areas, indicating that there were no differences with respect to location of the GP’s practice. The test results were found non-significant in all variables: performance expectancy (*p*=.217), effort expectancy (*p*=.238), social influence (*p*=.409), facilitating conditions (*p*=.170), job relevance (*p*=.974), satisfaction (*p*=.913), descriptive norm (*p*=1.00), and intention (*p*=.347).

**Differences in years of service of General Practitioners**

Three categories based on General Practitioners’ years in service were formed as follows: the first category was up to 10 years in service; the second category was 11 to 20 years in service; and the third category was >20 years in service. The Kruskal-Wallis test was used in the study for analyzing whether there were significant differences across the three categories of years in service. The test results were found non-significant in all three categories with respect to technology acceptance variables: performance expectancy (*p*=.158), effort expectancy (*p*=.261), social influence (*p*=.312), facilitating conditions (*p*=.127), job relevance (*p*=.651), satisfaction (*p*=.816), descriptive norm (*p*=.21), and intention (*p*=.108).

### Regression analyses

The literature review (Section 2.6) and data analyses review (Section 4.2.11) indicated that the following types of analyses could be used in the study: hierarchical linear regression, stepwise linear regression, moderated regression, and mediation analyses (Egea and Gonzalez 2011; Harle and Devar 2012; Gagnon et al. 2014). The hierarchical linear regression was used in the study with the aim of determining the extent to which the predictive link of the exogenous variable to the dependent variable is reduced after statistical control. This analysis assessed the effect of the technology acceptance predictor variables on the ‘intention to use’ dependent variable. Stepwise regression was used in this study with the aim of highlighting the proportion of the variance in the dependent variable that is accounted for by the independent variables. This, therefore, determined the importance of each separate independent variable in the technology acceptance model, tested in the study. However, structural equation modelling was used as a second level of analysis to reassess the findings from the regression analyses and to test the proposed hypotheses. The moderated regression assessed the moderation effect of the exogenous moderation variables (age, gender, and past work experience) on the basic UTAUT predictor variables (performance expectancy, effort expectancy, social influence, and facilitating conditions) tested in the study. Mediation analysis was used to assess the effect of job relevance as TAM2 distal predictor variable on usage intentions, after controlling for the potential mediation effects of the UTAUT variables.

### Hierarchical linear regression

In technology acceptance models with multiple predictors of human behaviour, hierarchical linear regression can be applied to measure the association of basic UTAUT predictors (performance expectancy, effort expectancy, social influence, and facilitating conditions) with intention to use the system (dependent variable) (Devane et al. 2010; Egea and Gonzalez 2011). However, hierarchical linear regression may be applied to other tested technology acceptance variables such as job relevance, satisfaction, use of ‘Other technology’, computer use, and descriptive norm. Harle and Dewar (2012) in their study used three types of regression analyses. Gagnon et al. (2014) used multivariate linear regression in their study to test the data (Section 2.6). Tests for multicollinearity, homoscedasticity, and Mahalanobis distance for outliers were performed before the hierarchical linear regression analyses.

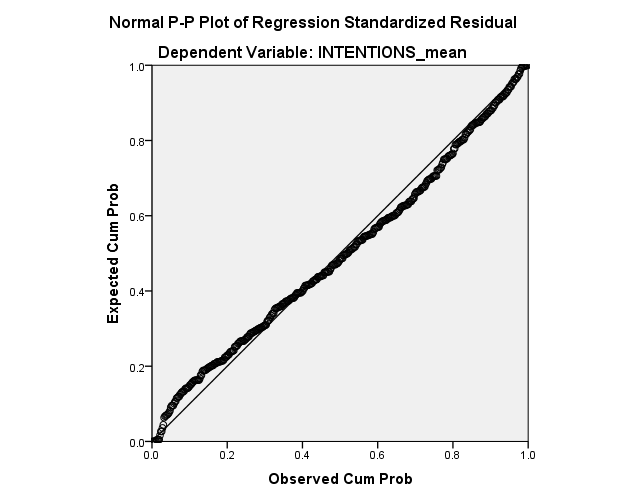
**Multicollinearity**

Multicollinearity tests were applied with the aim to assess whether there was any multicollinearity between the technology acceptance variables used in the model. The following tolerance levels were identified: effort expectancy (tolerance=.366, VIF=2.735); performance expectancy (tolerance=.310, VIF=2.588); social influence (tolerance=.356, VIF=2.391); satisfaction (tolerance=358, VIF=1.770); facilitating conditions (tolerance=.471, VIF=2.112); job relevance (tolerance=.448, VIF=2.234); and descriptive norm (tolerance=.665, VIF=1.503). Therefore, it could be concluded that there was no multicollinearity between technology acceptance variables in the study.

**Homoscedasticity**

Tests for the assumption of homoscedasticity and normality of residuals were carried out with normal P-P plot of regression standardized residuals being used. As shown in Figure 5.1, homoscedasticity was evidenced as the plotted points followed the straight line.

Figure 5.1: Homoscedasticity plot of the study data



**Mahalanobis distance for outliers**

Tests for Mahalanobis distance for outliers were used with the aim to identify possible outliers in the data. Three outliers were identified for the study of General Practitioners. All other participants in the study had results <1.00. However, these three outliers were not removed from the data eligible for regression analyses as they represent only .65% of the total data, and there were no evident observable differences between these respondents and the other 455 participants.

Hierarchical linear regression was used to assess the direct effects of multiple variables towards the usage intentions of participants in the study. The two-stage conceptualization of the model can predict future development, and measure individual change (Bryk and Raudenbush 1987; Lindenberger and Potter 1998; Ozborne 1999). The variables were estimated through their mean scores. For Likert scales and other measures used in the study, generating the mean score reflecting the total variable for further hierarchical linear regression analyses is the suggested way (Bryk and Raudenbush 1987; Lindenberger and Potter 1998; Ozborne 1999).

The hierarchical linear regression analysis was completed in two steps. Demographic factors (age, gender, and previous working experience), frequency of using ‘Other technologies’ (e.g., smartphones and tablets), and frequency of using other ICTs for personal/fun or professional purposes were included in the first step. The second step included the basic UTAUT variables (performance expectancy, effort expectancy, facilitating conditions, and social influence), plus other technology acceptance variables such as: job relevance, satisfaction (with using the current e-Health systems), and descriptive norm. The mean value of the intention to use the EHR system was used as the dependent variable. The results of the hierarchical linear regression analysis are summarized in Table 5.22.

Table 5.22: Predictors of participants’ intentions to use the EHR

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Predictors** | **95% CI** | **Standardised *β*** | **Adjusted *R*2** |
| 1 | Age | .007 – .021 | .091 | 1.8 % |
| Gender | .212 – .157 | .014 |
| Work experience | .022 – .007 | .092 |
| Computer use/years | .016 – .019 | .010 |
| Use of other technology | .593 – .110 | -.146\*\* |
| Internet fun | .055 – .160 | .050 |
| Internet work | .089 – .142 | .021 |
| 2 | Age | .014 – .004 | .062 | 65.4% |
| Gender | .016 – .206 | .049 |
| Work experience | .015 – .003 | .049 |
| Computer use/years | .011 – .011 | .001 |
| Use of Other technology | .144 – .151 | .001 |
| Internet personal | .060 – .069 | .004 |
| Internet professional | .188 – .048 | .096\*\* |
| Performance expectancy | .012 - .135 | .076 |
| Effort expectancy | .119 – .335 | .217\*\*\* |
| Facilitating conditions | .157 – .336 | .232\*\*\* |
| Job relevance | .070 - .232 | .172\*\*\* |
| Social influence | .016 - .162 | .108\* |
| Satisfaction | -.063 - .064 | .001 |
| Descriptive norm | .135 - .282 | .198\*\*\* |

\*\*\*= *p*<.001; \*\**p*<.005; \*=*p*<.05

In the first step of the analyses only 1.8 % (Adjusted R2=.018, R2 Change=.033) of the variance in intentions to use the EHR was predicted by the predictor variables. At this stage, only the use of the ‘Other technology’ variable from among all general background variables (i.e., the non technology acceptance variables) was found to be a statistically significant predictor of intentions to use the EHR (*p*=.004, *β*=-.146). All other variables including age, gender, and previous work experience were not established as predictors of intentions. However, the effect of these constructs as moderators is assessed in Section 5.3.11.

The negative Beta coefficient in the ‘Other technology use’ variable was strongly associated with user intentions, showing that those who responded negatively in the use of ‘Other technology’ had the highest intentions to use EHR. The participants’ familiarization with ‘Other technology’ use was assessed through Yes/No answering option. Therefore, a Mann-Whitney test was performed to assess the mean differences between these two groups of respondents who use/do not use ‘Other technology’, and to understand better the differences between the two groups. The Mann-Whitney test for differences between two groups of respondents is presented in Table 5.23.

Table 5.23: Mann-Whitney test for use of ‘Other technology’ variable

|  |  |  |  |
| --- | --- | --- | --- |
| **Mann-Whitney test for use of “Other technology” differences** | | **Mean ranks** | |
| **Construct:** | ***p*** | **Yes** | **No** |
| Performance expectancy | .004 | 237.51 | 191.64 |
| Effort expectancy | .001 | 243.96 | 161.18 |
| Facilitating conditions | .001 | 241.47 | 172.94 |
| Job relevance | .025 | 235.72 | 200.10 |
| Social influence | .036 | 235.39 | 201.69 |
| Satisfaction | .002 | 238.19 | 188.46 |
| Intention | .001 | 239.15 | 183.90 |

Note. \**p*=<.05

The Mann-Whitney test has indicated that doctors who used ‘Other technology’ had higher mean scores in almost all of the tested technology acceptance variables than their colleagues who did not use ‘Other technologies’. Statistically significant differences with respect to use of ‘Other technology’ were found in the following technology acceptance constructs: performance expectancy (Mann-Whitney U=120, z=-2.87, *p=.*004), effort expectancy (Mann-Whitney U=96, z=-5.09, *p*=.001), facilitating conditions (Mann-Whitney U=106, z=-4.24, *p*=.001), satisfaction (Mann-Whitney U=118, z=-3.06, *p*=.002), job relevance (Mann-Whitney U=128, z=-2.23, *p*=.025), intention (Mann-Whitney U=115, z=-3.73, *p*=.001), and social influence (Mann-Whitney U=129, z=-2.09, *p*=.036). Therefore, it can be considered that, if doctors use ‘Other technology’ in other domains in their life (e.g., a tablet, smartphone, iphone, or laptop) it is likely that they will use EHR technology in their job. This group of healthcare professionals will accept future EHR systems more easily than other colleagues who do not use ‘Other technology’ in other domains of their life.

In the second step of the hierarchical regression analyses, the proportion of variability in intentions to use the EHR system that was explained by the independent variables increased considerably, by 63.2% (R2 Change=.632). Therefore, the level of variance in intentions to use the EHR, was significantly explained by the additional predictor variables, and the overall model predicted 65.4% (Adjusted R2=.654) of the variance in intentions to use the system. In the second step, three out of the four basic UTAUT variables showed an association with intention to use variable. Effort expectancy (*β*=.212, *p*<.001), and facilitating conditions (*β*=.232, *p*<.001) as the basic UTAUT variables were shown to be strongly significant predictors. Social influence (*β*=.089, *p*<.05) as a less significant predictor was included as a basic UTAUT variable in the model. However, job relevance (*β*=.176, *p*<.001) and descriptive norm (*β*=.198, *p*<.001) as additionally proposed technology acceptance variables, were found as strong predictors of the users intentions in the study. The ‘Internet use for professional needs’ variable was found as a predictor (*β*=-.118, *p*<.005), and the negative Beta result means that those respondents who do not use the Internet in their daily routine have the weakest intentions to use the future EHR system.

The performance expectancy (*p*=.102) as a basic UTAUT variable, and satisfaction (*p*=.980) as another technology acceptance variable were not shown to be predictors in the model. Table 5.24 summarizes the outcomes of the hierarchical linear regression analyses:

Table 5.24: Hierarchical linear regression, predictors of intentions (step two)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Unstandardized B** | **95% CI for B** | **Standardized B** | **Adjusted R2** |
| Effort expectancy | .227 | .119 - .335 | .217\*\*\* | 65.4% |
| Facilitating conditions | .247 | .157 - .336 | .232\*\*\* |
| Descriptive norm | .209 | .135 - .282 | .198\*\*\* |
| Job relevance | .154 | .070 - .232 | .172\*\*\* |
| The Internet use/ professional needs | -.118 | .188 - .048 | .096\*\* |
| Social influence | .089 | .016 - .162 | .108\* |

\*\*\*= *p*<.001; \*\**p*<.005; \*=*p*<.05

### Stepwise linear regression

Stepwise linear regression was used for the study to test the proposed hypothesis, and to identify the separate effect of each variable on intentions to use the EHR system. The following basic UTAUT variables were assessed through stepwise linear regression:

* performance expectancy;
* effort expectancy;
* facilitating conditions; and
* social influence;

as well as other technology acceptance variables:

* job relevance;
* descriptive norm; and
* satisfaction (with currently used e-Health systems in the country: ‘My term’, ‘Electronic health card’).

However, other variables such as:

* use of ‘Other technology’;
* ‘computer use; and
* ‘the Internet use for personal and professional purposes’.

were also tested as predictors of usage intentions. A stepwise linear regression analysis was performed with respect to the intention (dependent) variable, for future use of the EHR system. This regression is a semi-automated process for regressing multiple variables, while removing those variables that are not significantly associated with the dependent variable in the study. The IBM SPSSTM software performed the multiple regressions a number of times, successively adding or removing UTAUT and other technology acceptance variables according to their level of significance. Stepwise linear regression determined the relative contribution of each predictor variable in the study technology acceptance model by adding variables, or taking them out of the model, based on significance *p*<.05. This analysis performed in the study, explained the relative contribution of each separate variable to intention to use the system. The results of the stepwise linear regression are presented in Table 5.25.

Table 5.25: Stepwise linear regression model summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step** | **Constant/Predicator** | **R2** | **R2 Change** | ***p*** |
| **Dependent variable:** Intention to use the EHR system | | | | |
| 1. | Effort expectancy | .517 | .517 | <.001 |
| 2. | Effort expectancy, descriptive norm | .587 | .070 | <.001 |
| 3. | Effort expectancy, descriptive norm, facilitating conditions | .617 | .031 | <.001 |
| 4. | Effort expectancy, descriptive norm, facilitating conditions, job relevance | .636 | .019 | <.001 |
| 5. | Effort expectancy, descriptive norm, facilitating conditions, job relevance, social influence | .642 | .006 | .008 |

Stepwise linear regression determined the most relevant predictor variables, and included six variables in the model (variables with probability: *p*<.05 were included into the model). The stepwise linear regression provided a six-step model for the study with respect to the technology acceptance variables’ separate contribution to the model.

In step one, 51.7% of the variation in intentions to use was explained by the independent variable (R2=.517), meaning that more than 50% of the variation in intentions to use was explained by effort expectancy. In step two, variation in intentions to use was increased by 7% (R2 change=.070, R2=.587), meaning that seven percent of the variation in intentions to use was explained by descriptive norm. Facilitating conditions contributed to 3.1% of the variation of the intentions to use (R2 Change= .31, R2=.615) in step three. The job relevance contributed 1.9% (R2 Change=.19, R2=.633) to the model in step four, and social influence explained .6% % of the variation (R2 Change=.006, R2=.642) in step five.

The performance expectancy, satisfaction (with currently used e-Health systems), ‘Computer use’, use of ‘Other technology’ and the Internet use for private and professional needs variables were excluded from the stepwise linear regression model.

### Structural equation modelling

A second level of analyses for the study was performed using structural equation modelling. Three Hypotheses (H1, H2, and H4) were tested with these analyses. However, the moderation effect (H3) could not be assessed through structural equation modelling; therefore, the moderated regression analyses (in the following section) were used for the assessment of H3.

**H1: Performance expectancy, effort expectancy, social influence, and facilitating conditions will directly predict intentions to use the EHR system.** Figure 5.2 presents structural equation model of H1.

Figure 5.2: Structural equation model of H1

\* standardized coefficients are presented

.22

.61

.40

.26

.40

.19

.40

.56

.61

.72

.21

.38

.50

.00

Performance expectancy

Social

influence

Intention to use the EHR system

Facilitating conditions

Effort expectancy

Table 5.26 presents the overall model fit of H1.

Table 5.26: Overall model fit, from the structural equation model for H1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Overall model fit, H1** | | | | |
| **χ2/ d.f.** | GFI | CFI | TLI | RMR |
| 9.453 | .992 | .995 | .945 | .015 |

As can be seen from the Table 5.26, the x2/df score is above the accepted limit of 5, the GFI, CFI, and the TLI are above the threshold of .9 and the RMR value is below the threshold of .1 (Diamantidis and Chatzoglou 2012). Table 5.27 presents the standardized effects of structural equation modelling of the H1 model factors.

Table 5.27: Direct and indirect standardized effects of H1 model factors

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | **Social influence** | **Facilitating conditions** | **Performance expectancy** | **Effort expectancy** |
| Facilitating conditions | D  I  T | .614  .614 |  |  |  |
| Performance expectancy | D  I  T | .559  .127  .687 | .207  .207 |  |  |
| Effort expectancy | D  I  T | .187  .519  .687 | .395  .083  .478 | .402  .402 |  |
| Intention | D  I  T | .215  .438  .653 | .259  .189  .448 | .159  .159 | .395  .395 |
| D=direct effect; I=indirect effect; T=total effect, *p*<.01 | | | | | |

As can be seen from Figure 5.2 and Table 5.27, effort expectancy (.40), social influence (.22), and facilitating conditions (.26) all had direct effects on intentions to use the system as hypothesized. The intention to use the EHR system (61%) was mainly explained by these three variables. However, performance expectancy did not have a direct impact on intentions. Performance expectancy had a direct effect (.402) on effort expectancy and only an indirect effect on intentions to use the EHR system, through effort expectancy (.159). New relationships, such as the effect of social influence on performance expectancy (variance explained=.56, direct effect=.559, indirect effect=.127, total effect=.687); on facilitating conditions (variance explained=.61, direct and total effect=.614); and on effort expectancy (variance explained=.19, direct effect=.187, indirect effect=.519, total effect=.706) emerged. Facilitating conditions had an effect on performance expectancy (variance explained=.21, direct and total effect=.207) and on effort expectancy (variance explained=.40, direct effect=.395, indirect effect=.083, total effect=.478).

The main findings from the regression analyses (hierarchical and stepwise) were reconfirmed from these analyses, as the effort expectancy had the strongest direct effect (.395) on intentions to use the EHR system. Social influence had a direct effect=.215, and facilitating conditions a direct effect=.259 on intentions. However, social influence had the strongest total effect on intentions (.653) augmented by an indirect effect=.438 through performance expectancy, effort expectancy, and facilitating conditions. The effect of facilitating conditions on intentions was augmented by an indirect effect=.189 through performance expectancy and effort expectancy. Performance expectancy did not have a direct impact on intentions (only indirect effect=.159, though effort expectancy). These findings are in line with the regression analyses. Therefore, the H1 could be partially accepted as effort expectancy, social influence and facilitating conditions were identified as direct predictors of intentions to use the system among the GPs.

**H2: Job relevance, satisfaction (with currently used e-Health systems), and use of ‘Other technology’ will predict intentions to use the EHR system indirectly, through the effects of performance expectancy.** Figure 5.3 presents structural equation model of H2.

Figure 5.3: Structural equation model of H2

.56

.56

.00

.07

.32

.51

.45

.28

.00

.55

.31

Job

relevance

Satisfaction

Intention to use the EHR system

Use of ‘Other technology’

Performance expectancy

\* standardized coefficients are presented

Table 5.28 presents the overall model fit of H2.

Table 5.28: Overall model fit, from the structural equation model for H2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Overall model fit, H2** | | | | |
| **χ2/ d.f.** | GFI | CFI | TLI | RMR |
| 6.447 | .978 | .976 | .939 | .037 |

As can be seen from the Table 5.28, the x2/df score is above the accepted limits of 5, the GFI, CFI, and the TLI are above the threshold of .9 and the RMR value is below the threshold of .1 (Diamantidis and Chatzoglou 2012). Table 5.29 presents the standardized effects of the H2 model factors.

Table 5.29: Direct and indirect standardized effects of H2 model factors

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | **Job relevance** | **Satisfaction (with currently used e-Health systems)** | **Use of ‘Other technology’** | **Performance expectancy** |
| Satisfaction (with currently used e-Health systems) | D  I  T | .560  .560 |  |  |  |
| Performance expectancy | D  I  T | .551  .157  .708 | .281  .281 |  |  |
| Intention | D  I  T | .451  .223  .675 | .089  .089 | -.075  -.075 | .315  .315 |
| D=direct effect; I=indirect effect; T=total effect, *p*<.05 | | | | | |

As can be seen from Figure 5.3 and Table 5.29, in total, 51% of the variation in intentions to use the EHR system was predicted by the model of H2. According to this model, job relevance had the strongest impact on intentions (direct effect=.451, indirect effect=.223, total effect=.675). However, the effect of satisfaction on intentions to use was very weak (indirect and total effect=.089), and effective through performance expectancy (direct and total effect=.281). The use of ‘Other technology” variable had weak and negative relation with intention variable (-.75). The H2 can be partially accepted, as only job relevance had a strongest and direct impact on intentions to use the EHR system.

**H4: Descriptive norm (e.g., how many colleagues will use the system if it is implemented) will predict intentions to use the EHR system, as a distinct/independent social influences indicator.**

Figure 5.4 presents structural equation model of H4.

Figure 5.4 Structural equation model of H4

.35

.59

.00

Descriptive norm

Intention to use the EHR system

\* standardized coefficients are presented

Table 5.30 presents the overall model fit of H2.

Table 5.30: Overall model fit, from the structural equation model for H4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Overall model fit, H2** | | | | |
| **χ2/ d.f.** | GFI | CFI | TLI | RMR |
| .978 | 1 | 1 | .979 | .001 |

As can be seen from Table 5.30, the x2/df score is below the accepted limit of .5, the GFI, CFI, and the TLI are above the threshold of .9 and the RMR value is below the threshold of .1. Table 5.31 presents standardized effects of H2 model factors.

Table 5.31: Direct and indirect standardized effects of H4 model factors

|  |  |  |
| --- | --- | --- |
|  | | **Descriptive norm** |
| Intention | D  I  T | .590  .001  .590 |
| D=direct effect; I=indirect effect; T=total effect, *p*<.001 | | |

As can be seen from Figure 5.4 and Table 5.31, descriptive norm had a (.59) direct effect on intentions to use the EHR system. The overall model of intentions to use the system in H4 was explained by 35% of the variance. Therefore, H4, can be accepted as descriptive norm was identified as predictor of intentions among the participants in the study. This finding is in line with regression (hierarchical and stepwise) analyses where descriptive norm was identified as predictor of intentions.

### Moderated regression

The moderated regression analysis was performed with the aim of assessing the influence of moderation variables on the basic UTAUT variables according to Venkatesh et al.’s (2003) model. According to Aiken and West (1990), the predictor and moderator variables should be mean-centred for this analysis. More specifically, this analysis was used to assess the interactive effects between UTAUT predictors (effort expectancy, social influence, and facilitating conditions) and moderators (age, gender, and previous work experience) in predicting EHR usage intentions among participants in the study. Following eight possible moderation/interaction effects were assessed with this analysis:

* effort expectancy will interact with gender, age, and experience in predicting usage intentions (the effort expectancy will be a stronger determinant in female GPs, particularly those who are older and with little job experience i.e. with limited exposure to technology);
* social influence will interact with gender, age, and experience in predicting usage intentions (social influence will be stronger among female GPs, even more among older, female GPs, and among workers in early stages of work experience); and
* facilitating conditions will interact with age and experience in predicting usage intentions (facilitating conditions is stronger amongolder and experienced GPs).

The moderating effect of voluntariness of use, as explained in Section 5.2.5, was not assessed, because the future EHR use in the country will be mandatory, and therefore this concept was not relevant to the sample in this study. Moderated regression on performance expectancy was excluded, because the hierarchical linear regression and stepwise linear regression found no significant influence of this variable on intentions to use the EHR among Macedonian GPs. An interaction term was computed (independent variable and moderator) for each pair of associations and each moderated regression analyses was concluded in two steps. In step one, only the direct effects of predictors (effort expectancy, social influence and facilitating conditions) according to the original UTAUT model on the intention (separate effects) dependent variable were assessed. Step two assessed the joint effect/interaction of UTAUT predictors and moderators (age, gender, and experience) on participants’ intentions to use the EHR system. Unstandardized beta weights (*β*) and 95% confidence intervals (CIs) were calculated.

**Moderation effects on effort expectancy**

The moderated effects of age, gender, and experience were tested on the effort expectancy variable’s association with intention dependent variable. Moderated regression analyses found no significant interaction of any of the three moderators on the effort expectancy. The relationship between effort expectancy and the intention dependent variable was not influenced by age, gender, and experience. While the variance was explained only by the direct effect of the effort expectancy construct (in step one) and was found to be highly significant, in the variance explained in step two (i.e. when the moderation variables were included) there were no significant interactions. The moderation analyses showed the following results: effort expectancy by experience (*p* value for F change =.653), effort expectancy by age (*p*=.273), effort expectancy by gender (*p*=.345).

**Moderation effects on facilitating conditions**

The moderation analyses performed on the facilitating conditions by: age (*p*=.345), and by experience (*p*=.201), did not confirm the hypothesis that these moderators would interact with the basic predictor (facilitating conditions).

**Moderation effects on social influence**

Moderated regression analyses found no significant interaction of gender as a moderator and social influence (*p*=.864) as a basic predictor on intentions. However, the relationship between social influence and intentions to use EHR was significantly (*p*=.025) moderated by age (B age × injunctive SI = .005, *β*=.077, *p*<.05, 95% CI for B = .001 to .010) showing that within older GPs, the association between injunctive social influence and intention was stronger. The relationship between social influence and the intention dependent variable was significantly moderated (*p*=.022) by experience (B age × injunctive SI = .005, *β*=.080, 95% CI for B = .001 to .010) as well, showing that in GPs in early stages of work experience there is a stronger relationship between injunctive social influence and intentions to use the EHR system.

### Mediation analyses

Preacher and Hayes’ (2008) multiple mediation methodology was used to assess the indirect effect of job relevance on usage intentions, after controlling for the potential mediation effects of the UTAUT variables. The job relevance according to the original TAM2 (Venkatesh and Davis 2000), explained in Figure 2.4 is a distal predictor with potential mediation effects from other variables technology acceptance variables. Job relevance as a distal predictor has indirect effects on usage intentions, while the central role of perceived usefulness and perceived ease of use is emphasised according to the original TAM2.

The SPSS Macro Indirect (Preacher & Hayes 2008) with 1000 resamples and 95% confidence intervals, and the Sobel test (z) was used to enable effect size comparisons between the mediators. More specifically, bootstrapping and bias-corrected confidence intervals were used to assess the total and indirect effects of the independent variable X (job relevance), on the dependent variable Y (usage intention), through the effects of multiple mediators Ms (effort expectancy, social influence, facilitating conditions, and descriptive norm). The findings from the multiple mediation analysis are summarized in Table 5.32.

Table 5.32: Mediation analyses

|  |  |  |
| --- | --- | --- |
| **Independent variable: Job relevance,**  **Dependent variable: Intention** | | |
| **Multiple mediators:** | **z** | ***p*** |
| Effort expectancy | 5.81 | .001 |
| Facilitating conditions | 4.54 | .001 |
| Social influence | 2.64 | .008 |
| Descriptive norm | 4.91 | .001 |

The mediation analysis showed that the effect of job relevance on the intention dependent variable was mediated by effort expectancy (*z*=5.81), social influence (*z*=2.64), descriptive norm (*z*=4.91), and facilitating conditions (*z*=4.54). The mediation effect of effort expectancy was significantly higher than the effects of social influence, descriptive norm, and facilitating conditions. No other significant differences with respect to comparing the effects of the mediator variables were found.

## Discussion

This section summarises the results and initiates the discussion on the major findings from the study of General Practitioners. Interesting and novel findings, with respect to technology acceptance were discovered in the study. However, the main findings of this study are discussed and related to literature review in detail in the next chapter (Chapter 6). The hypotheses are assessed in Section 7.5.3.

A large amount of data was collected during the study as the response rate was fairly high (i.e., 40.2%). Analysis of the Skewness and Kurtoses of the data distributions showed that only the intention variable was strongly negative skewed as GPs reported strong intention for future use of the system. However, the Kolmogorv-Smironov test showed that the data gathered was not normally distributed and non-parametric tests were applied.

Respondents in the study reported different level of usage of PCs (between 1 to 30 years) in their life. However, it is possible that GPs which use computers more frequently are more represented among the respondents of this survey. The descriptive statistics indicated that participants in the study seemed to expect performance improvements and had high effort expectancy from the EHR system. Participants in the study had high levels of social influence in all four measured items and considered that facilitating conditions are important for the future implementation of the EHR system. Therefore, it can be concluded that respondents in the study showed high levels of association with all basic UTAUT variables.

More than half of the respondents in the study claimed that they had high satisfaction with the ‘Electronic health card’ system currently used in the country, but slightly more than half were not satisfied or were neutral with the ‘My term’ system currently used. More than half of all participants responded that the systems they used at the time of the study had improved their performance. However, a surprisingly high percentage of all participants (35.4%) reported that their patients were not satisfied, or they were neutral (31.7%) with the systems currently used in the Republic of Macedonia. A little more than half did not agree or were neutral about the effectiveness of the systems that they currently used.

The Macedonian GPs in this study had very strong intentions for future use of the EHR system and reported high relevance expectations of the system. A very high number of participants (n=358; 78.1%) in the study believed that most of their colleagues would use the system when it is implemented (descriptive norm).

It is evident that respondents in the study reported high levels of association with all technology acceptance variables. However, the descriptive statistics do not allow inferring conclusions which of these variables can predict future behaviour of participants in the study. The regression analyses which were performed predicted future behaviour of participants and therefore, assessed the major findings of this study.

All the technology acceptance items from the UTAUT model, and other additionally proposed technology acceptance items, such as job relevance, descriptive norm, and satisfaction, significantly correlated with GPs’ intentions to use the system with respect to Spearman rank correlations. These results indicate that the research instrument, i.e., the questionnaire was meaningful and properly designed. This confirms the reason of selecting all those technology acceptance variables together in the questionnaire.

Gender differences among respondents in the study assessed through Mann-Whitney tests indicated that male GPs have a stronger association with job relevance and descriptive norm variables than female colleagues. The Kruskal-Wallis test performed for age groups differences assessment identified significant differences between age range groups, with respect to some UTAUT and other technology acceptance predictors. The 40-49 year-old age group had higher scores in social influence and job relevance from the future EHR system, and satisfaction with existing e-Health systems. The Mann-Whitney test found no statistically significant location differences with respect of where the GP’s practice is located (urban/rural area) in the Republic of Macedonia. No statistically significant differences with respect to years in service were observed. However, these findings reflect some basic differences between Macedonian GPs with respect to technology acceptance variables and cannot infer final conclusions on their intentions.

The first step of the hierarchical linear regression identified the use of the ‘Other technology’ construct as a weak predictor (*p*=.004) of GP intentions for future use of the EHR. The negative Beta coefficient (*β=-*.146) showed that GPs who did not use other technology (smartphones, tablets, laptops, iphones) in their lives had the weakest intentions for future use of the EHR system. This means that, if doctors use ‘Other technology’ in other domains in their life, it makes them more likely that they will use EHR technology in their job. The Mann-Whitney test showed significant associations between performance expectancy, effort expectancy, facilitating conditions, satisfaction, job relevance, social influence, and intention variables with the ‘Other technology use’ variable. However, the influence of this predictor variable is much smaller than the other technology acceptance variables discussed further in the next step of the analyses.

The second step of the analyses identified few technology acceptance items as strong predictors of EHR future use, contributing additional 63.6% to the model. Therefore, the hierarchical linear regression explained 65.4% (Adjusted R2 = .654) in the second step where basic UTAUT, effort expectancy and facilitating conditions variables were found as the strong technology acceptance predictors. Social influence, was also found to be a technology acceptance predictor, but with lower significance. Other technology acceptance variables, such as job relevance and descriptive norm were found as strong predictors of intentions to use the EHR. However, performance expectancy as a basic UTAUT variable was found to be not significant in predicting intentions to use the EHR system among the Macedonian GPs. Therefore, the job relevance construct had only a direct effect on intentions (without performance expectancy). Satisfaction was not proved as a predictor of intentions for future use of the EHR system. Findings from the second step of the hierarchical linear regression analyses reflected the initial understanding of GPs’ intentions on future EHR system use.

The stepwise linear regression determined the relative contribution of each predictor to the overall model, by performing multiple regressions a number of times successively. The effort expectancy was found to be the strongest predictor of behaviour within this sample of GPs in the Republic of Macedonia. The descriptive norm was included in the second step. Facilitating conditions variable was included in the third step, while job relevance was fourth. Overall, these four variables had very strong and significant influence. The social influence was sixth variable in the model. Performance expectancy and satisfaction variables were excluded from the model as their contribution was found to be non-significant statistically. Therefore, the stepwise linear regression analyses indicated the most important predictors of Macedonian GPs intentions on future EHR system use.

Two regression analyses showed similar outcomes. The effort expectancy was therefore identified as the most efficient predictor of future GPs behaviour. The literature review (Section 2.6) identified that performance expectancy is the major predictor of future behaviour across all studies on technology acceptance models on EHR (Archer and Cocosila 2011; Harle and Devar 2012; Razeghi and Nasiripour 2014). Effort expectancy was found as direct predictor of behaviour in almost all studies (Archer and Cocosila 2011; Harle and Devar 2012; Razeghi and Nasiripour 2014). However, the performance expectancy is identified as a first and most important behavioural predictor in all studies in the literature review, which is different from this research’ findings.

Social influence as a behavioural predictor has limited use in research studies (Archer and Cocosila 2011; Gagnon et al. 2014; Razeghi and Nasiripour 2014; Al-Adwan and Berger 2015; Steinninger and Stiglbauer 2015). Facilitating conditions variable’ prediction power was proved only in the Razeghi and Nasiripour’s (2014) study. Job relevance variable as a predictor was tested and found significant only in Archer and Cocosila’s (2011) study. Computer use at home and computer knowledge were found as predictors in the Devane et al. (2010) study. However, the UTAUT as a latest developed technology acceptance model does not been used as widely as other models (TAM and TAM2) in the literature (Section 2.6).

Structural equation modelling performed on three Hypotheses (H3 was assessed through mediated regression) mainly reconfirmed the findings from the regression analyses. However, there were small differences in the assessment of H2, where performance expectancy showed only a weak effect on intentions to use the EHR system. In the regression analyses, this variable did not have effect on intention at all.

The major finding from the study, i.e., that effort expectancy was shown to be the strongest predictor is different from those previously reported in the relevant literature. The original UTAUT model (Venkatesh et al. 2003) and all of the relevant studies (Section 2.6) identified in the literature review reported that performance expectancy is the strongest predictor of intentions from the UTAUT model. However, this construct in the study of GPs did not show association with the intention to use the system dependent variable. Facilitating conditions and job relevance were identified as strong predictors in this study of GPs. The facilitating conditions as predictor on intentions to use the EHR has been reported in one study in the literature review (Razeghi and Nasiripour’s (2014). The social influence prediction effect was reported in several studies (Archer and Cocosila 2011; Razeghi and Nasiripour 2014; Al-Aldwan and Berger 2015; Steinninger and Stiglbauer 2015).

Findings from this research suggest that technology acceptance plays an important role among healthcare professionals’ acceptance of new ICT in this country in SEE. This corresponds with the findings in the literature review with respect of technology acceptance in healthcare settings (Amatayakul 2005). A formal readiness assessment for EHR acceptance could help organisations to identify and develop strategies to address this challenge.

The moderation analyses showed that age and experience as moderators from the original UTAUT model, significantly moderated the effects of the social influence construct on intentions to use the EHR system. Therefore, it can be concluded that the relationship between social influence as a basic UTAUT predictor and the intention dependent variable to use the future EHR system was stronger among older GPs and GPs in early stages of work experience. The older GPs (based on the age moderator) socially validate the system and they are informed that other users appreciate the use of system. GPs in early stages of work experience have stronger influence from other colleagues.

In this study, unlike in Venkatesh et al.’s (2003) original UTAUT model, the effort expectancy and facilitating conditions variables were not moderated by age, gender, and experience moderators. These findings are different from the original UTAUT model (Venkatesh et al. 2003), in which age had a moderation effect on all four basic UTAUT constructs (performance expectancy, effort expectancy, facilitating conditions, and social influence) and experience influences effort expectancy, facilitating conditions, and social influence. In the original UTAUT, gender had an effect as a moderator on performance expectancy, effort expectancy and social influence, while in this study; this moderator did not have an influence at all. However, studies of technology acceptance on EHR discussed in the literature review (Section 2.6) did not assess the moderation effects at all. Therefore, there are no relevant studies that can be compared with this study with respect to moderation analyses.

The multiple mediation (Preacher and Hays 2008) analyses have shown that the effect of job relevance on intention variable is mediated by effort expectancy, social influence, descriptive norm, and facilitating conditions. This means that the effect of job relevance on participants’ intentions to use the EHR system will be stronger if the system is easy to use (effort expectancy), if there are important other colleagues which will influence (social influence and descriptive norm) the GPs’ behaviour, and if there is enough IT support for the system (facilitating conditions). These findings are compatible from those of hierarchical and stepwise linear regressions where effort expectancy, facilitating conditions, social influence, and descriptive norm are found as predictors of intentions. However, mediation analysis was not performed across relevant studies in the literature review (Section 2.6).

## Conclusions

This chapter presents the results from the study of General Practitioners. A positivist quantitative questionnaire survey assessed GPs’ attitudes towards the future EHR system in the Republic of Macedonia. The effectiveness of the on-line questionnaire was demonstrated with respect to validity and reliability. The response rate of more than 40% yielded robust and good quality data that were eligible for the further analyses. Spearman rank correlation confirmed that all of the proposed questionnaire items measure what they intended to and in the right direction.

Major study findings were revealed and confirmed through two types of regression analyses. In detail, the hierarchical linear regression indicated that effort expectancy, facilitating conditions, job relevance, and descriptive norm are significant predictors of GPs intentions to use the future EHR system. The use of the Internet for professional needs and social influence were shown to be predictors of intentions. The stepwise linear regression has confirmed the findings from the hierarchical linear regression confirming that effort expectancy is the strongest predictor, followed by descriptive norm, facilitating conditions, and job relevance. The social influence was also found to be a predictor although with weaker influence. The two types of regression analyses found no statistically significant association between performance expectancy (basic UTAUT prediction construct) and satisfaction (the other technology acceptance construct) variables with intention to use the future EHR system dependent variable. The structural equation modelling was conducted as a second level of analysis and mainly re-confirmed findings from the regression analyses.

Moderated regression found that effort expectancy and facilitating conditions in the study as basic UTAUT constructs were not moderated by the UTAUT original model moderators such as age, gender, and previous working experience. Performance expectancy was excluded as two types of regression analyses found non-significant association of this variable with intentions to use the system. Moderated regression confirmed the moderation effect only of age and working experience on UTAUT’s social influence variable association with intentions. This finding is different from the original UTAUT model. The mediation analysis showed that the job relevance’ (as a TAM2 distal predictor) effect on the intention dependent variable was mediated by effort expectancy, social influence, descriptive norm, and facilitating conditions.

The next Chapter 6, the Discussion Chapter, presents an in-depth comparison, discussion and interpretation of the findings from both studies of this Thesis. Findings from this study will be compared with those from the study of hospital healthcare professionals (Chapter 4), and related to the relevant literature from Chapter 2 of this Thesis.

# Discussion

## Introduction

The previous Chapters (4 and 5) presented the empirical studies conducted on healthcare professionals in the Republic of Macedonia. This chapter compares the research instruments, and discusses the findings of the two studies which contribute to research and new knowledge in the area of technology acceptance in healthcare settings in SEE. In particular, new findings concerning the TAM2 and the UTAUT will be presented together, compared, and discussed. Section 6.1 is a short overview of the research terms and literature. Section 6.2 presents the comparison and progress of the research instrument throughout the Thesis. Limitations of this research are discussed in section 6.3. Section 6.4 interprets the results and findings and compares them to the relevant literature in one place. Section 6.5 concludes this chapter

## Progress of the research instrument throughout the Thesis

This section compares the research instruments in both studies in order to show how the research instrument of the Thesis progressed from the first to the second study. Technology acceptance is a complex research tool represented by different assessment models, such as TAM, TAM2, TAM3, and UTAUT (Davis 1989; Venkatesh and Davis 2000; Venkatesh et al. 2003; Venkatesh and Balla 2008). However, there are many other technology acceptance constructs, such as descriptive norm (Rivis and Sheeran 2003), and various forms of ICT use assessment (Teo et al. 2008; Devane et al. 2010; Morton and Wiedenback 2010) described in the research literature, which may be used separately or in combination with the original technology acceptance models. This section presents the overall research model used in the Thesis. However, another aim of this section is to explain to the reader the complexity and development of the research instrument throughout the research. The lessons learned from the first study of hospital healthcare professionals (Section 4.4.2) were implemented in the development of the research instrument of the second study of General Practitioners. This represents the progress of the research instrument with respect to the development of more advanced methodological research throughout the study. The research instrument of the first study (conducted in 2011) reflected the published research of technology acceptance in healthcare settings (Section 2.6.1) at that time (Menachemi et al. 2007; Hyun et al. 2009; Morton & Wiendenbeck 2009; Wilkins 2009; Devane et al. 2010; Morton & Wiendenbeck 2010; Spil et al. 2010; Egea & Gonzalez 2011). The modified versions of TAM and TAM2 in healthcare settings were used across all studies published until 2011. The methodological approach of the second study, which was conducted in 2014, was influenced by recent research of technology acceptance in healthcare (Section 2.6.2) subsequently published by Archer & Cocosila (2011), Harle & Dewar (2012), and Razeghi & Nasiripour (2014). These authors used modified versions of the UTAUT in healthcare settings. Basically, the TAM2 and the UTAUT take the same research approach, and the UTAUT is a slightly improved and developed model. Ideally, and with hindsight, it may have been better that the same research model should have been used throughout the Thesis. This limitation is discussed in Section 6.3.1. The next two tables represent the progress of thinking and a slight improvement on the research model in order to develop the best research tool for the Thesis. Table 6.1 presents the development of the research model/tool (similarities, differences, and progress of the research instrument) throughout the Thesis with respect to the TAM2 and UTAUT constructs.

Table 6.1: Development of the research instrument: TAM2 and UTAUT variables

|  |  |  |  |
| --- | --- | --- | --- |
| **The study of hospital healthcare professionals** | | **The study of General Practitioners** | |
| **Model used: modified TAM2** | | **Model used: modified UTAUT** | |
| **Construct**  **(model)** | **Questions used in the study** | **Construct**  **(model)** | **Questions used in the study** |
| **Perceived usefulness**  **(TAM2)** | Using e-Health system at work would improve my job performance | **Performance expectancy**  **(UTAUT)** | Using EHR system would improve my job performance |
| Using e-Health system at work would increase my productivity | Using EHR system would increase my productivity |
| Using e-Health system at work would enhance my effectiveness | Using EHR system would enhance my effectiveness |
| Overall, I would find e-Health system useful for my work | Overall, I would find EHR system useful for my work |
|  | Using EHR system would help me to accomplish tasks more quickly |
| **Perceived ease of use**  **(TAM2)** | I would find e-Health system easy to use | **Effort expectancy**  **(UTAUT)** | I would find EHR system easy to use |
| Interacting with e-Health system will be easy and understandable | Interacting with EHR system would be easy and understandable |
| I would find it easy to get e-Health system to do what I want it to do | I would find it easy to get EHR system to do what I want it to do |
| Interacting with e-Health system would not require a lot of mental effort | Interacting with EHR system would require a lot of mental effort |
| I will be able to use e-Health system effectively | I will be able to use EHR system effectively |
| Using e-Health system will be an easy task for me | Using EHR system will be an easy task for me |
| I will easily work with e-Health system | I will easily work with EHR system |
|  | It would be easy to me to become skilful at using EHR system |
| **Subjective norm**  **(TAM2)** | In general, e-Health system will be well approved and supported by most of my colleagues | **Social influence**  **(UTAUT)** | In general, EHR system will be well approved and supported by most of my colleagues |
| The colleagues that I respect most would accept the e-Health system | The colleagues that I respect most would accept the EHR system |
|  | People who influence my behaviour think that I should use the EHR system if it is implemented |
| People who are important to me think that I should use the EHR system if it is implemented |
|  | | **Facilitating conditions**  **(UTAUT)** | I have the necessary resources to use the EHR system |
| I have the necessary knowledge to use the EHR system |
| The EHR system is compatible with other systems that I currently use |
| A specific person (or group) will be available for assistance with EHR system difficulties |
| **Job relevance**  **(TAM2)** | In my job, the use of e-Health system would be important | **Job relevance**  **(TAM2)** | In my job, the use of EHR system would be important |
| In my job, the use of e-Health system would be relevant | In my job, the use of EHR system would be relevant |
| **Intention**  **(TAM2, UTAUT)** | I intend to use e-Health system if it is implemented | **Intention**  **(TAM2, UTAUT)** | I intend to use EHR system if it is implemented |
| I expect to use e-Health system if it is implemented | I expect to use EHR system if it is implemented |
| I plan to use e-Health system if it is implemented | I plan to use EHR system if it is implemented |
| **Items assessed through 7-point Likert scale**  1. Strongly disagree, 2. Moderately disagree, 3. Somewhat disagree, 4. Neutral, 5. Somewhat disagree, 6. Moderately disagree, 7. Strongly disagree | | **Items assessed through 5-point Likert scale:**  1. Strongly disagree, 2. Moderately disagree, 3. Neutral, 4. Moderately agree, 5. Strongly agree | |

As can be seen from Table 6.1, perceived usefulness and performance expectancy are similar measurements representing participants’ beliefs on usefulness of the future e-Health/EHR system. There is a slight improvement in the second study questionnaire with introducing of one more assessment item with respect to this construct. Perceived ease of use and effort expectancy are representing the same construct (ease of interaction with the proposed e-Health/EHR system). In the second study there is one more question added with the aim of achieving a better assessment of participants’ attitudes on this construct. TAM2’s subjective norm progresses to UTAUT’s social influence throughout the research, with two added questions in the second study. This enables better capture of the social influences of the participants throughout the research. Facilitating conditions are assessed only in the second study as this construct is represented only in the UTAUT model. However, job relevance and intention variables are measured with same questionnaire items throughout the research.

With respect to other technology acceptance variables, descriptive norm was assessed similarly throughout the research. PC use, the Internet use, and use of ‘Other technology’ items are assessed differently throughout the Thesis. Computer anxiety was assess only in the first study and was excluded from the second study research instrument as this item’s influence on intentions was non-significant. Satisfaction items were used in the second study with the aim of assessing respondents’ beliefs on currently used e-Health systems in the country.

The TAM2 constructs (Venkatesh and Davis 2000), together with other technology acceptance constructs such as: computer use (Teo et al. 2008; Devane et al. 2010; Morton and Wiedenback 2010); TAM3’ computer anxiety (Venkatesh and Balla 2008); and descriptive norm (Rivis and Sheeran 2003), were used in the first study. The research instrument in the first study was tested in a relatively small sample of 200 participants (doctors and nurses) in hospital settings in the Republic of Macedonia. Table 6.2 presents the progress of the research instrument of the Thesis with respect to other technology acceptance constructs used in the studies, development and improvements.

Table 6.2: Research instrument progress: other technology acceptance constructs

|  |  |  |  |
| --- | --- | --- | --- |
| **Construct** | **Study of hospital healthcare professionals** | **Study of General Practitioners** | **Assessment options used for both studies**: |
| **Other technology acceptance questions used in the studies** | |
| **Descriptive norm** | How many of your colleagues do you think will use e-Health system if it is implemented? | How many of your colleagues do you think will use EHR system if it is implemented? | **Five-point pre-defined response categories:** 1=none of them, 2=a few of them, 3=some of them, 4=most of them, 5=all of them |
| **Computer use** | Do you have access to a personal computer at work or home? | Not applied | Yes/No |
| **Computer use/years** | On average, how long have you been using computers? | Approximately how long have you been using computers? | Years (fill in) |
| **Computer use/hours** | On average, how many hours a day do you use a computer? | On average, how many hours a day do you use a computer? | Hours (fill in) |
| **Use of ‘Other technology’** | Not applied | Do you use mobile devices to access the Internet, such as tablet, smartphone, iphone or laptop? | Yes/No |
| **Internet use/ for personal purposes** | Not applied | Approximately how often do you use the Internet for personal needs, such as entertainment, online banking, and social networking? | **Four-point pre-defined answering option:** 1=never/rarely, 2=1-2 times a month, 3=1-2 times a week, 4=several times a day |
| **Internet use/ for professional purposes** | Not applied | Approximately how often do you use the Internet for professional purposes, such as accessing or storing patient information? |
| **Computer anxiety**  **(TAM3)** | Computers make me feel uncomfortable | Not applied | 7-point Likert scale |
| Working with computer makes me nervous |
| Computers do not scare me at all |
| Computers make me feel uneasy |
| **Satisfaction**  **(Researcher)** | Not applied | I am satisfied with the ‘Electronic health card” system that I currently use | 5-point Likert scale |
| I am satisfied with the ‘My term’ system that I currently use |
| The systems I currently use have improved my performance |
| My patients are satisfied with the systems that are currently used |
| Overall, the systems used currently are effective |

An improved research instrument (Section 5.2.4) based on the lessons learned from the first study (Section 4.4.2) and review on latest developments in the literature (Section 2.6.2) was used in the second study. The UTAUT model (Venkatesh et al. 2003), utilising the latest concepts in technology acceptance used in studies in healthcare (Spil et al. 2010; Archer and Cocosila 2011; Harle and Dewar 2012; Razeghi and Nasiripour 2014), was used as the research instrument of the second study. The job relevance (TAM2) variable, which had an important predictive effect in the first study, remained in the research instrument for the second study. However, other technology acceptance constructs, such as: PC use years/hours; use of computer technology in other domains of participants’ lives; the Internet use for professional and personal reasons (Teo et al. 2008; Devane et al. 2010; Morton and Wiedenback 2010); and descriptive norm (Rivis and Sheeran 2003) were used in the revised UTAUT model in the second study. Moderators from the original UTAUT model, such as age, gender, and experience, were also included in the research instrument in the second study, in order to capture their moderating effect on the basic UTAUT predictors. The 7-point Likert scale used in the first study was narrowed to a 5-point Likert scale in the second study, as indicated in Section 5.2.6, the 7-point measurement creates difficulties in Macedonian language. The questionnaire of the second study was successfully distributed on a sample of 1139 GPs nationwide: 458 responded successfully (response rate = 40.2%), and its effectiveness was demonstrated in this study.

The first study was conducted through traditional ‘paper and pencil survey’. The second study survey, due to progress of thinking was conducted online through SharePointTM web platform.

The research instrument throughout the study progressed mainly for methodological reasons. The original technology acceptance models were initially developed in ICT settings, which are different from those in healthcare. As discussed in Section 2.6, there have been no studies of technology acceptance in healthcare settings in SEE. The main aim of the changes in the research instrument was to make progress and to develop the most efficient tool for assessing the attitudes of healthcare professionals in a SEE country. However, due to slight differences in the research instruments, the data from both studies could not be merged and analysed together.

The research instrument was developed further with the aim to provide greater depth to the research, as the TAM2 from the initial (scooping) study was not comprehensive enough. Therefore using the UTAUT in the second study improved the research, but reduced the comparability of the results. It is trade-off between improving the research instrument and the ability to compare the results.

### Reliability of the research instruments of both studies

This section compares the reliability of the research instruments of both studies. The reliability of the research instruments of both studies was calculated with pairwise correlations between technology acceptance assessment items. It was expressed through Cronbach’s alpha (α) coefficient, in accordance with Fink’s (1995), Devane et al.’s (2010), and Egea and Gonzalez’ (2011) recommendations. Table 6.3 shows the reliability coefficients of the research instruments of this Thesis. The reliability analysis in both studies, measured with Cronbach’s alpha (α), showed that all constructs used had *α* coefficients that ranged from .69 to .94. Studies with the multi-item Likert scale which measure more than 4 items and have coefficients in a range of .70 or higher indicate high internal consistency reliability (Im et al. 2011). Therefore, the internal consistency reliability indicator Cronbach’s α values in both studies had acceptable levels of internal consistency and indicated that all of the proposed technology acceptance constructs were coherent and measured similar concepts, and that it made sense to use them in this research.

Table 6.3: Reliability coefficients, both studies

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study of hospital healthcare professionals** | | | | | | | | |
| **Variable:** | Intention | Perceived usefulness | Perceived ease of use | Subjective norm | Descriptive norm | Job relevance | Computer anxiety | |
| Cronbach  α: | .85 | .91 | .92 | .89 | .87 | .73 | .71 | |
| **Study of General Practitioners** | | | | | | | | |
| **Variable:** | Intention | Performance expectancy | Effort expectancy | Social influence | Descriptive norm | Job relevance | Satisfaction | Facilitating conditions |
| Cronbach  α: | .94 | .91 | .88 | .93 | .85 | .69 | .88 | .74 |

### Validity of research instruments of both studies

This section compares the validity of the research instruments of both studies. The validity of the research instruments in this Thesis was assessed by inter-correlations between technology acceptance variables. The Spearman rank correlation coefficients, mean scores and standard deviations of both studies are presented in Table 6.4.

Table 6.4: Spearman rank correlations, mean (), and standard deviation (SD), both studies

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Study of hospital healthcare professionals** | | | | | | | |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 Intention | - | .62\* | .71\* | -.13 | .70\*\*\* | .67\* | .44\* |
| 2 Perceived usefulness |  | - | .67\* | -.11 | .61\* | .60\* | .38\* |
| 3 Perceived ease of use |  |  |  | -.18 | .66\* | .66\* | .40\*\* |
| 4 Computer anxiety |  |  |  | - | -.06 | .01 | -.13 |
| 5 Job relevance |  |  |  |  | - | .63\* | .38\* |
| 6 Subjective norm |  |  |  |  |  | - | .53\* |
| 7 Descriptive norm |  |  |  |  |  |  | - |
| () | 6.11 | 5.38 | 5.55 | 3.39 | 5.63 | 5.86 | 5.34 |
| SD | 1.39 | 1.77 | 1.40 | 1.48 | 1.50 | 1.51 | 1.72 |
| **Study of General Practitioners** | | | | | | | |
| 1 Performance expectancy | - | .71\* | .56\* | .66\* | .65\* | .58\* | .59\* |
| 2 Effort expectancy |  | - | .68\* | .69\*\*\* | .66\* | .61\* | .68\*\* |
| 3 Facilitating conditions |  |  | - | .61\* | .59\* | .58\* | .62\* |
| 4 Job relevance |  |  |  | - | .65\* | .55\* | .62\*\* |
| 5 Social influence |  |  |  |  | - | .58\*\*\* | .63\* |
| 6 Satisfaction |  |  |  |  |  | - | .52\* |
| 7 Intention |  |  |  |  |  |  | - |
| () | 3.95 | 3.82 | 4.04 | 3.87 | 3.73 | 3.40 | 4.41 |
| SD | 1.14 | .87 | .86 | 1.04 | 1.10 | 1.09 | .91 |

\*\*\*= *p*<.001; \*\**p*<.005; \*=*p*<.05

All Spearman rank correlations coefficients among the technology acceptance items within both studies, except for computer anxiety (first study), were statistically significant, and in the expected direction. This analysis confirms the validity and consistency of the research instruments used in both studies. Correlations between the intention dependent variable and the technology acceptance items indicated that there was a correlation between the different concepts that were measured (in the expected direction). Predictions about human behaviour can be made when strong correlations exist (Goodwin 1998). Therefore, it can be concluded that both studies have similar validity and consistency of the research instruments.

## Limitations of the study

This Thesis successfully identified many aspects of intentions of Macedonian healthcare professionals. However, this research in this Thesis’ instrument has some limitations, which are discussed in this section. These limitations will be divided in two groups: a priori limitations (limitations of which the author was aware before collecting the data), and limitations learned from the study.

### A priori limitations

The literature review conducted before the research in this Thesis had its limitations as there was no exact number of how many records were retrieved from each database. Articles in the literature review are presented chronologically, and it was also possible to present them by topic, making the discussion easier.

The methodological approach of this research has its own limitations. As only the quantitative approach was applied, it is possible that a qualitative approach could have provided a more profound explanation of healthcare professional’s preferences and attitudes to the new ICT. The technology acceptance research instrument uses self-reported data which are sometimes subjective. The research instrument of the first study was administered manually (traditional pen and pencil questionnaire) and the research instrument of the second study was administered online. The progress of thinking throughout the Thesis has led to more efficient instrument use in the second study. Therefore, there is a possible difference in respondents. It is possible that more conservative healthcare professionals took part in the first study, and more GPs which are familiar with the IT responded the second study questionnaire.

The first study for this Thesis was conducted in three hospitals in the capital Skopje. The sample in the first study was much smaller than the one used in the second study. The first study was conducted in only one city, the capital Skopje. The other parts (hospital healthcare professionals) of the country were not assessed in the first study and the findings cannot be generalized to the population of hospital healthcare professionals throughout the whole country. Although Skopje is the largest city in the country and, as described in Section 1.2, the major hospitals are located there, the sample may not be representative of the population of hospital doctors and nurses in other parts of the country.

The number of questionnaires that were distributed was limited to a total of 200 in three hospitals in the capital city, Skopje. The number of questionnaires and selection of capital Skopje was therefore a limitation of this study. The findings from this study therefore cannot be generalised to the whole hospital healthcare population in the Republic of Macedonia; however, they do provide a detailed account of the readiness of healthcare professionals in these hospitals to use the new system and the factors that may affect this. This study also served to develop an understanding of the issues for the second study of GPs.

The data on the hospital healthcare population in the Republic of Macedonia, i.e., the split between the city-based and less centralised hospitals, the male/female ratio, the ratio of doctors/nurses, the, mean years of experience are not available (through either the Ministry of Health or Health Insurance Fund). This is another limitation of this study.

Different research instruments were used in each of the two studies. Ideally, the same research instrument should have been applied throughout the Thesis, so that the data could have been easily compared, and a comparison could have been made of the different groups of healthcare professionals. However, the difference between the TAM2 (first study) and the UTAUT (second study) is very small, and it was possible to present the data together, side by side and to draw some final conclusions. In addition, the progress of the research instrument throughout the study helped to create a more accurate and more efficient research tool. However, the differences in the questionnaires’ items discussed in Section 6.2 are limitation which makes impossible to the data from the whole study to be merged and analyzed together.

There are other technology acceptance constructs described in the literature such as trust (Egea and Gonzalez 2011); privacy (Steinninger and Stiglbauer 2015); and data protection (Hoebrst and Ammenwerth 2010), which could have been used in the study. Previous research has most frequently applied the TAM2 and UTAT technology acceptance constructs modified with other technology acceptance constructs such as: descriptive norm, satisfaction, computer anxiety, computer and the Internet use, and ‘use of Other technology’. It is possible that trust, privacy, and data protection may have some influence among healthcare professionals with respect to technology acceptance. However, these constructs do not reflect the core predictors of intentions to use, but may have some influence in technology acceptance.

There were no open-ended items (e.g., an “Any further comments?” text box) included in the research instruments used for the Thesis. It is possible that these questions could have provided a further explanation on healthcare professionals’ attitudes towards e-Health/EHR systems. However, including more open-ended questions might have reduced the response/completion rate, and this study was primarily quantitative, not qualitative. It was a trade-off between designing a more comprehensive questionnaire, with opportunities for text responses, and gaining a good response rate by keeping it shorter. This is a limitation of the research instruments of the studies.

Other technology acceptance models such as: task-technology fit, and user-centred methods (Hyun et al. 2009); diffusion of innovation theories (Morton and Wiendenbeck (2009); Delone and Mclean model, USE-IT, and 4E model (Spil et al. 2010) were presented in the literature review (Section 2.6.2). In order to focus the study on one particular model, these models were not applied in this Thesis.

The management from the three hospitals in the first study were not familiar with the research ethics approval processes and while verbal approval for the study was given, no written ethics approval forms were available from the sampled hospitals to be included in the study.

### Limitations learned from the study

The design of the two-stage cluster sampling procedure in the first study was not conducted perfectly with respect to administering questionnaires to participants. As the questionnaires were distributed through the management of those clinics the research instrument was not administered as a random survey, which would have been the ideal way. It is therefore possible that views of some hospital healthcare professionals are under-represented in this study, and the results may not be generalizable within the hospital or beyond.

Although the response rate of 40% in the second study was acceptable for an email survey, the research instrument was not administered equally to cover all of the targeted GP population in the country. There were practices where few GPs work together but had only one registered e-mail address within the national Health Insurance Fund (source used for sampling procedure), and therefore not all the GPs were able to participate. Although this is a small number of practices, the views of all GPs were not represented equally. It is also possible that GPs who use IT less, either in their professional roles or in their personal lives were under-represented and this may have led to a response bias within this sample. It is also possible that the views in the study, in relation to readiness to adopt the health information technologies, as well as the relationships among the variables, reflect those participants who were more familiar with using ICT, as data were collected through an online survey, so the second study may have had a response bias.

Most of the participants in this research were females (88.7% in the hospital study and 66.2% in the study of GPs). This gender bias resonates with Lopez (2008) study, which had gender bias (77% males). The Ministry of Health in the Republic of Macedonia did not have detailed data on the population of hospital healthcare professionals, the split between city-based and less centralised hospitals, the male/female ratio, doctors/nurses ratio, or the mean years of experience for comparison with the data from the study of hospital healthcare professionals. This is a further limitation of the first study.

The national Health Insurance Fund did not have detailed demographic data of GPs in the country. This is another limitation, as the second study demographic data could not be compared with the whole population of GPs in the country.

Some analyses, such as the moderated regression and mediation analyses, were performed only on the second study data. These analyses have indicated some aspects of behaviour of the participants in the second study. This may have led to some differences in the findings from both studies.

## Results and findings of both studies

This section presents the major findings of this research. The previous two sections indicated that the research instruments and the study population are closely connected. However, due to data differences, the results and study outcomes of both studies could not be merged for further combined analyses. For this reason, the results and findings of the two studies are presented and discussed together in this section in order to draw the final conclusions of this Thesis and assess the national readiness for e-Health/EHR systems in the country. This can serve as a basis for developing a conceptual model and a diagram modelling the factors influencing the intentions to use ICT systems in healthcare (Figure 6.1). This might then help to explain the results more clearly, identifying which variables are more important and contribute more to the explanation of intentions, both in this particular setting and also factors that might affect technology acceptance more generally.

### Descriptive statistics of both studies

This section compares the descriptive statistics of this research. Both empirical studies of this Thesis were conducted in healthcare settings in the Republic of Macedonia. The first was conducted in hospital settings, while the second assessed the views of GPs nationwide. The next Table 6.5 presents the descriptive statistics of this research.

Table 6.5: Comparison of descriptive statistics, both studies

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Study of hospital healthcare professionals** | **Study of General**  **Practitioners** | |
| **Sampling** | Double stage cluster sampling | | |
| **Healthcare institution** | Three hospitals in the capital city, Skopje: City Surgery Hospital, Paediatric Hospital & Geriatric Hospital | | GPs nationwide survey |
| **Number of invited participants** | 200 | | 1139 |
| **Response rate N / %** | Collected questionnaires:  169 / 84.5%  Eligible for analyses:  133 / 66.5% | | 458 / 40.2% |
| **Participants:**  **doctors/nurses, N / %** | Hospital doctors: 68 / 51.1%  Nurses: 65 / 48.9% | | GPs = 458 (all with contracts, Health Insurance Fund) |
| **Male/Female N** | 15 / 118 | | 155 / 303 |
| **Male/Female %** | 11.3% / 88.7% | | 33.8% / 66.2% |
| **Age range** | 20–62 | | 24–65 |
| **Age / SD** | Hospital doctors:  =44.30 / SD=10.73 | | =44.15 / SD=11.41 |
| Nurses:  =40.09 / SD=9.83 | |
| **Years of work experience:**  **range // SD** | Not assessed | | 1–38 /=15.45 / SD=10.40 |

In the study of hospital healthcare professionals, the overall gender balance (female/male) was 88.7%/11.3%, and the age range was 20–62. The Paediatric Hospital at the time of the study had 205 employees, of which 178 were female and 27 were male; gender balance female/male 86.83/13.17%. The number of employees was: nurses=90, doctors=35, and other staff=80. The age range of staff was 19–65 years of age. Skopje City Surgery Hospital had 367 employees (female=248, male=119; gender balance female/male 67.58/32.42%. The number of employees was 153 nurses, 56 doctors, and 158 other staff. The age range was 20–65. The Geriatric Hospital had 251 employees (female=202, male=49; gender balance 80.48/19.52%. The employees were 80 nurses, 28 doctors and 143=other staff. Their age range was 19-65.

At the time of the second study, 1677 GPs had active contracts with the national Health Insurance Fund in the Republic of Macedonia. The gender balance (female : male) of the study of General Practitioners was female : male = 303 : 155 (66.2%:33.8%). However, the national Health Insurance Fund did not have data on the gender balance of GPs across the country, which was needed to compare the sample with the population of GPs; this limitation was discussed in Section 6.3.

Both studies of this research were conducted on healthcare professionals. Other groups of workers in healthcare settings were excluded from this research. The first study was conducted on a smaller city-based sample while the second on a larger nationwide sample. Both studies had different response rates. A major difference between the studies was that the first study was conducted on doctors and nurses and the second study only on doctors. The first study was conducted in the hospital environment and the second in GP practices. While the first study was conducted only in the capital, Skopje, the second one was conducted on a national sample. There were differences in both studies with respect to gender, while the age range was similar in both studies.

### Hierarchical linear regressions of both studies

Hierarchical linear regression analyses were conducted separately on the data from both studies collected for this purpose. Table 6.6 presents the significant predictors in step two of the hierarchical linear regressions of both studies.

Table 6.6: Hierarchical linear regressions (step two), comparison of the main predictor variables in both studies

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Study of hospital healthcare**  **professionals** | | | | | **Study of General**  **Practitioners** | | |
| **Model used:** TAM2 + other technology acceptance constructs | | | | | **Model used:** UTAUT + other technology acceptance constructs | | |
| Adjusted R2=68.1% | | | | | Adjusted R2=65.4% | | |
| **Dependent variable:** Intention to use  e-Health system | | | | | **Dependent variable:** Intention to use  EHR system | | |
| **Variable** | | *β* | | 95% CI | **Variable** | *Β* | 95% CI |
| Perceived ease of use | | .151\*\*\* | | .032 - .335 | Effort expectancy | .217\*\*\* | .119 - .335 |
| Facilitating conditions | .232\*\*\* | .157 - .336 |
| Subjective norm | .187\*\* | | .035 - .339 | | Descriptive norm | .198\*\*\* | .135 - .282 |
| Job relevance | .172\*\* | .070 - .232 |
| Job relevance | .132\* | | .031 - .296 | | Social influence | .108\* | .016 - .162 |
| The Internet use/ professional needs | .096\*\* | .118 - .048 |
| \*\*\*=p<.001, \*\*=*p*<.005, \*=*p* < .05 | | | | | \*\*\*=p<.001, \*\*=*p*<.005, \*=*p*<.05 | | |

Table 6.6 identifies the major predictors of the participants’ intentions in both studies regarding proposed new ICTs in healthcare settings in the Republic of Macedonia. The hierarchical linear regression models that were applied in both studies explained a high overall percentage of the variance in intentions.

Perceived ease of use, subjective norm, and job relevance were found to be the strongest predictors of the intentions to use e-Health system in the first study. Similar findings were discovered in the second study, where effort expectancy, facilitating conditions, job relevance, descriptive norm, social influence, and the Internet use (professional needs) were shown to be predictors of intentions to use the EHR system. These findings will be discussed together with the stepwise liner regression results in the next sections.

### Stepwise linear regressions of both studies

In addition to the initial (hierarchical linear regression) findings, stepwise linear regression was applied in both studies in order to identify the contribution of each separate technology acceptance construct to the overall prediction model. Table 6.7 presents the stepwise linear regression applied separately to the data of both studies.

Table 6.7: Stepwise linear regressions, both studies

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Study of hospital healthcare**  **professionals** | | | **Study of General**  **Practitioners** | | |
| **Model used:**  TAM2 + other technology acceptance constructs | | | | **Model used:**  UTAUT + other technology acceptance constructs | | |
| **Dependent variable:**  Intention to use the e-Health system | | | | **Dependent variable:**  Intention to use the EHR system | | |
| **Step** | **Variable** | **R2** | **R2 Change** | **Variable** | **R2** | **R2 Change** |
| **1.** | Perceived ease of use\*\* | .599 | .599 | Effort expectancy\*\* | .517 | .517 |
| **2.** | Subjective norm\*\* | .682 | .083 | Descriptive norm\*\* | .587 | .070 |
| **3.** | Job relevance\* | .697 | .016 | Facilitating conditions\*\* | .617 | .031 |
| **4.** |  | | | Job relevance\*\* | .636 | .019 |
| **5.** |  | | | Social influence\* | .642 | .006 |
| \*\*=*p*<.001, \*=*p*<.05 | | | | \*\*=*p*<.001, \*=*p*<.05 | | |

It can be seen from Table 6.7 that, in the first study, perceived ease of use, and, in the second study, effort expectancy were identified as the major predictors of intentions to use the new systems among the participants. Perceived ease of use, accounted for 59.9% (in the first study), and effort expectancy, accounted for 51.7% (in the second study) of the variance in intentions to use, and respectively were the strongest predictors of intentions among the two groups of participants. These two predictors, although representing different technology acceptance models, reflect the same construct, i.e., how easy it would be for the healthcare professionals to interact with the proposed ICT systems in healthcare.

Subjective norm, contributing an additional 8.3% to the explanation of the prediction model (R2 Change=.083) in the first study, and descriptive norm, predicting an additional 7% (R2 Change=.070) in the second study, were identified as the second most powerful predictors of intentions in the two studies. However, social influence was ranked fifth as a predictor in the second study (contributing to .06% of the variance). Although all of these constructs sound different, they reflect similar normative beliefs of social influences, reflecting how an individual perceives what important others believe about whether s/he should use the system (subjective norm and social influence) and the participants’ estimates of how many of his/her colleagues would use e-Health/EHR systems if they were implemented (descriptive norm). This finding indicates that participants’ intentions regarding e-Health/EHR technology are, to certain limited extent, based on social influences.

Facilitating conditions construct was identified as the third most important predictor for the participants in the second study. However, this construct was not assessed in the first study, because the TAM2 does not include this variable. Although this variable explained only 3.1% of the variability in the intentions to use the EHR system, its importance is greater, since this variable is closely related to the effort expectancy construct, as it reflects the participants’ beliefs about the technical and personal support available for ICT system use (Venkatesh et al. 2003). This finding reflects participants’ expectations that there would be technical support in their daily routine, for better acceptance of the proposed EHR system.

Job relevance effect as a predictor of technology acceptance behaviour was established in both studies. It was identified as the third most important predictor in the first study (R2 Change=.016) and the fourth most important in the second study (R2 Change=.019). This construct reflects participants’ belief that the proposed e-Health or EHR systems should be highly relevant to their daily work.

It can be concluded that all of the predictor variables have different strengths of association with the ‘intention to use’ dependent variable in both studies with respect to R2 measurement in the stepwise linear regression. There were some differences between the strength of the variables within and between the models. This is an important finding, indicating that the TAM2 and UTAUT variables may have differing predictive power among healthcare professionals. However, these variables may have different predictive power among different groups of healthcare professionals. Another possibility is that these differences arose because of the different system being asked about in the outcome variable, i.e., the smart card system in the first study and the proposed EHR system in the second study.

The perceived usefulness (TAM2) and performance expectancy (UTAUT) constructs, which reflect broadly similar concepts with respect to the participants’ beliefs about the usefulness of e-Health/EHR systems in their every day working routine, were found to be less significant in either study in this Thesis.

### Structural equation modelling, both studies

The structural equation modelling that was conducted as a second level of analyses in both studies mainly confirmed the findings from the regression analyses. There was a difference in the first study H1 structural equation modelling and the regression analyses, as both perceived usefulness and perceived ease of use were identified as predictors of intentions among the targeted population (structural equation modelling). This is different from the regression analyses where perceived usefulness was not established as a predictor at all. However, the structural equation modelling indicated that the total effect of the perceived ease of use (total effect=.714) was much stronger than the total effect of perceived usefulness (total effect=.269). This finding re-confirmed the earlier finding from this research that perceived ease of use was the most important predictor of intentions among the targeted group of healthcare professionals.

Structural equation modelling of H2 in the first study had almost identical findings with the regression analyses. Although perceived usefulness was established as a predictor it had a very weak effect (total effect on intention=.211). Subjective norm (total effect=.670), job relevance (total effect=.465), and descriptive norm (total effect=.347) were reconfirmed as predictors of intentions among the targeted groups of healthcare professionals.

The structural equation modelling in the first study suggests that findings from this Thesis are slightly different from the original TAM2 (Venkatesh and Davis 2000). It is evident that perceived ease of use, together with job relevance, subjective norm, descriptive norm, are more important predictors of intentions than perceived usefulness, which is an important predictor in almost all of the studies (Sections 2.6 and 2.7) presented in the literature review (Hyun et al. 2009; Wilkins 2009; Devane et al. 2010; Egea and Gonzalez 2011; Archer and Cocosila 2011).

The second study structural equation modelling of H1 reconfirmed the main findings of the regression analyses. Effort expectancy, facilitating conditions, and social influence were reconfirmed as major predictors of intentions. However, performance expectancy had a weak and indirect effect on intention variable, which is different from regression analyses findings.

The H2 structural equation modelling (second study) indicated that job relevance had a stronger effect than performance expectancy on intention variable. The weak effect of satisfaction was established through performance expectancy. The finding that ‘Use of Other technology’ had a weak and negative relationship with intention variable was also reconfirmed.

The H4 structural equation modelling (second study) had similar findings with the regression analyses as the effect of ‘descriptive norms’ on users’ intentions was established.

Finally, the structural equation modelling established that the effect of specific technology acceptance variables on intentions was also determined by their indirect effects.

### Moderation effects in the second study

Age, gender, and experience moderation effects on the UTAUT technology acceptance constructs were assessed in the second study. A moderation analyses showed that age and experience significantly moderated the effects of social influence on intentions. Social influence effect on intentions was stronger among older GPs and employees in early stages of work experience. However, moderated regression analyses showed no significant influence of gender as a moderator on social influence. Voluntariness of use was not assessed at all in this study. The moderated regression analyses showed that effort expectancy and facilitating conditions (UTAUT variables) association with intention variable were not moderated at all.

### Mediation effects in the second study

Mediation analysis was conducted only in the second study and showed that the effect of job relevance (as a TAM2 distal predictor) on intentions to use the EHR system was mediated by effort expectancy, social influence, descriptive norm, and facilitating conditions. The mediation effect of effort expectancy was significantly higher than the effects of social influence, descriptive norm, and facilitating conditions. These findings are compatible with those from the hierarchical and stepwise linear regressions where effort expectancy, facilitating conditions, social influence, and descriptive norm were found as predictors of intentions. No other significant differences with respect to comparing the effects of the mediator variables were found.

### Differences in findings between the studies

In the first study, significantly more doctors than nursing staff reported having access to a PC, but there were no gender differences with respect to having access to a PC. The results showed that non-users of PCs differed significantly from users, and had lower association with intention (dependent variable) to use the e-Health system, lower perceived usefulness and lower job relevance. In the second study, Mann-Whitney tests indicated that male GPs had a stronger association with job relevance and descriptive norm variables than female colleagues (gender differences). The Kruskal-Wallis test performed for age groups differences with respect to UTAUT and other technology acceptance predictors indicated that the 40-49 year-old age group had higher mean rank values compared to other age range groups with respect to: social influence and job relevance from the future EHR system, and satisfaction with existing e-Health systems. However, these findings reflect some basic differences between respondents in the research with respect to technology acceptance variables and cannot infer final conclusions on their intentions.

Both the studies in this Thesis had consistent findings with respect to the most important technology acceptance variables from TAM2 and UTAUT models. However, a few technology acceptance constructs were assessed additionally and separately in the two studies. The facilitating conditions variable was found to be a significant predictor of usage intentions in the second study. This construct was not assessed at all in the first study, as the TAM2 model does not include this variable.

The use of ‘Other technology’ construct was assessed only in the second study. The hierarchical linear regression in step one indicated that if GPs do not use ‘Other technology’ (tablet, smartphone, iphone, or laptop) in other domains in their life, they would have higher level of intention to use EHR technology in their daily work routine.

The ‘Internet use for professional needs’ variable was found to be a predictor (weak effect) in the hierarchical linear regression (step two) of the second study, and the negative Beta result means that those respondents who do not use the Internet in their daily routine had the weakest intention to use the future EHR system. However, this construct’ influence was not established in the stepwise linear regression of the second study.

### Interpretation of results, consistency and synthesis of findings

This section presents the overall expression from both studies in order to develop the final conclusions of this Thesis. A few of the variables derived from the TAM2, UTAUT, and other technology acceptance constructs significantly predicted use intentions. More specifically, higher scores in perceived ease of use from the e-Health system (first study) and expected higher effort expectancy in interacting with the EHR system (second study) were shown to be significant predictors of intentions. The perceived ease of use and effort expectancy variables that were found to be significant predictors in both studies suggest that participants perceived the ICT systems in healthcare as follows: “The e-Health/EHR system will be easy to use, therefore I intend to use it.”

The facilitating conditions variable was found to be strongly significant in the second study reflecting the participants’ belief that: “There will be persons responsible for supporting me and I will use the system”. The subjective norm (first study) and social influence (second study) reflected the participants’ belief that: “Important others are using the system” and “I will use it”. The descriptive norm included as a new technology acceptance variable, denoting that perceived future use of the e-Health system by colleagues was not correlated with intentions to use the e-Health system in the first study. However, a descriptive norm, which is part of the social influences construct, was found to be significant in the second study. This construct reflects the belief “I think my colleagues will use EHR system if it is implemented, and I will use it”. Stronger beliefs about job relevance (i.e., direct relevance of the specific e-Health system to hospital healthcare professionals) in the first study and the direct relevance of the EHR to GP practice in the second study significantly predicted intentions to use the system. Job relevance as a technology acceptance variable derived from TAM2 reflects the participants’ belief that: “The e-Health/EHR system is relevant to my job, and I will use it.”

The satisfaction with e-Health systems currently implemented in the country (‘My term’, an online appointment system, and ‘Electronic health card’) assessed in the second study did not correlate with intention to use the EHR system, when controlling for other UTAUT variables.

The effect of social influence on intentions in the second study was moderated by age and experience moderators. Older GPs socially validate the influence of important other colleagues (age moderation). Participants in the second study of this Thesis who will use the EHR system, and are in the early stages of their career, were more influenced by important others colleagues using the system (experience moderation). The effect of social influence is strong among professionals in the early stages of experience, and weaker among more experienced professionals.

The effect of job relevance variable on intentions in the second study was mediated by effort expectancy, subjective norm, descriptive norm, and facilitating conditions. The influence of job relevance on intentions to use the EHR system will be stronger if: “the system is easy to use” (effort expectancy); “important others are using the system” (social and descriptive norms); “there is a person available for system support” (facilitating conditions). This finding complements findings from the hierarchical and stepwise linear regressions where these technology acceptance constructs (effort expectancy, social influence, descriptive norm, and facilitating conditions) were identified as strong predictors of intentions.

According to the second study findings, the use of other ICTs (e.g., tablets, smartphones, iphones, or laptops) for personal purposes was a significant predictor of intentions in the first step of the hierarchical linear regression analysis in the second study. This may indicate that, unsurprisingly, GPs who currently use ICTs for personal purposes are more inclined to accept the EHR system as a way of improving their performance and/or becoming more efficient and effective in patient care. However, the effect of this variable is weak, as its association with intention variable was found to be significant only in the first step of the hierarchical linear regression analyses.

On the whole, the findings in this Thesis suggest that variables derived from the original TAM2 and UTAUT models and other technology acceptance model constructs can predict healthcare professionals’ acceptance of e-Health/EHR systems. The findings also highlight the importance of newly added variables outside the traditional TAM2 and UTAUT models, such as descriptive norm and the use of ICTs for private purposes. With respect to moderation constructs, age and work experience emerged as important moderators of intentions to use the system, in addition to UTAUT variables, when these moderators were added to the model with respect to social influence. Finally, it appears that perceived usefulness and performance expectancy are not as important as other technology acceptance constructs.

The results in both studies, where hierarchical linear analyses showed a high association of study participants with the perceived ease of use (TAM2) and effort expectancy (UTAUT) variables, do not necessarily mean that Macedonian healthcare professionals have a negative attitude towards other technology acceptance variables. If perceived usefulness (TAM2) and performance expectancy (UTAUT) are excluded from the intentions prediction model of this study, this does not indicate that Macedonian healthcare professionals believe that these predictors are not important. It is possible that they perceive that these constructs are a normal attribute of e-Health/EHR systems, and believe that perceived ease of use and effort expectancy are more important. Therefore, a future qualitative study is recommended to assess why perceived usefulness and perceived ease of use do not influence Macedonian healthcare professionals. Areas for further research will be discussed in the final chapter of the Thesis (Section 7.4).

Finally, hierarchical linear regression and stepwise linear regression indicated that perceived ease of use and effort expectancy are the strongest determinants of the attitudes of Macedonian healthcare professionals in their intentions to use future e-Health/EHR systems. Perceived usefulness and performance expectancy were excluded from the overall prediction model (regression analyses). However, structural equation modelling in both studies indicated some slight differences, which are presented at the end of this section.

Job relevance and social influences were found to be strong predictors of behaviour in both studies. Although there are some different outcomes with respect to descriptive norm and facilitating conditions, which were assessed only in the second study, it can be concluded that both empirical studies of this Thesis have consistent findings.

The results and findings from both studies can be summarised and presented together with the aim of developing the final conclusions of this research. The findings from hierarchical linear regression, stepwise linear regression, moderated regression, and mediation analyses were used in the creation of Figure 6.1 below. It synthesises the findings of this Thesis, with the respect to the hierarchical and stepwise linear regression models on technology acceptance constructs, the effect of moderators on basic technology acceptance constructs, and mediation interactions between the constructs. All findings were tested with respect to ‘intention to use the e-Health/EHR systems’ dependent variable. This diagram presents and visualises all major findings of this Thesis in one place.

Figure 6.1: Conceptual modelling of factors influencing users’ intentions across the two studies (according to regression analyses)

Intention to use:

e-Health/

EHR

system

Computer use

years/hours

Subjective norm 8.3%

Job relevance 1.6%

**Perceived ease of use** **59.9%**

Internet use

Perceived usefulness

Descriptive norm

Computer anxiety

Job relevance 1.9%

Descriptive norm 7%

Facilitating conditions 3.1%

**Effort expectancy 51.7%**

Social influence 0.6%

Performance expectancy

Satisfaction

Internet use

Use of ‘Other technology’

Computer use

Years/hours

age

experience

gender

**Study 1** Modified TAM2

**Study 2** Modified UTAUT

= direct effect (technology acceptance constructs on intentions to use: e-Health/EHR system

= moderation effect (age and experience moderators on social influence construct)

= mediation effect (effort expectancy, descriptive norm, social influence, and facilitating conditions on job relevance)

\* the technology acceptance constructs without arrows did not have an effect on users’ intentions

Figure 6.1 syntheses all major findings from this research in a single diagram and brings together the results of this Thesis. Although, the data from both studies could not be merged and analysed together, it can be seen (from Figure 6.1) that the variables of ease of use of the proposed e-Health/EHR systems (perceived ease of use and effort expectancy) in the first place are the strongest predictors of intentions among Macedonian healthcare professionals. The perceived ease of use (with 59.9%) and effort expectancy (with 51.7%), have the strongest predictive power with respect to stepwise linear regression analyses. More than half of the variance in intentions to use the proposed e-Health/EHR systems was explained by technology acceptance variables which are associated with the ease of use of the proposed ICT system. However, technology acceptance constructs that are presented in boxes without arrows in Figure 6.1, were found not to predict intentions among the participants in this research.

Social influences constructs, such as subjective norm with 8.3% (first study); and descriptive norm (it is a social influence construct according to Rivis and Sheeran 2003) with 7%, together with social influence with .6% (second study); were the second major predictors of intentions among the participants of this research. From Figure 6.1 it can be concluded that the social influences contribute approximately 8% to the intentions among the participants of this research.

Facilitating conditions was the third most important predictor in the second study with 3.1%. The job relevance construct was third predictor of intentions in the first study with 1.6% and fourth in the second study with 1.9%. However, the findings with respect to job relevance variable are the same throughout the Thesis.

The association of the social influence variable with the intention dependent variable (second study), although it was very low, was moderated by age and experience moderators. This finding is showing that, among older GPs, the association between social influence and intention dependent variable was stronger than among younger GPs (age’ moderation effect). The relationship between social influence and intention dependent variable was moderated by experience, showing that GPs, in the early stages of their work, are more influenced by social influence than the other colleagues.

The effect of job relevance’ (in the second study) on the intention to use dependent variable was mediated by effort expectancy, social influence, descriptive norm, and facilitating conditions. The mediation effect of effort expectancy was significantly higher than the effects of social influence, descriptive norm, and facilitating conditions. This also corresponds with the findings from the stepwise linear regression analyses where the effort expectancy variable was established as the strongest technology acceptance construct. Finally, the findings from this section will be used in the next chapter for future research and policy recommendations and assessment of the national readiness to use the EHR system.

The structural equation modelling findings mainly reconfirmed the findings from the regression analyses. However, there were some slight differences, i.e., in the first study the structural equation modelling established a weak direct effect of perceived usefulness on intentions. Job relevance has shown additional weak indirect effect (through perceived usefulness) on intentions. Subjective norm has shown additional stronger indirect effect (through perceived usefulness) as well. The effect of descriptive norm was very weak (through subjective norm).

In the second study, the performance expectancy showed a weak indirect effect (through effort expectancy) on intentions. Job relevance had a weak indirect effect (through performance expectancy). Satisfaction has expressed a very weak and indirect effect (through performance expectancy) on users intentions.

### Thesis findings related to the relevant literature

This section relates major findings from the Thesis to the relevant literature (Chapter 2). According to the authors, the original TAM2 (Venkatesh and Davis 2000) and UTAUT (Venkatesh et al. 2003) models provide useful tools for researchers for assessing attitudes and predicting behaviour. The results derived from these studies may be used by policy makers and managers when assessing the likelihood of success of introducing new ICT. These technology acceptance models contribute to understanding the reasons for acceptance, and enables managers and policy makers to design and implement interventions proactively, such as training, policy making, marketing etc. The original UTAUT model according to Venkatesh et al. (2003) explains as much as 70% of the variance in behavioural intentions and 50% in actual use.

The hierarchical linear regression in the first study of this Thesis explained 68.1% of the variation in the intentions to use the e-Health system. The results of the second study of this Thesis were very similar to those of the original UATUT model, as the hierarchical linear regression explained 65.4% of intentions to use the EHR system. A literature review of studies of technology acceptance in healthcare settings (Section 2.6) indicated variations in intentions to use the system which correspond to the levels of this study, as Morton and Wiedenbeck’s study (2009) indicated that 73% of the variance was explained, and 64% of variance was explained in Al-Adwan and Berger’s study (2015). These variations in intentions to use the system in the literature review are similar to above mentioned (first study: 68.1% and second study: 65.4%) variations in intentions to use the e-Health/EHR system derived from the hierarchical linear regression analyses of this research.

The stepwise linear regression in the first study revealed a new and interesting finding, confirming that perceived ease of use (as core TAM2 predictor variable) is the strongest predictor of technology acceptance among the Macedonian hospital healthcare professionals (doctors and nurses). This is a novel finding, different from those previously described in other settings in the literature. As discussed in Section 2.6, perceived usefulness (as a TAM2 behaviour predictor variable) was confirmed as the strongest predictor across studies in healthcare settings (Hyun et al. 2009; Morton and Wiedenback 2009; Wilkins 2009; Devane et al. 2010; Holden and Karsh 2010; Archer and Cocosila 2011; Egea and Gonzalez 2011). The original TAM used in a field study conducted by Davis (1993), found that perceived usefulness was 50% more influential than perceived ease of use in determining usage. However, this study assessed the attitudes of managers and employees in large corporations, which may be different from healthcare settings. The results of Ma and Liu’s (2004) meta-analyses generally confirmed Davis’ findings, although they found a stronger relationship between perceived usefulness and technology acceptance, while the influence of perceived ease of use on technology acceptance was weaker.

The structural equation modelling of H1 from the first study revealed that perceived ease of use has a stronger effect than perceived usefulness. However, this is different from the latest studies presented in the literature review (Hyun et al. 2009; Morton and Wiedenback 2009; Wilkins 2009; Devane et al. 2010; Archer and Cocosila 2011; Egea and Gonzales 2011; Harle and Devar 2012; Gagnon et al. 2014; Razeghi and Nasiripour 2014, Al-Adwan and Berger 2015; Steinninger and Stiglbauer 2015; Bahadori et al. 2017; Tubaishat 2017).

Venkatesh and Davis (2000) noted that a better understanding of determinants of perceived usefulness can be used as a basis for a strategy for managerial interventions that can increase end users’ acceptance and use of the new system. The authors also proposed that perceived ease of use would have less influence on a participant’s intentions for future use of the e-Health system. However, they also proposed that if the system required less effort to use, this would lead to greater use and increased job performance. Therefore, findings from this Thesis with respect to the basic TAM2 constructs are different from those described in the relevant literature. Perceived ease of use was found as strongest predictor of intentions in this research which is different from the relevant literature findings (Venkatesh and Davis 2000).

Venkatesh et al. (2003) proposed that performance expectancy in the original UTAUT model would be the strongest predictor of intentions to use a system. The UTAUT has been used only in a few studies in healthcare settings (Section 2.6) to assess intentions regarding the EHR system (Harle & Dewar 2012; Razeghi and Nasiripour 2014). Performance expectancy and effort expectancy were found to be strong predictors, which is different from the findings in this Thesis. The finding from the second study in this Thesis, that only effort expectancy, but not performance expectancy (although it had weak indirect effect in the structural equation modelling analyses), was found as a predictor of intention to use, is different from those in the relevant literature (Section 2.6).

Job relevance construct was proposed by Venkatesh and Davis (2000) as a behavioural predictor. This construct was assessed and proved to be a predictor of intentions in both studies of this Thesis. However, the literature review (Section 2.6) indicated that this variable was assessed and established as a predictor of intentions among healthcare professionals only in one study of technology acceptance on EHR, by Archer & Cocosila (2011).

The Taylor and Todd (1995) study showed that subjective norm (also used in the first study of this research) had a significant influence on user intentions. This was later confirmed in similar findings by Holden and Karsh (2010), Mun et al. (2006), and Venkatesh and Balla (2008). The quantitative meta-analyses by Schepers and Wetzels (2007) showed that subjective norm had a significant influence on TAM variables. However, the studies of Davis et al. (1989) and Matheison (1991) showed as non-significant influence of the subjective norm on user intentions, and proposed future research in this area. Subjective norm in healthcare settings was shown to be a predictor in Spil et al.’s (2010) study. Therefore, findings from the first study of this Thesis with respect to subjective norm correspond with those in the relevant literature where this technology acceptance construct was found as predictor of intentions. However, as indicated in the literature review (Section 2.6), this construct is rarely used in healthcare settings.

Social influence, which is a similar construct to subjective norm, has been more widely used and has been shown to be a behavioural predictor in healthcare settings in studies by Archer & Cocosila (2011), Razeghi & Nasiripour (2014), Steinninger & Stiglbauer (2015), and Al-Adwan & Berger (2015). The findings of this Thesis, where social influence in the second study was established as a behavioural predictor, correspond with those described in the relevant literature. However, the descriptive norm variable proved to be a predictor in the second study of this Thesis has not been used by researchers in empirical studies of technology acceptance in healthcare settings (Section 2.6).

The authors of the UTAUT (Venkatesh et al. 2003) proposed that the effect of performance expectancy on behavioural intention would be moderated by gender and age moderators; effort expectancy would be moderated by gender and experience; while facilitating conditions should be moderated by age and experience. Social influence in the original UATUT model is moderated by gender, age, experience, and voluntariness of use. However, the moderation effect in the second study of this Thesis showed only the moderation impact of age and experience on social influence. According to the original UTAUT model, social influence is stronger among older women, it is significant in mandatory settings in the early stages of experience, weakening over time (gender, age, experience, and voluntariness of use moderation). Therefore, the findings in this study with respect to moderated effects are different from the original UTAUT model, as only two (age and experience) out of four moderators (gender, age, experience, and voluntariness) were shown to be effective in only one construct, i.e., social influence. Other moderation effects described in the original UTAUT model were not established in the second study of this Thesis. However, moderation effects were not assessed at all in relevant studies in healthcare settings in the literature (Section 2.6).

Mediation analysis performed in the second study of this research established the mediation effect of effort expectancy, social influence, descriptive norm, and facilitating conditions on job relevance influence on intentions to use the EHR system. However, the mediation analysis has not been performed at all in relevant studies in healthcare setting literature (Section 2.6).

Computer skills were established as technology acceptance predictor in Yu et al.’s (2009) study. Computer use at home and computer knowledge predicted attitudes in Devane et al.’s (2010) study in healthcare settings. These finding can be related only to the use of ‘Other technology’ construct, which was found to be a predictor of intentions in the first step of the hierarchical linear regression of the second study of this Thesis.

The updated literature review in Section 2.7 indicated that the issues discussed in the literature review prior to the commencement of the research are still current. Garavand et al. (2016) study indicated that TAM and UTAUT are still the most important models for assessing attitudes in healthcare. Sligo et al.’s (2017) study recently confirmed that technology acceptance is still important for healthcare practitioners, i.e., technology acceptance models can help providing useful information how ICT systems might be developed. Although there have been advances in the use of ICT in healthcare, end users are not using the technology to its full extent. Bartholomew (2017) conducted a study assessing the technology acceptance among healthcare professionals beside the mandatory use of the e-Health system, which is similar to the assessment undertaken in this Thesis. The author reported that the interviewed healthcare providers expressed frustration with government requirement for meaningful use of the PHR. The latest empirical studies (which were conducted after the study in this Thesis) on technology acceptance on EHR adoption such as Al-Adwan and Berger (2015), Steinninger and Stiglbauer (2015), and Tubaishat (2017) were using the TAM as their leading theoretical framework. These studies support the use of the TAM and UTAUT models in this Thesis. These two technology acceptance models (TAM and UTAUT) were still playing an important role in the research after the completion of this Thesis. Stepwise regression was used by Holden et al.’s (2016) study, which is similar to the study in this Thesis.

## Conclusions

This chapter has brought together the findings of both studies. The results of the regression analyses and structural equation modelling were consistent across the two studies, and the main predictors of intentions among Macedonian healthcare professionals were established as the main finding of this Thesis. The contribution of this Thesis to new knowledge in the area of technology acceptance among healthcare professionals in SEE was identified and it will be discussed in the next chapter. The next chapter provides the conclusions of this Thesis and summarises its contribution to new knowledge in the area of technology acceptance in healthcare.

# Conclusions

## Introduction

The findings of the two studies were presented and discussed in the previous chapter. This chapter summarises the findings and outcomes of the research. The national readiness to accept prospective e-Health/EHR technologies in the Republic of Macedonia is presented in Section 7.2. The novel contributions that this Thesis makes to knowledge are presented in Section 7.3. Recommendations for future research are proposed in Section 7.4. Outcomes on aims, objectives, research questions, and hypotheses are presented Section 7.5. Finally, Section 7.6 concludes this Thesis.

## National readiness to accept e-Health/EHR in SEE country

This research contributes to understanding of healthcare professionals’ willingness to accept the new developing e-Health/EHR systems in Republic of Macedonia in South East Europe (SEE). This Thesis has identified how to learn from people’s reactions to failures in the implementation of these systems in healthcare settings. It has assessed and compared the SEE country perspectives in technology acceptance in healthcare with those of developed countries.

This study has validated a technology acceptance framework for assessing the extent to which end users are ready, and want, to use ICT technology in healthcare. The technology acceptance tool can assess whether the targeted population is ready to use the new ICT for research purposes, and if they are not ready, what the policy makers and managers can do to address it. These findings can be used as a tool to implement e-Health/EHR systems more efficiently, with the aim of reducing the time and funds needed to implement ICT in healthcare in the future.

Firstly, both of the studies in this Thesis indicated that the targeted population in the Republic of Macedonia had high expectations of the future e-Health/EHR systems. The descriptive statistics in this Thesis showed a high level of association of Macedonian healthcare professionals with almost all variables of the technology acceptance models and intentions to use the system. On the other hand, not all of the technology acceptance variables were shown to be predictors of attitudes within the targeted population. However, those variables that were shown to be efficient predictors of intentions should be focused on, meaning that future implementation policy should be based on those findings.

This study found that the healthcare professionals who responded in this research will be more ready to accept the prospect e-Heath/EHR systems in the country if they believe that:

* the system is easy to use (perceived ease of use and effort expectancy);
* ‘important other colleagues’ are using the system (social influences: subjective norm, social influence, and descriptive norm);
* they have the necessary technical support for the system (facilitating conditions); and
* it is relevant to their job design (job relevance).

Although this study applied different variations of the technology acceptance models in different healthcare groups in the country, it has broadly similar overall results in both empirical studies (Section 6.4). Structural equation modelling has established direct weak effect of perceived usefulness (first study), and weak indirect effect of performance expectancy (second study) on user’s intentions. These two variables represent the effect of usefulness of e-Health/EHR on users’ intentions. However, the effect of those two variables on participants in this research was very weak.

As the quantitative research instrument of this Thesis was applied to large sample of GPs, the findings with respect to readiness assessment can be generalised to this targeted population in the country. Therefore, this study assessed the national readiness for specific EHR system at the national level for the targeted population of GPs. The limitations to generalisation to this population were discussed in Section 6.3. However, findings from this research cannot be generalised to the whole hospital healthcare population, but have revealed new findings with this aspect of the study population.

## Novel contribution to research and knowledge

This is a first study of its kind in Republic of Macedonia and in SEE. It was indicated in the literature review (Chapter 2) that there are no studies on technology acceptance among healthcare professionals in SEE. It is possible that healthcare professionals in the Republic of Macedonia have different intentions to e-health/EHR systems compared or other parts of Europe. There may be cultural differences in e-Health/EHR acceptance between Macedonian healthcare professionals and those in other parts in Europe: this was discussed in Section 2.5.6. This is novel finding that should be investigated in a future study.

This Thesis has two important features: this kind of research has not been done before in SEE; and this Thesis contributes to the general understanding of technology acceptance in healthcare. However, this study has its own complexity, and incorporates perspectives from the different disciplines such as health informatics (e-Health and EHR), psychology (technology acceptance), and healthcare. Conducting this type of interdisciplinary research through a technology acceptance approach helps in understanding the complexity of implementing the most recently developed ICT systems in healthcare settings and in assessing the formal readiness of a SEE country for e-Health/EHR systems.

This study has some interesting findings that are novel and different from those in the reviewed literature (Section 2.6). It can therefore, be considered that this research has some useful implications for current research in the area of technology acceptance in healthcare. This Thesis established a new technology acceptance framework in the field of technology acceptance in healthcare settings generally, and locally in Republic of Macedonia. Two modified versions of technology acceptance models (TAM2 and UTAUT) with other technology acceptance constructs (descriptive norm, and use of ‘Other technology’) were shown to be predictors of intentions to use e-Health/EHR technology among participants of this study. However, not all of the technology acceptance constructs were shown to be predictors of behaviour among the participants. Performance expectancy (UTAUT) and perceived usefulness (TAM2) were not established as predictors of intentions to use the system (from the regression analyses). These two variables are the most important predictors across the studies in this research area as discussed in Section 2.6.

Perceived ease of use (TAM2) and effort expectancy (UTAUT) were established as major predictors of intentions in this Thesis (Section 6.4.8). Satisfaction with e-Health systems already in use was proposed and assessed in this Thesis. This variable was later used as a technology acceptance item by other researchers (e.g., Holden et al. 2016; Chen et al. 2017). These findings present a novel contribution to what is already known.

It can be concluded that all of the prediction variables have different strengths of association with intentions in both studies of this Thesis with respect to R2 measurement in the stepwise linear regression. There were some differences between the strength of the variables within the models. However, the strength of association between different technology acceptance variables and intentions to use the systems in both studies are different, as perceived ease of use (TAM2) and effort expectancy (UTAUT) have significantly stronger association with intention variable than other technology acceptance constructs (Figure 6.1). Perceived ease of use (59.9%) in the first study and effort expectancy (51.7%) in the second study were strongly associated with the intention dependent variable. Following variables according to their association with intention dependent variable were subjective norm (8.3%) in the first study and descriptive norm (7%) in the second study. The difference in strength of association between technology acceptance variables and the intention variable was not measured at all in the previous literature (Section 2.6) which is a novel finding from this research.

Different strengths in the association between technology acceptance variables and intention (as dependent variable) were also identified through structural equation modelling. Perceived ease of use in the first study (.53) and effort expectancy in the second study (.40) were reconfirmed as major predictors of intentions with a stronger effect than perceived usefulness (first study) and performance expectancy (second study). Other technology acceptance variables such as: subjective norm and job relevance (first study); and facilitating conditions, social influence and job relevance (second study) were reconfirmed as predictors of intentions in this Thesis. These variables are less frequently used by the researchers (Sections 2.6 and 2.7).

As a more complex assessment tool, the UTAUT can identify broader aspects of the attitudes of the targeted population concerning new ICT system use in healthcare settings. This research model should use all technology acceptance variables and moderators. Social influence and facilitating conditions variables can have same or stronger predictive power as the other two most commonly used variables (performance expectancy and effort expectancy) in healthcare settings (Section 2.6). Job relevance as TAM2 construct and descriptive norm as additionally added technology acceptance construct may be used in the technology acceptance models. Therefore, modified versions of technology acceptance models may be used in healthcare settings. In this research, variables such as job relevance, subjective norm, facilitating conditions, descriptive norm, and social influence were identified that have stronger influence on intention dependent variable than the basic technology acceptance variables (TAM2’ performance expectancy and UTAUT’ perceived usefulness). These are novel finding different from those in the relevant literature.

The moderation effects of basic UTAUT moderators such as age and experience on social influence as UTAUT technology acceptance construct were established in this study. Moderation effects were not assessed in the relevant studies in technology acceptance in healthcare (Section 2.6). However, according to the original UTAUT model (Venkatesh et al. 2003) there are other moderation effects (Section 2.5.4) which were not established (significant) in this Thesis. These findings are different from the original UTAUT model.

Mediation analyses in this research indicated that technology acceptance variables have interference between them. Some technology acceptance variables may mediate the effects of other variables and intentions. The effect of job relevance on intention dependent variable was mediated by effort expectancy, facilitating conditions, descriptive norm, and social influence. These analyses were not performed at all in the relevant literature in healthcare settings (Section 2.6). These are novel findings and future researchers in healthcare settings should take into consideration moderation and mediation effects when conducting research in healthcare settings.

However, this study has overall practical implications for policy making perspectives and national readiness assessment. It can also serve as a basis for managerial interventions for successful implementation and promotion of e-Health/EHR systems in SEE. These are explained in the following section.

The updated literature review (Section 2.7) confirmed that the technology acceptance issues tested in this Thesis are still current even after its completion. Therefore, although the use of ICT in healthcare is advancing, in the future managers and policy makers in healthcare still need to pay attention to technology acceptance. It is evident that the technology acceptance will play an important role in the foreseeable future.

### Implications for ICT producers, policy making and managerial practice

The study findings may be useful for managers and policy makers in the future development and adoption of e-Health/EHR systems in the Republic of Macedonia and possibly in other countries developing such systems. In fact, the findings from this Thesis can serve as a basis for informing evidence-based interventions and/or training to promote e-Health/EHR use more effectively among healthcare professionals.

The implementation of ICT in healthcare settings is a complex, time-consuming and costly process, and there are more failure than success stories in healthcare, as discussed in the literature review (Sections 2.6 and 2.7). This study has shown that the national readiness assessment of the targeted population for the new ICT in healthcare can provide useful information and should be performed prior to introducing the new technology.

A set of specific proposals based on the findings of this Thesis can be inferred for policy making and managerial practice in the country. Firstly, a formal assessment of the readiness, and understanding the factors that may influence the acceptance of the prospect ICT, could be beneficial for the overall implementation. However, the final work-floor deployment of e-Health/EHR systems should be done through a specific set of practical measures.

Government and policy makers should be aware that e-Health/EHR systems need to be promoted with specific interventions. However, it is not enough to implement e-Health/EHR system only because it is good for the government and the public. There is a need to translate government policy into working-level interventions. Knowledge from this study may bridge the gap that exists between policy (government), industry (hardware and software producers) and users (healthcare professionals). Knowledge gained from this research on how e-Health/EHR systems should be designed and implemented with respect to technology acceptance should be used in closing these gaps. Findings of this study with respect to intentions of healthcare professionals should be used to create effective policies on e-Health/EHR.

Even though a government mandates an e-health/EHR system, the users might not use it as is intended. Therefore, technology acceptance assessment is needed to identify end users intentions and preferences. Once possible difficulties are identified, a set of specific measures can be introduced. For instance, if ease of use/effort expectancies plays an important role in the intentions of healthcare professionals, the specific systems to be developed should have user friendly and ease to use attributes.

The main concern of the respondents in both studies of this Thesis was the ‘ease of use’ of the e-Health/EHR system. Recommendations for producers in e-Health industry (hardware and software producers) are that systems should be user friendly and easy to use (perceived ease of use and effort expectancy) and relevant to everyday work routine (job relevance). It is strongly recommended that healthcare professionals should be involved in design and testing of future e-Health/EHR systems. The future e-Health/EHR systems design should contain all of the features described in this section.

Healthcare managementshould provide user friendly easy to use e-Health/EHR systems. Together with the providers they should also provide training for healthcare professional staff. The focus should be on persuading employees that the specific e-Health/EHR system will be user friendly, easy to use (perceived ease of use, effort expectancy) and relevant (job relevance) to their everyday work routine. Training procedures should be targeted so that healthcare professionals understand and believe the system is easy to use (perceived ease of use and effort expectancy) and relevant to job routine (job relevance). Early career (experience moderator) and older employees (age moderator) will be influenced by important other colleagues (moderation on social influence technology acceptance construct). Management should provide measures and explain to healthcare professionals that the necessary staff and techniques to support the work of the system will be available (facilitating conditions). However, the effect of social influences i.e., subjective norm, social influence, and descriptive norm (involving important others influence on employees), should be considered by the management when implementing e-Health/EHR systems.

## Recommendations for further research

This section discusses ideas for further research based on the findings of this Thesis. Although, this study established a relationship of technology acceptance predictors in healthcare settings in one SEE developing country, unanswered questions and issues in this area remain to be addressed.

Begley (1996) discussed the fact that a quantitative approach is used in cases when something is known about a topic and a qualitative approach can be applied in exploratory studies with the aim of conducting a more in-depth investigation to develop a deeper understanding of the issues. Therefore, a future study to investigate the findings in more detail is recommended to supplement the findings of this Thesis. Future research is needed through a qualitative study of Macedonian healthcare professionals with the aim of investigating why some technology acceptance variables are more important than others, which in the present research is in contrast with the relevant literature.

The aim of a future study should be to assess why, among Macedonian healthcare professionals, perceived ease of use and effort expectancy are more important predictors of intentions to use technology rather than perceived usefulness and performance expectancy. A future qualitative interview study may provide answers to this question. Quantitative research provides quantified answers to research questions, whereas qualitative research develops concepts that help to understand social phenomena (Pope and Mays 1995). These authors proposed using a qualitative approach for a more in-depth analysis. A future study could usefully contain open-ended components (e.g. a ‘further comments’ or other open-ended questions) with the aim to assess further the attitudes of healthcare professionals.

Participants in this research paid more attention to ease of use (perceived ease of use and effort expectancy) of e-Health/EHR systems, while the actual utility and usefulness of those systems were not found to be so important. However, it is possible that participants in this research perceived performance expectancy and perceived usefulness to be normal attributes to the e-Health/EHR system and did not pay much attention to them. This should be investigated in future research, possibly with open-ended questions.

The findings from the future qualitative study should be triangulated with those from the current study (qualitative and quantitative triangulation) as discussed in Section 3.3.6. The main aim of triangulation is to control biases and to achieve completeness (quantitative plus qualitative study). The results from a quantitative study may be checked against the results derived from a qualitative study and vice versa (Punch 1998; Denscombe 2007). Participants in questionnaire surveys (quantitative study) can be interviewed (qualitative study) in order to obtain an in-depth understanding of their responses. According to Cahill (1996), qualitative research can be used as both preliminary research, before a quantitative study, and after the quantitative study to determine the credibility of the study. Therefore, a future qualitative study could be undertaken with Macedonian healthcare professionals to complete the findings.

Nevertheless, further research is also needed to verify the finding that other technology acceptance variables such as the use of ‘Other technology’ for personal purposes is a predictor of the intentions to use of the e-Health/EHR system. The effect of this variable should be assessed in detail using qualitative research.

The findings relating to the moderation effects of age and experience from this Thesis indicate that these moderators have an effect on social influence. However, further research is needed on this in order to establish the effect of age, experience, gender, voluntariness of use, and other moderators on technology acceptance constructs in healthcare settings in the country. Mediation analyses indicated the effects of effort expectancy, social influence, descriptive norm, and facilitating conditions on job relevance relationship with the intention variable. Further research is also needed to examine the possible mediation effects of other technology acceptance variables.

As discussed in the previous section, this research study has provided new knowledge on how technology acceptance models predict intentions to use ICT healthcare technologies. Now when the types of technology acceptance constructs that predict intentions to use have been established, subsequent research should investigate whether these intentions predict actual behaviour. There are studies in the literature that have investigated the intention-behaviour gap (Webb and Sheeran 2006; Carrington et al. 2014). A longitudinal study should be set up to assess the variables that predict users’ intentions in step one, and their actual behaviour in step two (i.e., after six months or once the system is implemented). The aim of such a study should be to learn how, and if, the intentions are translated into actual use. The relationship of technology acceptance variables predicting intentions in the Thesis and actual behaviour in the new study should be compared, as it was assessed in Hseih et al. (2017) study. Their research has showed that behavioural intentions for PHR, significantly and positively correlated with usage behaviour among the participants.

Future research is needed to investigate cultural and regional differences with respect to e-Health acceptance. As discussed in Section 6.4.8, this study found differences among SEE country healthcare professionals’ intentions to use the new system compared with those identified in studies conducted in other parts of Europe. A possible comparative study with the same research instrument applied in different regional settings is strongly recommended to investigate cultural differences, as discussed in Section 2.5.6.

Findings from this research can be generalised to the population of GPs in the Republic of Macedonia. These findings are different from those described in the current literature and are conducted in studies in other parts of the world. However, it is possible that these findings may be applicable to other countries in SEE. There is a need for future research in this area, mainly to assess factors that predict behaviour in this and other healthcare settings in SEE.

There are other technology acceptance constructs such as trust (Egea and Gozalez 2011), privacy (Steinninger and Stiglbauer 2015), and data protection (Hoebrst and Ammenwerth 2010) that need to be tested in larger extent in healthcare settings. At the time of the two studies, these constructs were not regarded as important. However, a future assessment instrument could include these constructs with the aim to assess their effectiveness.

The TAM2 and UTAUT models applied in this research were modified to some extent. Some of the additionally added technology acceptance variables (descriptive norm, and “use of Other technology” partially) were established as predictors of intentions. However, future technology acceptance measuring instruments could be more country- and culture-specific, and should include as much additional technology acceptance constructs as possible that could reflect the real attitudes of the healthcare population.

## Summary overview of the research

This section summarises the main findings from the Thesis in relation to the original aims, objectives, research questions, and hypotheses of this research. Theories were developed, and two empirical studies were conducted in this Thesis to address these aims and objectives outlined in Section 1.6, the research questions identified in Section 3.2.2, and the hypotheses stated in sections 4.2.3 and 5.2.3. Following the review of the latest developments in healthcare and technology acceptance discussed in the literature review (Chapter 2) and methodology (Chapter 3) this research examined the intentions of healthcare professionals regarding prospective ICT systems in healthcare. Two modified technology acceptance models (i.e., TAM2 and UTAUT) were applied and tested for the first time on different samples of Macedonian healthcare professionals.

### Aims and objectives outcomes

The overall aim of the study was to “Assess the overall readiness of healthcare professionals to accept proposed e-Health/EHR systems in the Republic of Macedonia” (Section 1.6).

It can be concluded that this research has managed to assess the overall national readiness to accept proposed EHR system in the Republic of Macedonia. The national readiness for prospect ICT systems was presented and discussed in Section 7.2 and identified the major factors that contribute to understanding of healthcare professionals’ willingness to accept the new developing EHR system in Republic of Macedonia. As the research instrument of this Thesis was applied to a large sample of GPs, the findings with respect to readiness for the systems can be generalised to this targeted population. It can be concluded that, this study assessed the national readiness for specific EHR system at the national level for GPs’ intentions. However, the limitations to generalisation to this population (second study) and, generalisation limitations of the first study were discussed in Section 6.3.

Four objectives were posed for this research (Section 1.6).

The **first objective** intended to:

identify the factors that predict how well the proposed e-Health/EHR systems will be accepted among healthcare professionals in the Republic of Macedonia.

This objective was successfully addressed as this Thesis has identified the factors (technology acceptance variables) that predict acceptance of e-Health/EHR among health professionals in Republic of Macedonia (Section 6.4.8). Figure 6.1 identified the major factors that predict e-Health/EHR technology among selected groups of healthcare professionals in the country. These technology acceptance variables were:

* perceived ease of use (TAM2) and effort expectancy (UATUT) as basic technology acceptance variables;
* subjective norm (TAM2), descriptive norm (additionally added variable), and social influence (UATUT) as social influences variables;
* job relevance (TAM2); and
* facilitating conditions (UTAUT).

However, perceived usefulness and performance expectancy were established as weaker predictors of intentions in structural equation modelling analyses.

The **second objective** intended to:

develop a novel, healthcare oriented technology acceptance model based on the situation in the Republic of Macedonia.

This objective was met, as this research established a novel, contextualised model of technology acceptance for healthcare, which is described in Section 6.2 and presented in Tables 6.1 and 6.2. A novel research instrument developed through this research was successfully tested in the second study.

**The third objective** intended to:

contribute to new knowledge in the area of technology acceptance in healthcare that may help other countries developing e-Health/EHR systems, for example, in other parts of SEE.

This objective was successfully addressed as this research contributed to new knowledge in the area of technology acceptance in healthcare. Novel findings to the current knowledge were identified in Section 7.3. This Thesis identified technology acceptance predictors and other findings that had not previously been reported as being important (described in the research literature). These findings were:

* technology acceptance variables have different strengths of association with intention dependent variable;
* two similar constructs, perceived usefulness (TAM2) and performance expectancy (UTAUT) were not significant predictors of intentions in both studies of this Thesis;
* perceived ease of use (TAM2) and effort expectancy (UTAUT) were found as most important predictors of intentions in this research;
* variables such as job relevance, subjective norm, facilitating conditions, descriptive norm, and social influence were identified that have stronger influence on intentions than the basic technology acceptance variables (TAM2’ performance expectancy and UTAUT’ perceived usefulness);
* moderation effects of basic UTAUT moderators such as age and experience on social influence variable were established; and
* mediation analyses in this research indicated that technology acceptance variables have interference between them.

These findings are different from those referred in the relevant literature. They contribute to the new knowledge in this area. However, policy makers in other parts in SEE may use them in creation of policy measures.

**The fourth objective** intended to:

identify and propose policies for better technology acceptance of prospect e-Health/EHR systems in the county.

This objective was successfully accomplished as this research managed to propose measures to increase the acceptance and actual use of e-Health/EHR systems among healthcare professionals in the country. Policy recommendations for the Government, industry, and healthcare management were proposed in Section 7.3.1. These policy measures and recommendations were:

* a formal assessment of the readiness, and understanding the factors that may influence the acceptance of the prospect ICT, could be beneficial for the overall implementation of the ICT systems;
* e-Health/EHR systems should be user friendly and easy to use (perceived ease of use and effort expectancy) and relevant to everyday work routine (job relevance);
* healthcare managementshould provide training for healthcare professional staff with focus on persuading employees that the specific e-Health/EHR system will be user friendly, easy to use (perceived ease of use, effort expectancy) and relevant (job relevance) to their everyday work routine;
* the effect of social influences i.e., subjective norm, social influence, and descriptive norm (involving important others influence on employees), should be considered by the management when implementing e-Health/EHR systems; and
* healthcare management should provide measures and explain to healthcare professionals that the necessary staff and techniques to support the work of the e-Health/EHR system will be available (facilitating conditions).

### Research questions outcome

Three research questions were presented in the methodology chapter (Section 3.2.2):

**Research question 1:**

Which factors influence and what is the level of national readiness for acceptance of new information and communication technologies in healthcare settings in SEE country?

This research question was addressed in Section 7.3. The most important factors that influence national readiness for acceptance of new ICT in healthcare settings were established. However, the actual measurable level of national readiness for acceptance on new ICT cannot be assessed with the findings of this research. There is a need for future research to address the level (with numbers or percentages) of readiness of the Macedonian healthcare professionals (Section 7.4).

**Research question 2:**

Which technology acceptance variables and moderators described in the UTAUT and other technology acceptance models have a significant influence on healthcare professionals’ acceptance of new information and communication technologies in healthcare?

This research question was addressed in Sections 4.3 and 5.3. In these sections main technology acceptance constructs that can predict intentions of healthcare professionals were established. The moderation effects of age and previous work experience and their influence as moderators were identified successfully.

**Research question 3:**

What is the effectiveness of TAM2, UTAUT and other technology acceptance models in studying healthcare professionals’ acceptance of new information and communication technologies in healthcare?

This research question was addressed in Sections 6.4.2 to 6.4.4 were technology models’ effectiveness was tested through regression analyses and structural equation modelling. The application of modified versions of TAM2, UTAUT and other technology acceptance constructs is recommended in future studies in this area.

### Outcomes of the hypotheses tested

Two hypotheses were posed for the first study (Section 4.2.3) and four were posed for the second study (Section 5.2.3) of this Thesis.

Hypothesis **H1** (study of hospital healthcare professionals) stated that:

perceived usefulness and perceived ease of use will significantly predict healthcare professionals’ intentions to use the e-Health system.

This hypothesis was accepted. The structural equation modelling as a second level of analyses established a weak effect of perceived usefulness on intentions.

Hypothesis **H2** (study of hospital healthcare professionals) stated that:

subjective norm, descriptive norm, job relevance, and computer anxiety will predict healthcare professionals’ intentions to use the e-Health system indirectly, through the effects of perceived usefulness.

This hypothesis was partially accepted, as the subjective norm and job relevance were found to be predictors of intentions among the participants (regression analyses), but only with a direct effect (without perceived usefulness), while the descriptive norm and the computer anxiety’ effect on participant’s intentions were not established in this study. However, the structural equation modelling has established an indirect effect of subjective norm and job relevance (through perceived usefulness) on intentions as well. It has to be stressed that subjective norm and job relevance had a stronger effect on intentions than perceived usefulness.

Hypothesis **H1** (study of General Practitioners) stated that:

performance expectancy, effort expectancy, social influence, and facilitating conditions will directly predict intentions to use the EHR system.

This hypothesis was partially accepted, as effort expectancy, social influence, and facilitating conditions were found to be predictors of intentions to use the systems, while performance expectancy’s effect on intentions was not established (regression analyses). These findings were mainly reconfirmed by structural equation modelling during the second level of analyses where performance expectancy has showed only indirect effect (through effort expectancy) on intentions.

Hypothesis **H2** (study of General Practitioners) stated that:

job relevance, satisfaction (with currently used e-Health systems), and use of ‘Other technology’ will predict intentions to use the EHR system indirectly, through the effects of performance expectancy.

This hypothesis was partially accepted, as job relevance and use of ‘Other technology’ (although this construct with far smaller influence) were established (regression analyses) as predictors of intentions among the participants, but only with a direct effect (i.e., without performance expectancy). The structural equation modelling has established weak effect of job relevance (through performance expectancy) on intentions. However, the direct effect of job relevance was stronger than the effect of performance expectancy. The effect of use of ‘Other technology’ was reconfirmed (as a direct and very weak effect).

Hypothesis **H3** (study of General Practitioners) stated that:

the effects of performance expectancy, effort expectancy, social influence, and facilitating conditions will be moderated by the following UTAUT moderators: age, gender, and previous work experience.

This hypothesis was partially accepted, as only age and experience were reported as moderators of social influence.

Hypothesis **H4** (study of General Practitioners) stated that:

descriptive norm (e.g., how many colleagues will use the system if it is implemented) will predict intentions to use the EHR system, as a distinct/independent social influences indicator.

This hypothesis was accepted, as this social influences construct was proved to be predictor of intentions in the study (regression analyses). The structural equation modelling reconfirmed the findings from the regression analyses. Table 7.1 summarises the outcomes of hypotheses testing.

Table 7.1: Summary of the hypotheses testing

|  |  |  |  |
| --- | --- | --- | --- |
| **Study of hospital healthcare professionals** | | **Study of General Practitioners** | |
| **Dependent variable: Intention to use e-Health/EHR systems** | | | |
| **H1** | **Hypothesis:** Perceived usefulness and perceived ease of use will significantly predict healthcare professionals’ intentions to use e-Health system. | **H1** | **Hypothesis:** Performance expectancy, effort expectancy, social influence, and facilitating conditions will directly predict intentions to use the EHR system |
| **Accepted:** Perceived ease of use found as main predictor. However, structural equation modelling established a weak effect of perceived usefulness on intentions to use the e-Health system. | **Partially accepted:** Effort expectancy, social influence, and facilitating conditions found as predictors. Performance expectancy had an indirect and weak effect (structural equation modelling). |
| **H2** | **Hypothesis:** Subjective norm, descriptive norm, job relevance, and computer anxiety will predict healthcare professionals’ intentions to use the e-Health system indirectly, through the effects of perceived usefulness. | **H2** | **Hypothesis:** Job relevance, satisfaction with currently used e-Health systems and use of ‘Other technology’ will predict intentions to use the EHR system indirectly through the effects of performance expectancy. |
| **Partially accepted:** Subjective norm and job relevance found as predictors. They had stronger and direct effect on intentions than perceived usefulness (structural equation modelling). | **Partially accepted:** Job relevance and use of ‘Other technology found as predictors (regression analyses). The direct effect of job relevance was stronger than the indirect effect (through performance expectancy) according to the structural equation modelling analyses. Satisfaction had an indirect and very weak effect (structural equation modelling). |
|  | | **H3** | **Hypothesis:** The effects of performance expectancy, effort expectancy, social influence, and facilitating conditions will be moderated by the following UTAUT moderators: age, gender, and previous work experience. |
| **Partially accepted:** Only age and experience moderated the social influence effect on intentions. |
| **H4** | **Hypothesis:** Descriptive norm, i.e., how many colleagues will use the system, will predict intentions to use the EHR system as a distinct/ independent social influences indicator. |
| **Accepted:** Descriptive norm found as predictor of intentions (regression analyses and structural equation modelling. |

## Conclusions

This chapter concludes the Thesis by summarising the main findings and implications for research and policy making. The findings with respect to the importance of perceived ease of use (TAM2) and effort expectancy (UTAUT) are novel and different from those described in the relevant literature (Sections 2.6 and 2.7), where perceived usefulness (TAM2) and performance expectancy (UTUAT) were identified as the most effective predictors of behaviour. However, this study has also identified the important role of social influences (subjective norm in the first study; social influence and descriptive norm in the second study) in explaining the intentions of the targeted healthcare population. Job relevance (TAM2) and facilitating conditions (UTAUT) were also identified as predictors of intentions among the participants of the study. Perceived usefulness (TAM2) and performance expectancy (UTAUT) expressed weak and indirect effect (structural equation modelling) on intentions to use the e-Health/EHR system.

The findings of this research showed that the level of association between the ease of use of the proposed e-Health/EHR system (perceived ease of use and effort expectancy) and intentions to use the proposed system among the participants is much stronger than the remaining technology acceptance constructs (regression analyses and structural equation modelling). Other technology acceptance constructs may be used with the original technology acceptance models in assessing the intentions of healthcare professionals to use the technology (regression analyses and structural equation modelling).

Regression analyses may be used for analysing data from quantitative studies and structural equation modelling may be used as a further level of analyses with the aim to reassess the findings from the regression analyses. Moderated regression and mediation modelling should be taken into consideration when designing and conducting technology acceptance research in healthcare, because they were found to be effective in this research. With respect to the overall aim and objectives of this research it can be concluded that this research successfully managed to address them. All the research questions that were posed in this research were successfully answered.

This study has assessed factors of readiness of Macedonian healthcare professionals to accept new ICT systems. It is strongly recommended that the new ICT systems in healthcare are: easy to use (perceived ease of use and effort expectancy), relevant to the work design (job relevance), and that technical support should be provided (facilitating conditions). However, the effect of social influences on Macedonian healthcare professionals is very strong and should be taken into consideration (subjective norm, social influence, and descriptive norm). The moderation effect of only two moderators (age and experience) on social influence was established, and should be taken into consideration when implementing ICT systems in healthcare settings.

Recommendations for future research in the area of technology acceptance in healthcare were proposed. The findings of this Thesis can therefore serve as a basis on which to build a bridge between the policy makers, (i.e., the government and management), industry, (i.e., ICT producers of hardware and software for healthcare) and end users (i.e., healthcare professionals). A set of specific measures have been proposed for future managerial and policy interventions in the area of implementing e-Health/EHR systems in a developing country in SEE. Finally, this may have many benefits, reducing time and costs, making the adoption of e-Health/EHR systems more efficient and providing more effective healthcare.

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# Appendices

APPENDIX A.1 Study 1, Invitation email for the pilot study

Dear participant,

I have the pleasure to invite you to participate in the pilot survey for a PhD study being prepared by Tomi Dimitrovski M.D. MBA, who is studying at the University of Sheffield in the UK. The study has the title “Management and policy issues emerging from the use of information technology (IT) in health care delivery: Investigation of national readiness for electronic health record system”.

This pilot survey will be used for creation of the questionnaire for the next study.

The aim of the study is to assess doctors’ attitudes toward the e-Health system in the Republic of Macedonia.

e-Health can be defined as the use of Internet technology and electronic communications to support the delivery and management of healthcare services. It is a powerful technology tool which could improve the quality of care and services delivered, could add new dimensions to the patient-provider relationship, and be used to explore new models of access to care. e-Health has many components, and more are emerging, including telemedicine, telecare, telehealth, mobile computing, public health informatics, pharmacy informatics, e-nursing, etc.

Please fill in the accompanying evaluation questionnaire.

Thanks,

Tomi Dimitrovski M.D., MBA

APPENDIX A.1 Study 1, Pilot study questionnaire

**Definition of e-Health**

Generally, by e-Health we mean the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision-making.

In the questions that follow, we’d like to know your beliefs and opinions about using e-Health system in your work in the future. Please select an answer to each question by ticking or circling the answer that best represents your views.

**E-HEALTH QUESTIONNAIRE**

**1. How old are you?** \_\_\_\_ Years old (Please fill in)

**2. What is your gender?** □ Male □ Female

**3. What is you occupation?**

Physician/doctor □ Nurse □ Administration officer □

Technical support staff □Other ………………….. (please specify)

**How much do you agree or disagree with the following statements?**

|  | **Strongly Disagree** | **Moderately Disagree** | **Somewhat Disagree** | **Neutral** | **Somewhat Agree** | **Moderately Agree** | **Strongly Agree** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4. Using e-Health system at work would improve my job performance | □ | □ | □ | □ | □ | □ | □ |
| 5. Using e-Health system at work would increase my productivity | □ | □ | □ | □ | □ | □ | □ |
| 6. Using e-Health system at work would enhance my effectiveness | □ | □ | □ | □ | □ | □ | □ |
| 7. Overall, I would find e-Health system useful for my work | □ | □ | □ | □ | □ | □ | □ |
| 8. I would find e-Health system easy to use | □ | □ | □ | □ | □ | □ | □ |
| 9. Interacting with e-Health system would be easy and understandable | □ | □ | □ | □ | □ | □ | □ |
| 10. I would find it easy to get e-Health system to do what I want it to do | □ | □ | □ | □ | □ | □ | □ |
| 11. Interacting with e-Health system would not require a lot of my mental effort | □ | □ | □ | □ | □ | □ | □ |
| 12. I intend to use e-Health system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 13. Computers make me feel uncomfortable | □ | □ | □ | □ | □ | □ | □ |
| 14. Working with a computer makes me nervous | □ | □ | □ | □ | □ | □ | □ |
| 15. Computers do not scare me at all | □ | □ | □ | □ | □ | □ | □ |
| 16. In my job, the use of e-Health system would be important | □ | □ | □ | □ | □ | □ | □ |
| 17. I expect I to use e-Health system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 18. Computers make me feel uneasy | □ | □ | □ | □ | □ | □ | □ |
| 19. In my job, the use of e-Health system would be relevant | □ | □ | □ | □ | □ | □ | □ |
| 20. I will be able to use e-Health system effectively | □ | □ | □ | □ | □ | □ | □ |
| 21. Using e-Health system will be an easy task for me | □ | □ | □ | □ | □ | □ | □ |
| 22. I will easily work with e-Health system | □ | □ | □ | □ | □ | □ | □ |
| 23. I plan to use e-Health system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 24. In general, e-Health system will be well approved and supported by most of my colleagues | □ | □ | □ | □ | □ | □ | □ |
| 25. The colleagues that I respect most would accept the e-Health system | □ | □ | □ | □ | □ | □ | □ |

**26. How many of your colleagues do you think will use e-Health system if it is implemented?**

□ None of them □ Few of them □ Some of them □ Most of them □ All of them

**27. Do you have access to a personal computer at work or home?** □ Yes □ No

**28. On average, for how long have you been using computers?** \_\_\_\_ Years (Please fill in)

**29. On average, how many hours a day do you use a computer?** \_\_\_ Hours (Please fill in)

**THANK YOU VERY MUCH FOR YOUR PARTICIPATION**

APPENDIX A.1 Study 1, Evaluation questionnaire for the pilot study

Dear participant,

Your comments have inevitable value for improving of the questionnaire. Please add your comments/remarks to the online questionnaire, answering the following questions:

1. The questionnaire was easy to understand and complete?
2. Please mark/report the items that you cannot understand their meaning on the questionnaire.
3. Please tell us how you would like to see the items that you cannot understand (re-worded/rephrased)?
4. Are response options provided (strongly agree to strongly disagree) were meaningful and relevant to all items?
5. Please report the items where the response options seemed less relevant.

APPENDIX A.2 Study 1, Invitation email main study

Dear participant,

I have the pleasure to invite you to participate in an online survey for a PhD study being prepared by Tomi Dimitrovski M.D. MBA, who is studying at the University of Sheffield in the UK. The study has the title “Management and policy issues emerging from the use of information technology (IT) in health care delivery: Investigation of national readiness for electronic health record system”.

The aim of the study is to assess doctors’ attitudes toward the e-Health system in the Republic of Macedonia.

e-Health can be defined as the use of Internet technology and electronic communications to support the delivery and management of healthcare services. It is a powerful technology tool which could improve the quality of care and services delivered, could add new dimensions to the patient-provider relationship, and be used to explore new models of access to care. e-Health has many components, and more are emerging, including telemedicine, telecare, telehealth, mobile computing, public health informatics, pharmacy informatics, e-nursing, etc.

The aggregated and anonymised results will be written in the PhD Thesis and may be presented in research papers, but it will not be possible to identify anyone from the results. The anonymised results from this study will made be available to the Health Insurance Fund with the aim of increasing the performance of the EHR and its adjustment to doctors’ needs. All responses will be anonymous.

Please fill in the accompanying questionnaire.

Thanks,

Tomi Dimitrovski M.D., MBA

APPENDIX A.2 Study 1, Main questionnaire

**Definition of e-Health**

Generally, by health information technology (or e-Health) we mean the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision-making.

In the questions that follow, we’d like to know your beliefs and opinions about using e-Health system in your work in the future. Please select an answer to each question by ticking or circling the answer that best represents your views. Please bear in mind that there are no good or bad answers, and we are only interested in your personal views. So, please respond as honestly as possible.

**NOTE: EVEN SOME QUESTIONS LOOK RELEVANT OR VERY SIMILAR TO EACH OTHER PLEASE COMPLETE THEM AS APPROPRIATE.**

**E-HEALTH QUESTIONNAIRE**

**1. How old are you?** \_\_\_\_ Years old (Please fill in)

**2. What is your gender?** □ Male □ Female

**3. What is you occupation?**

□ Physician/doctor Nurse □ Administration officer □

Technical support staff □Other ……………. (please specify)

**How much do you agree or disagree with the following statements?**

|  | **Strongly Disagree** | **Moderately Disagree** | **Somewhat Disagree** | **Neutral** | **Somewhat Agree** | **Moderately Agree** | **Strongly Agree** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 4. Using e-Health system at work would improve my job performance | □ | □ | □ | □ | □ | □ | □ |
| 5. Using e-Health system at work will improve my job productivity | □ | □ | □ | □ | □ | □ | □ |
| 6. Using e-Health system at work would enhance my effectiveness | □ | □ | □ | □ | □ | □ | □ |
| 7. Overall, I would find e-Health system useful for my work | □ | □ | □ | □ | □ | □ | □ |
| 8. I would find e-Health system easy to use | □ | □ | □ | □ | □ | □ | □ |
| 9. Interacting with e-Health system would be easy and understandable | □ | □ | □ | □ | □ | □ | □ |
| 10. I would find it easy to get e-Health system to do what I want it to do | □ | □ | □ | □ | □ | □ | □ |
| 11. Interacting with e-Health system would not require a lot of my mental effort | □ | □ | □ | □ | □ | □ | □ |
| 12. I intend to use e-Health system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 13. Computers make me feel uncomfortable | □ | □ | □ | □ | □ | □ | □ |
| 14. Working with a computer makes me nervous | □ | □ | □ | □ | □ | □ | □ |
| 15. Computers do not scare me at all | □ | □ | □ | □ | □ | □ | □ |
| 16. In my job, the use of e-Health system would be important | □ | □ | □ | □ | □ | □ | □ |
| 17. I expect that I would use e-Health system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 18. Computers make me feel uneasy | □ | □ | □ | □ | □ | □ | □ |
| 19. In my job, the use of e-Health system would be relevant | □ | □ | □ | □ | □ | □ | □ |
| 20. I will be able to use e-Health system effectively | □ | □ | □ | □ | □ | □ | □ |
| 21. Using e-Health system will be an easy task for me | □ | □ | □ | □ | □ | □ | □ |
| 22. I will easily work with e-Health system | □ | □ | □ | □ | □ | □ | □ |
| 23. I plan to use e-Health system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 24. In general, e-Health system will be well approved and supported by most of my colleagues | □ | □ | □ | □ | □ | □ | □ |
| 25. The colleagues that I respect most would accept the e-Health system | □ | □ | □ | □ | □ | □ | □ |

**26. How many of your colleagues do you think will use e-Health system if it is implemented?**

□ None of them □ Few of them □ Some of them □ Most of them □ All of them

**27. Do you have access to a personal computer at work or home?** □ Yes □ No

**28. On average, for how long have you been using computers?** \_\_\_\_ Years (Please fill in)

**29. On average, how many hours a day do you use a computer?** \_\_\_\_ Hours (Please fill in)

**THANK YOU VERY MUCH FOR YOUR PARTICIPATION**

APPENDIX B.1 Study 2, Invitation email for the pilot study

Dear participant,

I have the pleasure to invite you to participate in the pilot survey for a PhD study being prepared by Tomi Dimitrovski M.D. MBA, who is studying at the University of Sheffield in the UK. The study has the title “Management and policy issues emerging from the use of information technology (IT) in health care delivery: Investigation of national readiness for electronic health record system”.

This pilot survey will be used for creation of the questionnaire for the next study

The aim of the study is to assess doctors’ attitudes toward the electronic health record (EHR) system in the Republic of Macedonia.

EHR is computerised repository of information regarding the health status of a person or patient. IT is designed to be stored and transmitted securely, and to be accessible by multiple authorized users. The primary purpose is to support continuing, efficient and quality integrated health care and they can contain information which may be historical, current, or may be useful in the future.

In the Republic of Macedonia only a few parts of the e-Health system, such as ‘Electronic health card’; and ‘My term’, have been implemented at present. Other components of the e-Health system will be introduced in the foreseeable future.

Please fill in the accompanying evaluation questionnaire.

Thanks,

Tomi Dimitrovski M.D., MBA

APPENDIX B.1 Study 2, Pilot study questionnaire

**Introduction and explanation of electronic health record (EHR)**

**Thank you for taking part in this study.**

EHR is computerised repository of information regarding the health status of a person or patient. It is designed to be stored and transmitted securely, and to be accessible by multiple authorized users. The primary purpose is to support continuing, efficient and quality integrated health care and they can contain information which may be historical, current, or may be useful in the future.

In the Republic of Macedonia only a few parts of the e-Health system, such as ‘Electronic health card’ and ‘My term’, have been implemented at present. Other components of the e-Health system will be introduced in the foreseeable future.

In the questions that follow, we’d like to know your beliefs and opinions about using health EHR system in your future work. Understanding doctors’ expectations of systems can help develop and implement better systems.

Please select an answer to each question by ticking or circling the answer that best represents your views. Many are standard questions from a standard questionnaire. Please bear in mind that there are no wrong or right answers, and we are only interested in your personal views. Even if you are not sure please answer as best you can. All responses will be anonymous. The aggregated results will be written in the PhD Thesis and may be presented in research papers, but it will not be possible to identify anyone from the results.

**EHR QUESTIONNAIRE**

**1. How old are you?** \_\_\_\_ Years old (Please complete)

**2. What is your gender?** □ Male □ Female

**3.Working experience in present specialization \_\_\_\_\_** years?

**4. Where is your practice located?**

□ Mainly urban area □ Mainly rural area

**How much do you agree or disagree with the following statements?**

|  | **Strongly Disagree** | **Moderately Disagree** | **Somewhat Disagree** | **Neutral** | **Somewhat Agree** | **Moderately Agree** | **Strongly Agree** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 5. Using EHR system would improve my job performance | □ | □ | □ | □ | □ | □ | □ |
| 6. Using EHR system would increase my productivity | □ | □ | □ | □ | □ | □ | □ |
| 7. Using EHR system would enhance my effectiveness | □ | □ | □ | □ | □ | □ | □ |
| 8. Using EHR system would help me to accomplish tasks more quickly | □ | □ | □ | □ | □ | □ | □ |
| 9. Overall, I would find EHR system useful for my work | □ | □ | □ | □ | □ | □ | □ |
| 10. I would find EHR system easy to use | □ | □ | □ | □ | □ | □ | □ |
| 11. Interacting with EHR system would be easy and understandable | □ | □ | □ | □ | □ | □ | □ |
| 12. I would find it easy to get the EHR system to do what I want it to do | □ | □ | □ | □ | □ | □ | □ |
| 13. Interacting with EHR system would not require a lot of mental effort | □ | □ | □ | □ | □ | □ | □ |
| 14. It would be easy to me to become skilful at using EHR system | □ | □ | □ | □ | □ | □ | □ |
| 15. I intend to use EHR system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 16. I have the necessary resources to use the EHR system | □ | □ | □ | □ | □ | □ | □ |
| 17. I have the necessary knowledge to use the EHR system | □ | □ | □ | □ | □ | □ | □ |
| 18.The EHR system is not compatible with other systems that I currently use | □ | □ | □ | □ | □ | □ | □ |
| 19. In my job, the use of EHR system would be important | □ | □ | □ | □ | □ | □ | □ |
| 20. I expect to use EHR system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 21. A specific person (or group) will be available for assistance with EHR system difficulties | □ | □ | □ | □ | □ | □ | □ |
| 22. In my job, the use of EHR system would not be relevant | □ | □ | □ | □ | □ | □ | □ |
| 23. I will be able to use EHR system effectively | □ | □ | □ | □ | □ | □ | □ |
| 24. Using EHR system will be an easy task for me | □ | □ | □ | □ | □ | □ | □ |
| 25. I will easily work with EHR system | □ | □ | □ | □ | □ | □ | □ |
| 26. I plan to use EHR system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 27. In general, EHR system will be well approved and supported by most of my colleagues | □ | □ | □ | □ | □ | □ | □ |
| 28. The colleagues that I respect most would accept the EHR system | □ | □ | □ | □ | □ | □ | □ |
| 29. People who influence my behaviour think that I should use the EHR system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 30. People who are important to me think that I should use the EHR system if it is implemented | □ | □ | □ | □ | □ | □ | □ |
| 31. I am satisfied with the ‘Electronic health card’ system that I currently use | □ | □ | □ | □ | □ | □ | □ |
| 32. I am satisfied with the ‘My term’ system that I currently use | □ | □ | □ | □ | □ | □ | □ |
| 33. The systems I currently use have improved my performance | □ | □ | □ | □ | □ | □ | □ |
| 34. My patients are not satisfied with the systems that are currently used | □ | □ | □ | □ | □ | □ | □ |
| 35. Overall, the systems used currently are not effective | □ | □ | □ | □ | □ | □ | □ |

**36. How many of your colleagues do you think will use EHR system if it is implemented?**

□ None of them □ Few of them □ Some of them □ Most of them □ All of them

**37. Approximately for how long have you been using computers?** \_\_\_\_ Years (Please fill in)

**38. On average, how many hours a day do you use a computer?** \_\_\_\_ Hours (Please fill in)

**39.** **Do you use mobile devices to access the Internet, such as a tablet, smartphone, iphone or laptop** Yes/No

**40. Approximately how often do you use the Internet for personal needs, such as entertainment, online banking, and social networking?** 1 = never/rarely, 2 = 1-2 times a month, 3 = 1-2 times a week, 4 = several times a day

**41. Approximately how often do you use the Internet for professional purposes, such as accessing or storing patient information**? 1 = never/rarely, 2 = 1-2 times a month, 3 = 1-2 times a week, 4 = several times a day

**By completing and returning this questionnaire, I agree to take part in this study.**

**THANK YOU VERY MUCH FOR YOUR PARTICIPATION**

Tomi Dimitrovski M.D., MBA

APPENDIX B.1 Study 2, Evaluation questionnaire for the pilot study

Dear participant,

Thank you again for taking part in the pilot study for this questionnaire.

It would be very helpful if you could give me any comments to help improve of the questionnaire. Please add your comments/remarks to the online questionnaire, answering the following questions:

1. How easy was it to understand and complete the questionnaire?
2. Were there any items on the questionnaire that you could not understand or were not clear?
3. Please tell us how you would like to see the items that you could not understand re-worded or re-phrased.
4. Are the response options provided (strongly agree to strongly disagree) meaningful and relevant to the items in the questionnaire?
5. Please show any items where the response options seemed less relevant?
6. Are there any other ways the questionnaire could be improved?

APPENDIX B.2 Study 2, Ethics application to the Sheffield Ethics Committee

**The University of Sheffield.**

**Information School**

**Proposal for**

**Research Ethics Review**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Students** | |  | **Staff** | |
| **This proposal submitted by:** | | **This proposal is for:** | |
|  | Undergraduate |  | Specific research project |
|  | Postgraduate (Taught) – PGT |  | Generic research project |
| X | Postgraduate (Research) – PGR | This project is funded by: | |
|  | |  | |

|  |  |  |  |
| --- | --- | --- | --- |
| **Project Title:** | “Management and policy issues emerging from the use of information technology (IT) in health care delivery: Investigation of national readiness for electronic health record system”. | | |
| **Start Date:** | 1st February | **End Date:** | January 2016 |

|  |  |
| --- | --- |
| **Principal Investigator (PI):**  *(student for supervised UG/PGT/PGR research)* | Tomi DIMITROVSKI |
| **Email:** | [tdimitrovski@seerc.org](mailto:tdimitrovski@seerc.org) |

|  |  |
| --- | --- |
| **Supervisor:**  ***(if PI is a student)*** | Professor Peter BATH/  Professor Panayiotis KETIKIDIS |
| **Email:** | p.a.bath@sheffield.ac.uk/ketikidis@city.academic.gr |

|  |  |
| --- | --- |
| **Indicate if the research: (*put an X in front of all that apply*)** | |
|  | Involves adults with mental incapacity or mental illness, or those unable to make a personal decision |
|  | Involves prisoners or others in custodial care (e.g. young offenders) |
|  | Involves children or young people aged under 18 years of age |
|  | Involves highly sensitive topics such as ‘race’ or ethnicity; political opinion; religious, spiritual or other beliefs; physical or mental health conditions; sexuality; abuse (child, adult); nudity and the body; criminal activities; political asylum; conflict situations; and personal violence. |

|  |  |
| --- | --- |
| **Please indicate by inserting an “X” in the left hand box that you are conversant with the University’s policy on the handling of human participants and their data.** | |
| X | **We confirm that we have read the current version of the University of Sheffield *Ethics Policy Governing Research Involving Human Participants, Personal Data and Human Tissue*, as shown on the University’s research ethics website at:** [**www.sheffield.ac.uk/ris/other/gov-ethics/ethicspolicy**](http://www.sheffield.ac.uk/ris/other/gov-ethics/ethicspolicy) |

**Part B. Summary of the Research**

|  |
| --- |
| **B1. Briefly summarise the project’s aims and objectives:**  (This must be in language comprehensible to a layperson and should take no more than one-half page. Provide enough information so that the reviewer can understand the intent of the research) |

**Summary:**

Positivist quantitative research will be conducted with aim to assess physicians’ attitudes toward the Electronic Health Record system in the Republic of Macedonia. To meet the aims and objectives of the study, a questionnaire survey will be conducted on doctors. The questionnaire, which will be used in this research, will be designed in accordance with the literature review of this study, the findings of the first stage of the research and experts’ knowledge. Data analyses will be made on the collected data. This research will provide comprehensive information on physician’s intentions to use the EHR system in the Republic of Macedonia. A model for EHR implementation strategy for the Republic of Macedonia will be developed on the basis of the findings of this study.

|  |
| --- |
| **B2. Methodology:**  Provide a broad overview of the methodology in no more than one-half page. |

**Overview of Methods:**

For the purpose of this project up to 400 participants GPs and clinical doctors from the Republic of Macedonia will be invited to complete and return a printed questionnaire. The questionnaire will be distributed and collected through postal mail.

|  |
| --- |
| **If more than one method, e.g., survey, interview, etc. is used, please respond to the questions in Section C for each method. That is, if you are using both a survey and interviews, duplicate the page and answer the questions for each method; you need not duplicate the information, and may simply indicate, “see previous section.”** |

|  |
| --- |
| **C1. Briefly describe how each method will be applied** |

**Method (e.g., survey, interview, observation, experiment):**

The researcher will conduct survey using a printed questionnaire.

**Description – how will you apply the method?**

The research instrument will be distributed and collected through postal mail. The questionnaire will be sent out to doctors throughout Macedonia and they will be invited to complete and return the questionnaire in the envelope provided.

|  |
| --- |
| **About your Participants** |

**C2. Who will be potential participants?**

GPs in the Republic of Macedonia. The survey will be conducted on a national level. Participant from all parts of the country will be invited to participate in the survey. The questionnaire will be distributed through postal mail. There will be short introduction of the questionnaire

**C3. How will the potential participants be identified and recruited?**

A random sample of potential participants will be generated from a list provided by the government Health insurance fund.

**C4. What is the potential for physical and/or psychological harm / distress to participants?**

None, there are no questions that are likely to cause any harm or distress to the participants. Participants will answer the questionnaire anonymously.

**C5. Will informed consent be obtained from the participants?**

|  |  |
| --- | --- |
| x | **Yes** |
|  | **No** |

**If Yes, please explain how informed consent will be obtained?**

A letter of invitation will be included with the questionnaire. This will introduce the study to the potential participants, will give details about the study, including its aims and objectives, it will invite them to participate by completing and returning the questionnaire. Therefore, informed consent will be obtained. By participants completing and returning the questionnaire, it will be assumed that participants are consenting implicitly to take part.

**If No, please explain why you need to do this, and how the participants will be de-briefed?**

**C6. Will financial / in kind payments (other than reasonable expenses and compensation for time) be offered to participants?** (Indicate how much and on what basis this has been decided)

No, there will be no financial or any other in kind payments to the participants.

|  |
| --- |
| **About the Data** |

**C7. What data will be collected? (Tick all that apply)**

|  |  |  |
| --- | --- | --- |
|  | **Print** | **Digital** |
| **Participant observation** |  |  |
| **Audio recording** |  |  |
| **Video recording** |  |  |
| **Computer logs** |  |  |
| **Questionnaires/Surveys** | X |  |
| **Other:** |  |  |
| **Other:** |  |  |

**C8. What measures will be put in place to ensure confidentiality of personal data, where appropriate?**

Participant will take part in the study voluntarily, they will not disclose any personal data in the questionnaire.

**C9. How/Where will the data be stored?**

The data will be stored on the researcher’s personal computer and back-ups of the data will be held on a secure device. The data may also be shared with supervisors on secure computers.

**C10. Will the data be stored for future re-use? If so, please explain**

Yes, data will be stored in researcher’s personal computer for future re-use, e.g., for preparing articles for publication.

|  |
| --- |
| **About the Procedure** |

**C11. Does your research raise any issues of personal safety for you or other researchers involved in the project (especially if taking place outside working hours or off University premises)? If so, please explain how it will be managed.**

No, this research does not raise any issues of personal safety.

**The University of Sheffield.**

**Information School**

**Proposal for**

**Research Ethics Review**

**Title of Research Project: *[Management and policy issues emerging from the use of information technology (IT) in health care delivery: Investigation of national readiness for electronic health record system*]**

We confirm our responsibility to deliver the research project in accordance with the University of Sheffield’s policies and procedures, which include the University’s ‘*Financial Regulations*’, ‘*Good Research Practice Standards’* and the ‘*Ethics Policy Governing Research Involving Human Participants, Personal Data and Human Tissue’* (Ethics Policy) and, where externally funded, with the terms and conditions of the research funder.

**In submitting this research ethics application form I am also confirming that:**

* The form is accurate to the best of our knowledge and belief.
* The project will abide by the University’s Ethics Policy.
* There is no potential material interest that may, or may appear to, impair the independence and objectivity of researchers conducting this project.
* Subject to the research being approved, we undertake to adhere to the project protocol without unagreed deviation and to comply with any conditions set out in the letter from the University ethics reviewers notifying me of this.
* We undertake to inform the ethics reviewers of significant changes to the protocol (by contacting our academic department’s Ethics Coordinator in the first instance).
* we are aware of our responsibility to be up to date and comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data, including the need to register when necessary with the appropriate Data Protection Officer (within the University the Data Protection Officer is based in CiCS).
* We understand that the project, including research records and data, may be subject to inspection for audit purposes, if required in future.
* We understand that personal data about us as researchers in this form will be held by those involved in the ethics review procedure (e.g. the Ethics Administrator and/or ethics reviewers) and that this will be managed according to Data Protection Act principles.
* If this is an application for a ‘generic’ project all the individual projects that fit under the generic project are compatible with this application.
* **We understand that this project cannot be submitted for ethics approval in more than one department, and that if I wish to appeal against the decision made, this must be done through the original department.**

**Name of the Student (if applicable):**

*Tomi DIMITROVSKI*

**Name of Principal Investigator (or the Supervisor):**

*Professor Peter BATH, Professor Panayotis KETIKIDIS*

**Date:**

*05.01.2014*

APPENDIX B.2 Study 2, Written approval of Sheffield Ethics Committee

Information School Research Ethics Panel

Letter of Approval

Date: 24th February 2014

To: Tomi Dimitrovski

The Information School Research Ethics Panel has examined the following application:

Title: Management and policy issues emerging from the use of information technology (IT) in healthcare delivery: Investigation of national readiness for electronic health record system.

Submitted by: Tomi Dimitrovski

And found the proposed research involving human participants to be in accordance with the University of Sheffield’s policies and procedures, which include the University’s ‘*Financial Regulations*’, ‘*Good Research Practice Standards’* and the ‘*Ethics Policy Governing Research Involving Human Participants, Personal Data and Human Tissue’* (Ethics Policy).

This letter is the official record of ethics approval by the School, and should accompany any formal requests for evidence of research ethics approval.

Effective Date: 24th February 2014

C:\Users\Matt\AppData\Local\Temp\As signature 09-31-46.jpg

Dr Angela Lin

Research Ethics Coordinator

APPENDIX B.3 Study 2, Invitation email main study

Dear participant,

I have the pleasure to invite you to participate in an online survey for a PhD study being prepared by Tomi Dimitrovski M.D. MBA, who is studying at the University of Sheffield in the UK. The study has the title “Management and policy issues emerging from the use of information technology (IT) in health care delivery: Investigation of national readiness for electronic health record system”.

Further information related to this work, and the ethics issues are explained in detail in the attachment of this email.

The aim of the study is to assess doctors’ attitudes toward the electronic health record (EHR) system in the Republic of Macedonia. The study has received research ethics approval from the University of Sheffield.

EHR is repository of information regarding the health status of a person or patient. It is designed to be stored and transmitted securely, and to be accessible by multiple authorized users. The primary purpose is to support continuing, efficient and quality integrated health care and they can contain information which may be historical, current, or may be useful in the future.

In the Republic of Macedonia only a few parts of the e-Health system, such as ‘Electronic health card’ and ‘My term’, have been implemented at present. Other components of the e-Health system will be introduced in the foreseeable future.

The aggregated and anonymised results will be written in the PhD Thesis and may be presented in research papers, but it will not be possible to identify anyone from the results. The anonymised results from this study will made be available to the Health Insurance Fund with the aim of increasing the performance of the EHR and its adjustment to doctors’ needs. All responses will be anonymous.

To take part in the study please go to the following link:

Thanks,

Tomi Dimitrovski M.D., MBA

APPENDIX B.3 Study 2, Attachment with the invitation email

**Electronic health records** (EHR) is a repository of information regarding the health status of a subject of care in computer processable form, stored and transmitted securely, and accessible by multiple authorized users. Its primary purpose is the support of continuing, efficient and quality integrated health care and it contains information which is retrospective, concurrent, and prospective.

In the Republic of Macedonia only few parts of the e-Health system, such as ‘Electronic health card’ and ‘My term’, have been implemented at the moment. Other components of the e-Health system will be introduced in the foreseeable future.

In the questions that follow, we’d like to know your beliefs and opinions about using health EHR system in your work in the future. Understanding physician’s expectations of systems can help to develop and implement better systems.

Please select an answer to each question by ticking or circling the answer that best represents your views. Please bear in mind that there are no wrong or right answers, and we are only interested in your personal views. Please respond as honestly as possible.

The aim of the study is to assess doctor’s attitudes toward the EHR system in the Republic of Macedonia.

The objectives of the study are:

* to provide comprehensive information on doctors’ intentions to use the EHR system;
* to examine relationships between technology acceptance variables and doctors’ readiness to use the EHR in the Republic of Macedonia;
* to discover doctors’ views on the possible use of the EHR;
* to explore relationships between various demographic factors;
* to develop an EHR implementation strategy; and
* to examine relationships between demographic factors and doctors’ willingness to use EHR.

We like to inform you that your contact details were generated randomly from GP’s list provided by the national Health Insurance Fund.

APPENDIX B.3 Study 2, Main questionnaire

**EHR QUESTIONNAIRE**

**1. How old are you?** \_\_\_\_ Years old (Please complete)

**2. What is your gender?** □ Male □ Female

**3.Working experience in present specialization \_\_\_\_\_** years?

**4. Where is your practice located?**

□ Mainly urban area □ Mainly rural area

**How much do you agree or disagree with the following statements?**

|  | **Strongly Disagree** | **Moderately Disagree** | **Neutral** | **Moderately Agree** | **Strongly Agree** |
| --- | --- | --- | --- | --- | --- |
| 5. Using EHR system would improve my job performance | □ | □ | □ | □ | □ |
| 6. Using EHR system would increase my productivity | □ | □ | □ | □ | □ |
| 7. Using EHR system would enhance my effectiveness | □ | □ | □ | □ | □ |
| 8. Using EHR system would help me to accomplish tasks more quickly | □ | □ | □ | □ | □ |
| 9. Overall, I would find EHR system useful for my work | □ | □ | □ | □ | □ |
| 10. I would find EHR system easy to use | □ | □ | □ | □ | □ |
| 11. Interacting with EHR system would be easy and understandable | □ | □ | □ | □ | □ |
| 12. I would find it easy to get the EHR system to do what I want it to do | □ | □ | □ | □ | □ |
| 13. Interacting with EHR system would require a lot of mental effort | □ | □ | □ | □ | □ |
| 14. It would be easy to me to become skilful at using EHR system | □ | □ | □ | □ | □ |
| 15. I intend to use EHR system if it is implemented | □ | □ | □ | □ | □ |
| 16. I have the necessary resources to use the EHR system | □ | □ | □ | □ | □ |
| 17. I have the necessary knowledge to use the EHR system | □ | □ | □ | □ | □ |
| 18.The EHR system is compatible with other systems that I currently use | □ | □ | □ | □ | □ |
| 19. In my job, the use of EHR system would be important | □ | □ | □ | □ | □ |
| 20. I expect to use EHR system if it is implemented | □ | □ | □ | □ | □ |
| 21. A specific person (or group) will be available for assistance with EHR system difficulties | □ | □ | □ | □ | □ |
| 22. In my job, the use of EHR system would be relevant | □ | □ | □ | □ | □ |
| 23. I will be able to use EHR system effectively | □ | □ | □ | □ | □ |
| 24. Using EHR system will be an easy task for me | □ | □ | □ | □ | □ |
| 25. I will easily work with EHR system | □ | □ | □ | □ | □ |
| 26. I plan to use EHR system if it is implemented | □ | □ | □ | □ | □ |
| 27. In general, EHR system will be well approved and supported by most of my colleagues | □ | □ | □ | □ | □ |
| 28. The colleagues that I respect most would accept the EHR system | □ | □ | □ | □ | □ |
| 29. People who influence my behaviour think that I should use the EHR system if it is implemented | □ | □ | □ | □ | □ |
| 30. People who are important to me think that I should use the EHR system if it is implemented | □ | □ | □ | □ | □ |
| 31. I am satisfied with the ‘Electronic health card’ system that I currently use | □ | □ | □ | □ | □ |
| 32. I am satisfied with the ‘My term’ system that I currently use | □ | □ | □ | □ | □ |
| 33. The systems I currently use have improved my performance | □ | □ | □ | □ | □ |
| 34. My patients are satisfied with the systems that are currently used | □ | □ | □ | □ | □ |
| 35. Overall, the systems used currently are effective | □ | □ | □ | □ | □ |

**36. How many of your colleagues do you think will use EHR system if it is implemented?**

□ None of them □ Few of them □ Some of them □ Most of them □ All of them

**37. Approximately for how long have you been using computers?** \_\_\_\_ Years (Please fill in)

**38. On average, how many hours a day do you use a computer?** \_\_\_\_ Hours (Please fill in)

**39.** **Do you use mobile devices to access the Internet, such as a tablet, smartphone, iphone or laptop** Yes/No

**40. Approximately how often do you use the Internet for personal needs, such as entertainment, online banking, and social networking?** 1 = never/rarely, 2 = 1-2 times a month, 3 = 1-2 times a week, 4 = several times a day

**41. Approximately how often do you use the Internet for professional purposes, such as accessing or storing patient information**? 1 = never/rarely, 2 = 1-2 times a month, 3 = 1-2 times a week, 4 = several times a day

**By completing and returning this questionnaire, I agree to take part in this study.**

**THANK YOU VERY MUCH FOR YOUR PARTICIPATION**

Tomi Dimitrovski M.D., MBA