Towards the development of an integrated model for examining the determinants affecting the use of Queue Management Solutions in Healthcare

نحو تطوير نموذج متكامل لفحص المحددات التي تؤثر على استخدام حلول إدارة قوائم الإنتظار في الرعاية الصحية

by

ADI AHMAD ALI ALQUDAH

A thesis submitted in fulfilment

of the requirements for the degree of

DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE

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Abstract

Over the years, long queues were recognized as a common problem in the healthcare domain, and it is significant to manage them for patients' safety and overall satisfaction. Prolonged queues in healthcare organizations can produce high levels of distraction for the employees instead of focusing on their original activities. As a solution, queue management technologies became more popular in healthcare organizations to solve queue issues, gather data, and generate statistical reports for the current and future flow trends. The adoption of new technologies in healthcare has been turned into a must rather than a luxury due to the rapid changes of technology advancements and people's needs. In general, the success of technology adoption in healthcare relies on the behavior of end-users towards accepting and using the technology. Queue management solutions (QMS) face resistance from users, and their acceptance is not assured. A quick review of the literature showed a lack of studies that discuss the acceptance of QMS.

Therefore, this research has three main objectives. First, conducting a systematic review to address the research gaps in the existing literature and understand the extensively utilized acceptance models in healthcare and their related constructs. The systematic review included empirical studies published between January 2010 and December 2019 on the topic of technology acceptance in healthcare. A total of 1,768 studies have been reviewed, and 142 studies were found eligible and considered in the analysis. Through the analysis, the technology acceptance model (TAM) and the Unified theory of acceptance and use of technology (UTAUT) have been recognized as the prevailing models in technology acceptance in healthcare. Additionally, 11 factors from various acceptance models were found extensively investigated to understand and analyze the technology acceptance in the healthcare domain. These factors include Performance Expectancy, Effort Expectancy, Social Influence,

Facilitating Conditions, Attitude Towards, Behavioral Intention, Use Behavior, Computer Anxiety, Computer Self-Efficacy, Innovativeness, and Trust. In line with the gaps found in the literature, this research has presented a case study for the currently implemented queue management solution (QMS) in the out-patient department (OPD) in a healthcare organization in UAE. The research discussed the suggested business and technical optimizations that include integrating the QMS with the electronic medical records solution (EMR). The integration was achieved using Health Level Seven (HL7) integration standards, including the exchange of custom-designed XML and HL7 messages. The goal of the integration was to implement a novel tool for patient's self-check-in and enhance the ease of use and usefulness of QMS. As a pilot implementation, the feasibility of the newly implemented tool was assessed through a simulation experiment in the internal medicine clinic over two different weeks (control and intervention). A total of 127 appointments were identified as eligible and included in the study. The patient's journey was split into five stages: identification, wait to triage, triage process, wait to treatment, and treatment process. The results revealed that the new tool is beneficial, and the median times to finish the processes within the patient's journey have significantly decreased.

To evaluate the use of the enhanced QMS, this research develops an integrated model based on the integration of various constructs extracted from different theoretical models, including the UTAUT, TAM, and social cognitive theory (SCT) along with trust and innovativeness as external factors. The model was empirically validated using the partial least squares-structural equation modelling (PLS-SEM) approach based on data collected through a questionnaire survey from 242 healthcare professionals. In brief, the results exposed that the suggested model can be helpful to explore the acceptance of information technologies in healthcare. The model has explained 66.5% of the total variance in the behavioral intention to use the enhanced QMS,

along with 59.3% of the total variance for the actual use of the enhanced QMS. The results indicated that innovativeness and computer self-efficacy factors have a positive significant influence on the effort expectancy of professionals to use QMS. The computer anxiety factor has a negative significant influence on the effort expectancy to use QMS. Besides, trust and computer self-efficacy factors have a positive significant influence on the performance expectancy when using QMS. Other results, related implications, limitations, along with future research were also clarified and discussed.

الخلاصة

على مر السنين ، تم النظر الى الطوابير الطويلة باعتبارها مشكلة شائعة في مجال الرعاية الصحية ، ومن المهم إدارتها من أجل سلامة المرضى ورضاهم بشكل عام. يمكن أن تؤدي قوائم الانتظار الطويلة في مؤسسات الرعاية الصحية إلى مستويات عالية من التشتيت للموظفين بدلاً من التركيز على أنشطتهم الأصلية. كنتيجة لذلك ، أصبح تطبيق تقنيات إدارة قائمة الانتظار أكثر شيوعًا في مؤسسات الرعاية الصحية لحل مشكلات قائمة الانتظار، جمع البيانات، وإنشاء التقارير إحصائية لأعداد المرضى الحالية والتوقعات المستقبلية. في الوقت الحاضر ، تحول اعتماد التقنيات الجديدة في مجال الرعاية الصحية إلى ضرورة بدلاً من الرفاهية بسبب التغيرات السريعة في التقدم التكنولوجي واحتياجات الناس. بشكل عام ، يعتمد نجاح تبني التكنولوجيا في الرعاية الصحية على سلوك المستخدمين النهائيين تجاه قبول التكنولوجيا واستخدامها. في هذه حالة هذا البحث ، تتطلع إحدى مؤسسات الرعاية الصحية في الإمارات العربية المتحدة إلى تعزيز نظام إدارة قوائم المرضى المطبق حاليًا مع وجود بعض الشكوك فيما يتعلق بجدوى عملية التطوير، نظرًا لوجود مستوى من الرفض من المتخصصين في الرعاية الصحية لاستخدام النظام. على غرار تقنيات تكنولوجيا المعلومات الأخرى ، تواجه تقنيات إدارة قائمة الانتظار مقاومة من المستخدمين ، ولا يمكن تأكيد قبول استخدامها.و قد أظهر استعراض سريع للأدبيات نقصًا حادًا في الدراسات التي تناقش قبول حلول إدارة قوائم الانتظار.

لذلك ، فإن لهذا البحث ثلاثة أهداف رئيسية. أولاً ، إجراء مراجعة منهجية لمعالجة فجوات البحث في الأدبيات الحالية وفهم نماذج القبول المستخدمة على نطاق واسع في الرعاية الصحية والتركيبات ذات الصلة. حيث تضمنت المراجعة المنهجية دراسات تجريبية نُشرت بين يناير 2010 وديسمبر 2019 بما يخص موضوع قبول التكنولوجيا في مجالات الرعاية الصحية. تمت مراجعة ما مجموعه 1768 دراسة ، ووجدت 142 دراسة مؤهلة والتي تم أخذها في الإعتبار و ضمها للتحليل. من خلال التحليل ، تم التعرف على نموذج قبول التكنولوجيا (TAM) والنظرية الموحدة لقبول واستخدام التكنولوجيا (UTAUT) كنماذج سائدة في قبول التكنولوجيا في مجال الرعاية الصحية. بالإضافة إلى ذلك ، تم تحديد 11 عاملاً من نماذج القبول المختلفة و التي تم فحصها على نطاق واسع بغرض فهم وتحليل قبول التكنولوجيا في مجال الرعاية الصحية. تشمل هذه العوامل الأداء المتوقع (الفائدة المرجوة) ، الجهد المتوقع (سهولة الاستخدام) ، التأثير الاجتماعي، تسهيل الظروف ، الموقف تجاه القبول ، النوايا السلوكية ، سلوك الاستخدام ، القلق من استخدام الكمبيوتر ، الفعالية الذاتية لإستخدام الكمبيوتر ، الابتكار ، والثقة. بالإعتماد على الثغرات الموجودة في الأدبيات ، قدم هذا البحث دراسة حالة لحل إدارة قوائم الانتظار (QMS) المطبق حاليًا في قسم العيادات الخارجية (OPD) في إحدى مؤسسات الرعاية الصحية في

دولة الإمارات العربية المتحدة. كما ناقش البحث الأعمال المقترحة والتحسينات التقنية التي تشمل عملية ربط الكتروني لنظام إدارة قوائم الإنتظار مع نظام السجلات الطبية الإلكترونية (EMR). تم تنفيذ الربط الالكتروني بإستخدام معايير تكامل المستوى السابع (HL7) ، بما يشمل تبادل رسائل XML و HL7 المصممة خصيصًا. كان الهدف من من الربط الإلكتروني و التكامل هو تطبيق حل جديد لتسجيل الوصول الذاتي للمريض وتعزيز سهولة الاستخدام وخصائص فائدة نظام إدارة قوائم الإنتظار. كتطبيق تجريبي ، تم تقييم جدوى الحل المقترح حديثًا من خلال تجربة محاكاة في عيادة الطب الباطني على مدى أسبوعين مختلفين (التحكم والتدخل). تم تحديد ما مجموعه 127 موعد على أنها مؤهلة وتم تضمينها في الدراسة. تم تقسيم رحلة المريض إلى خمس مراحل: تحديد الوصول ، وانتظار الفحص الأولي ، وعملية الفحص الأولي ، وانتظار العلاج، وعملية العلاج. كشفت النتائج قدرة الحل المقترح على تحقيق الفائدة المرجوة منه، و ذلك من خلال اللإنخفاض الواضح في متوسط الوقت اللازم لإتمام العمليات السابق ذكرها في رحلة المريض.

لتقييم قبول و استخدام نظام إدارة قوائم المرضى المحسن ، يسعى البحث إلى تطوير نموذج جديد و متكامل لقبول التكنولوجيا في مجال الرعاية الصحية و يعتمد على تكامل العوامل المستخرجة من النماذج النظرية المختلفة ، بما يشمل نظريات UTAUT و TAM والنظرية المعرفية الاجتماعية (SCT) بالإضافة الى عاملي الثقة والابتكار كعوامل خارجية. تم التحقق من صلاحية النموذج تجريبياً باستخدام منهج (PLS-SEM) استنادًا إلى البيانات التي تم جمعها من خلال استبيان من 242 متخصصًا في الرعاية الصحية. باختصار ، كشفت النتائج أن النموذج المقترح يمكن أن يكون مفيدًا في استكشاف قبول تقنيات المعلومات في الرعاية الصحية. حيث استطاع النموذج من تحقيق ما نسبته 66.5٪ من التباين الإجمالي في النية السلوكية لاستخدام نظام إدارة قوائم الانتظار ، إلى جانب تحقيق ما نسبته 59.3٪ من التباين الإجمالي للاستخدام الفعلي لنظام إدارة قوائم الانتظار. أشارت النتائج إلى أن عوامل الابتكار والكفاءة الذاتية لاستخدام الكمبيوتر لها تأثير إيجابي كبير على الجهد المتوقع للمهنيين لاستخدام نظام إدارة قوائم الانتظار، بينما كان لعامل القلق من استخدام الكمبيوتر تأثير سلبي كبير على الجهد المتوقع لاستخدام نظام إدارة قوائم الانتظار. إلى جانب ذلك ، فإن عاملي الثقة والكفاءة الذاتية لاستخدام الكمبيوتر قد أظهرا تأثيرا إيجابيا كبيرا على تحسين الأداء المتوقع عند استخدام نظام إدارة قوائم الانتظار. في النهاية، سيعمل هذا البحث على توضيح ومناقشة النتائج الأخرى ، والآثار ذات الصلة ، والقيود ، إلى جانب اقتراحات و اتجاهات البحث في المستقبل.

Dedication

I dedicate this thesis to the people who gave me everything, believed in me and supported me in every stage in my life. To my parents with love, my wife, my brothers, my sisters, and of course to my cute funny daughter, Laura.

Acknowledgement

By the name of God. Praises and thanks to the almighty for his uncountable graces. I would like to express my respect and appreciation for my research 1st supervisor, Prof. Khaled Shaalan, for his continuous support and guidance. His vision, wisdom, motivation, and massive knowledge have deeply encouraged me. Without him, this thesis would not have been possible. As well, I would like to pass my sincere and deep gratitude to my 2nd supervisor, Dr. Mostafa Al-Emran. His encouragement, honesty, analytical thinking, and experience helped me a lot to achieve this task successfully.

Furthermore, I will be forever grateful for my family for being there when I needed them, specifically my parents for their encouragement, prayers, and unstoppable love. As well, I also express my deepest appreciation to my best friend “Omar Abu Sheikha” for his support and inspiration in the tough times during this journey. Special thanks with love to my dearest wife Sarah, who suffered the most because of my swinging moods, and my work schedule at the weekends. You have always been the sparkling light in the dark nights.

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List of Abbreviations

Abbreviation	Meaning
QMS	Queue Management Solutions
EMR	"Electronic Medical Records" Solution
EID	"Emirates Identification" Card
IBM	"International Business Machines" Corporation
SPSS	Statistical Package for the Social Sciences – Series of Software Packages Used for Data Analysis
PLS – SEM	Partial Least Squares - Structural Equation Model
Healthcare Professionals	Physicians, nurses, pharmacists, clinical technicians and receptionists
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
SCT	Social Cognitive Theory
TIB	Theory of Interpersonal Behavior
PCIT	Perceived Characteristics of Innovating Theory
TPB	Theory of Planned Behavior
MPCU	Model of PC Utilization
DIT	Diffusion of Innovation Theory
MM	Motivational Model
PE	Performance Expectancy
EE	Effort Expectancy
SI	Social Influence
SN	Subjective Norm
FC	Facilitating Conditions
AT	Attitude Towards
INV	Innovativeness
TRU	Trust
CSE	Computer Self-Efficacy
ANX	Computer Anxiety
BI	Behavioral Intention
UB	Use Behavior
AU	Actual Use
SRMR	Standard Root-mean Square Residual
NFI	Normed Fit Index
RMS_{theta}	Root Mean Squared
d_{ULS}	The Squared Euclidean Distance
d_G	The Geodesic Distance
CMB	Common Method Bias
VIF	Variance Inflation Factor

List of Publications

Sr.	Title	Publication Venue	Type	Status
1	The Role of Technology Acceptance in Healthcare to Mitigate COVID-19 Outbreak	Emerging Technologies During the Era of COVID-19 Pandemic (Scopus Indexed)	Book Chapter	Published
2	Technology acceptance in healthcare: A systematic review	Applied Sciences (ISI Web of Science (IF = 2.679) and Scopus Indexed)	Journal Article	Published
3	Extending UTAUT to Understand the Acceptance of Queue Management Technology by Physicians in UAE	ICETIS 2021 (Scopus Indexed)	Conference	Accepted
4	Towards an integrated model for examining the factors affecting the acceptance of queue management solutions in healthcare	Multimedia Tools and Applications	Journal Article	Under Review
5	Medical data integration using HL7 standards for patient's early identification	PlosOne Journal	Journal Article	Under Review

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Chapter 1

Introduction

Objectives

- Research Introduction and Motivation.
- Clarify Aims, Objectives and Research Questions.
- Describe The Key Contribution and Research Methodologies.
- Describe The Thesis Structure.

1. Introduction

A comprehensive overview of the research will be presented in this chapter. This chapter will discuss the definition of the research problem along with the motivation and objectives. Also, the chapter includes an explanation for the research questions, the employed methodology, assumptions, and the faced limitations. Finally, the dissertation outline and chapters are provided in this chapter.

1.1. Overview

Due to the boom in information technologies, it became broadly recognized to implement and use technology in healthcare organizations worldwide. This research focuses on the acceptance of information technology in the healthcare field, specifically the acceptance of Queue Management Solutions (QMS) in the healthcare domain as an effective tool to organize the patients' visits and scheduled appointments.

Understanding the needs and requirements of a software solution can lead to an efficient implementation of a solution and its related acceptance factors. Therefore, this research is going to concentrate on understanding the technology acceptance factors among healthcare professionals. It will explore a set of factors from different widespread theories, those where should be considered when planning to implement and use technology in the healthcare field.

The basic framework for the research was studying various technology acceptance models, specify the prevailing acceptance models, extract the most utilized factors, and their relationships. Then the research presented a novel integrated theoretical model for technology acceptance in healthcare, and finally validate the acceptance of QMS through the novel model.

1.2. Research Motivation

Healthcare professionals in developing countries spend much time and efforts in order to handle manual tasks. For instance, it took physicians in developing countries much time and effort to handle manual prescriptions, which is simply can be reduced by using online technologies (Khan et al. 2018).

It is crucial for healthcare organizations to assess the acceptance of information technologies by end users, this will help to evaluate the level of success in their experiments and investments in information technologies. The response of healthcare professionals to the usage of information technology is a significant research topic that can partially clarify the level of success or failure of any health information technology (Ketikidis et al. 2012). It was pointed out by (Khan et al. 2018) that despite the various proposed and discussed technology acceptance models, the literature regarding their use and application in healthcare in developing countries is still limited and sparse, especially when it comes to apply innovative integrated models.

Analyzing the information technology literature is one of the key purposes for this research, where that literature is linked to the applied technology acceptance models in the recent decade. Besides, the research is aiming to understand the role of QMS in healthcare, and its responsibilities in organizing the patients' appointments and journey. Long waiting list of patients in healthcare is challenging and notorious issue, so there is a need to understand the patient flow as a complex phenomenon due to the random nature of services and time of arrival (Lade, Choriwar & Sawaitul 2013), and to find practical solutions for the ongoing issue.

Also, this research will develop a novel integrated model to include the key constructs that impact the information technology adoption in healthcare. Many studies have been discussed the adoption and acceptance of technology in healthcare in developing countries (Miiro & Maiga 2015; Amin et al. 2017; Nematollahi et al. 2017; Aldosari et al. 2018; Martins et al.

2018; Tubaishat 2018). Nevertheless, there is limited number of empirical technology acceptance researches that focuses on the technology acceptance in UAE (Alhashmi, Salloum & Abdallah 2020) and especially in healthcare (AlQudah, Al-Emran & Shaalan 2021b; AlQudah, Salloum & Shaalan 2021; AlSuwaidi & Moonesar 2021; AlQudah & Shaalan 2022). These reasons play critical role to conduct the research in the healthcare domain in the UAE to fill these literature gaps.

1.3. Problem Definition

Technology acceptance is crucial to signify the positive perception towards using an innovative technology solution (Taherdoost 2018, 2019). As a part of the human-computer interaction field, it is important to explore the determinants that affect the acceptance or rejection of a particular technology (Al-Emran & Granić 2021).

Hundreds of studies have discussed the acceptance of various information technologies in different domains and settings. The acceptance of multiple technologies was discussed, including smart wearable devices (Özdemir-Güngör et al. 2020; Arpaci et al. 2021), cryptocurrency (Alzahrani & Daim 2021), telehealth (Zhou et al. 2019), google translation tool (Al-Maroof et al. 2020), and WhatsApp messaging platform (Al-Maroof, Arpaci, et al. 2021). Also, the involved domains include but are not limited to: education (Al-Maroof, Alshurideh, et al. 2021; Al-Qaysi, Mohamad-Nordin & Al-Emran 2021), banking (Al-Saedi & Al-Emran 2021; Zhang et al. 2021), transportation (Wang, Wang, et al. 2020), data management (Cabrera-Sánchez & Villarejo-Ramos 2019; Rahman, Daim & Basoglu 2021), and healthcare (Basoglu et al. 2018; Özdemir-Güngör et al. 2020).

Worldwide, information technology becomes vital aspect of the healthcare system and it is gaining further attention (Alzahrani & Daim 2019). So, this research focuses on the acceptance of technologies in the healthcare domain. In general, technology acceptance in healthcare was

examined in many studies, and the healthcare professionals' attitude towards using different technologies was discussed extensively. However, the current literature did not adequately discuss the acceptance of using queue management solutions (QMS) by healthcare professionals in healthcare organizations. This research studies the most extensively used technology acceptance models and their constructs in the healthcare field. Those constructs are to be used to build a novel integrated technology acceptance model in healthcare and adapt it to explore the acceptance of QMS by various healthcare professionals. Moreover, patients are facing the issue of long waiting times in the outpatient department in healthcare organizations, and there is a need to present innovative solutions to minimize the waiting times and provide better medical services.

1.4. Aims and Objectives

This research pursues to investigate the applied and studied technology acceptance models in healthcare field in the recent decade, along with their related sets of factors that could have significant impact on the perceptions of healthcare professionals regarding the acceptance and usage of technology. These factors to be combined in order to develop an integrated theoretical model to accept technology in healthcare.

Moreover, it is essential to develop innovative solutions in healthcare to provide better health services, so the research will present a thorough analysis for the integration between Queue Management Solutions (QMS) and Electronic Management Records (EMR). Consequently, the research will report the development of an innovative solution to apply patient's self-check-in using Emirates Identification Card (EID). A simulation experiment will be conducted to explore the benefits and feasibility of that innovative solution in terms of reducing the patients' waiting times in the outpatient departments. Finally, the constructed integrated theoretical model aims to evaluate the acceptance of the proposed enhanced queue management solution by various

healthcare professionals in the UAE. This evaluation can be recognized as a base to evaluate queue management solutions or other technology solutions in the healthcare domain.

As a result, the objectives to achieve can be summarized as below:

1. To conduct a systematic review to explore the literature gaps and study the extensively used influential factors in the recent literature on technology acceptance in the healthcare context.
2. To develop an integrated model for measuring the actual use of queue management solutions in healthcare.
3. To empirically evaluate the developed healthcare integrated technology acceptance model through statistical analysis methods.

1.5. Research Questions

To achieve the abovementioned objectives, the research should answer the following questions:

1. What are the research gaps in the existing literature and the common factors influencing the acceptance of technology in the healthcare domain?
2. Which theoretical model is most appropriate for measuring the actual use of queue management solutions in healthcare?
3. How well does the proposed model capture the healthcare professionals' use of queue management solutions?

1.6. Key Contributions

The key contributions of this thesis can be summed up as below:

- ✓ Provide a systematic review of the literature of technology acceptance in the healthcare domain.

- ✓ Study the extensively used technology acceptance models and influential factors in the last decade regarding the adoption and acceptance of technology by healthcare professionals.
- ✓ To develop an integrated theoretical Model for technology acceptance in healthcare domain.
- ✓ Propose set of optimizations to enhance the currently implemented queue management solution in healthcare organization in UAE.
- ✓ Propose an innovative solution for patient's self-check-in using Emirates ID by achieving the integration between the queue management solution and the electronic medical records (EMR).
- ✓ Conduct simulation experiments to explore the feasibility of the implemented optimizations and the self-check-in solution and their ability to reduce the time and efforts spent through the patients' journey.
- ✓ Adapt the developed integrated technology acceptance model to empirically evaluate it by assessing the acceptance of the enhanced queue management solution in healthcare organization in the UAE and through set of statistical analysis methods.

1.7. Outline of Dissertation

The dissertation has been structured as below:

- **Chapter 1: Introduction**

This chapter will introduce an overview for the research, research problem definition along with the motivations that led to conduct the research. Also, the chapter will provide the aims, developed questions and the methodology to be followed in order to fulfil the research aims.

- **Chapter 2: Literature Review**

The chapter will include a systematic literature review to explore the existing literature regarding the technology adoption and acceptance in the healthcare domain. As well, the chapter will study the key acceptance models and their related constructs that have impact on the acceptance of technology in healthcare; where these constructs will be utilized to build the new hybrid integrated model for technology acceptance in healthcare.

On the other hand, the chapter will explore the Queue Management Solution, its functions, key features and role in various domains; especially the healthcare. Also, the importance and features of Electronic Medical Records will be analyzed in this chapter. Finally, the chapter will review the integration through the Health Level Seven International Standards (HL7), and its crucial role to integrate the information technology solutions as a unified system in the healthcare domain.

- **Chapter 3: QMS and Integration with EMR**

This chapter will be responsible to present the case study of healthcare organization, the integration between Queue Management solution (QMS) and Electronic Medical Records (EMR), through using the Health Level Seven International Standards (HL7). Also, this chapter will provide a thorough explanation about the developed innovative solution for patient's self-check-in, along with the prospected benefits for the solution.

- **Chapter 4: QMS - Simulation Experiment**

An explanation to be provided for the conducted simulation experiment to validate the innovative solution in this solution. The chapter will present how the experiment was conducted, experiment settings, timeframe, results as compared to the targets, and how these results can help to understand the feasibility of the solution.

- **Chapter 5: Research Model and Hypotheses**

The chapter will be responsible to present the employed approach to examine the widely used technology acceptance models in healthcare and their constructs. The chapter will discuss the most confirmed relationships between those constructs, and the validation of these relationships by other researchers. Finally, the chapter will include the development of hypotheses and research model as a theoretical foundation to conduct this research.

- **Chapter 6: Research Methodology**

The employed methodology and study instrument to conduct this research will be defined in this chapter. The chapter will explain the survey structure. Also, it will give details about the developed questionnaire, target population, and data collection.

- **Chapter 7: Results and Discussion**

In this chapter, the findings of the study will be reported. The chapter to explain extensively how the collected surveys were analyzed. In addition, the analysis techniques that can help to fit the study theoretical model with the collected data to be presented, and the creation for the final study model. Then, the research hypotheses to be validated and results will be illustrated.

- **Chapter 8: Conclusions**

This chapter to include the research limitations, the theoretical and practical implications, and conclusions. Finally, the chapter will provide the suggested recommendations and future work that can be achieved in future studies.

Chapter 2

Literature Review

Objectives

- Systematic Literature Review for the Technology Acceptance Model (TAM) in healthcare.
- Review the Queue Management solutions (QMS) and key features.
- Review the Health Level Seven International Standards (HL7).
- Explore the Literature Gaps.

2. Literature Review

2.1. Overview

This chapter will present a review for the literature of technology acceptance in the healthcare domain, an overview of the queue management technology, electronic medical records, and the integration in the healthcare domain.

Mainly, the chapter discusses the utilized methodology to assess the extensively used constructs in various technology acceptance models with regards to technology adoption in the healthcare domain. A total number of 142 studies that have been published from 2010 till 2019 were considered and analyzed as a part of a systematic review of the existing literature. These 142 studies are concerned about the acceptance of different information technologies within the healthcare field. The findings of analysis showed that the widely used constructs that impact the acceptance of technology in healthcare, were mainly the constructs of The Unified Theory of Acceptance and Use of Technology (UTAUT), Technology Acceptance Model (TAM), Social Cognitive Theory (SCT) along with two external factors: innovativeness and trust. The way how those constructs and factors affect each other and the acceptance of technology in healthcare were analyzed, through different types of technology and users (professionals) in healthcare.

A statistical classification analysis of different technology acceptance models was achieved using 142 published studies in order to offer ample data to be authentic. According to the results, it is not possible to say that one technology acceptance model is enough, robust and valid to be used widely and standalone. It is mandatory to consider the integration of constructs from different acceptance models, in order to construct an integrated models to accept technology in

the healthcare domain. The constructed integrated model can be applied to assess the acceptance of different technologies in healthcare by specific user type or various types in a general context.

2.2. Technology Acceptance Models

Technology acceptance is defined as an opposite to the term rejection, where it signifies the positive decision towards using an innovative solution (Taherdoost 2018, 2019). Technology acceptance is concerned about the psychological status of a person regarding the intention to use a specific technology (Chau & Hu 2002). The user's acceptance of technology is significant at any time and not only at the design phase or directly after implementation. Non-stop changes will occur in the information systems, their designs, working environments, and potential users. Users' needs may also differ due to these changes, especially those in the business requirements, which can negatively impact the system's levels of suitability (Mathieson 1991).

In general, various theoretical models and extensions have been proposed and discussed in order to understand and assess the acceptance and behavior that are related to technology in different disciplines (Rahimi et al. 2018). These acceptance models have introduced various factors that have an influence on the user's acceptance of technology. These models include, the Theory of Reasoned Action (TRA) (Fishbein & Ajzen 1975), Technology Acceptance Model (TAM) (Davis 1985, 1989; Davis, Bagozzi & Warshaw 1989), Extensions of TAM (TAM2/TAM3) (Venkatesh & Davis 2000; Venkatesh & Bala 2008), Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003), Social Cognitive Theory (SCT) (Bandura 1977, 1986), Theory of Interpersonal Behavior (TIB) (Triandis 1977), Perceived Characteristics of Innovating Theory (PCIT) (Moore & Benbasat 1991), Theory of Planned Behavior (TPB) (Ajzen 1985), Model of PC Utilization (MPCU) (Thompson, Higgins & Howell 1991), Diffusion of Innovation Theory (DIT) (Rogers 1995), Motivational Model (MM) (Davis, Bagozzi & Warshaw 1992), And Igbaria's Model (Igbaria, Schiffman & Wieckowski 1994).

Among the aforementioned theories and models, TAM is recognized as the gold standard model (Holden & Karsh 2010; Kim et al. 2016). On the other hand, UTAUT has shown (20-30%) better explanatory power than TAM, which means (40-50%) of the explanatory power regarding the behavior intention of end-users (Venkatesh et al. 2003; Kim et al. 2016). UTAUT model is known as the most relevant (Bennani & Oumlil 2013) and the most actively used in the technology acceptance studies in the healthcare domain (Bennani & Oumlil 2013; Perlich, Meinel & Zeis 2018).

2.3. Technology Acceptance in Healthcare - Systematic Review

It is noticeable that the information technologies are continuously getting expanded in healthcare (Blackwell 2008). Information technology is important to enhance the quality of healthcare services, improve patient safety and satisfaction. Besides, the staff as users for the technology in the healthcare domain are essential since the information technologies play a vital role in increasing the levels of their work efficiency and effectiveness (Rahimi et al. 2018). That is why it is crucial to determine and understand how people react to the emergence of new technologies or advancements. The low levels of acceptance for particular information technology can lead to failure or delay in implementing that technology. Also, the lack of technology acceptance in healthcare can negatively impact its key objectives (Ketikidis et al. 2012).

Over the years, the acceptance of different information technologies and applications were explored in the healthcare field. These technologies include, internet-based health websites (Boon-itt 2019), smart watches (Al-Maroof, Alhumaid, et al. 2021), picture archiving and communication systems (PACs) (Ahmadi et al. 2017), Web 2.0, mobile applications (Ketikidis et al. 2012), telemedicine technologies, and electronic health records (Venugopal et al. 2019). This study aims to systematically review the studies that empirically evaluated the different

technologies in healthcare with relation to technology acceptance models and theories. Stemming from this aim, the systematic literature review intends to answer the following questions:

- What are the prevailing technology acceptance models and theories explored in the healthcare domain?
- What are the key factors affecting technology acceptance in the healthcare domain?
- What are the main confirmed relationships among the influential factors in the past studies?
- What are the leading information technologies studied, and their relationships with countries and participants?
- How are the reviewed studies distributed across the regions and countries of technology implementation?
- What is the progress of technology acceptance studies in healthcare?

Answering the abovementioned questions will help to build a general comprehensive insight about the status of the current literature of technology acceptance in healthcare, achieve the classification analysis, and accordingly facilitate building the right acceptance model to understand the acceptance of technologies in healthcare. On the other hand, several reviews were conducted to analyze the technology acceptance models and their related constructs/factors in healthcare. It is impossible to ignore those reviews. As seen in Table 1, most studies have focused on the acceptance of specific technology instead of multiple technologies. The reviews have mainly discussed one specific technology acceptance model except for two review studies (Peek et al. 2014; Vaezipour et al. 2019). Besides, only one study focused on the classification of studies based on the examined technologies, participants, and country of implementation (Rahimi et al. 2018).

A review of the previous relevant literature is a vital phase of any scientific study. Generally, reviews can simplify and extend the theory development, filling the gap wherever more research is required or close areas where a profusion of research exists (Marangunić & Granić 2015). A systematic review is helpful to make researchers more familiar with the research topic (Almansoori et al. 2021) and previous theories. Systematic reviews are different from traditional or narrative reviews since systematic reviews are more rigorous and provide a well-defined approach to review a particular subject area (Almansoori et al. 2021).

Moreover, it is beneficial to have a general literature review that can explore multiple technology acceptance models instead of focusing on one acceptance model (e.g., TAM). Also, reviewing different information technologies instead of only one technology (e.g., electronic medical records) is important to recognize if there is a plethora or gap in the research. Therefore, this review study attempts to present a fresh overview of the literature of technology acceptance in the healthcare domain by classifying the collected studies based on the utilized technology acceptance models, the studied information technologies, participants, and countries of implementation. Additionally, the study aims to identify the prevailing acceptance models, the most utilized factors along with the most confirmed relationships to address the literature gaps and assist further research to build integrated models for technology acceptance in the healthcare domain.

Table 1. Previous Review Studies – Technology Acceptance in Healthcare.

Source	Multiple Models	Multiple Technologies	Databases	Coverage	Aim
(Holden & Karsh 2010)	-	✓	16 datasets (Names not reported)	Before July 2008	Literature review of 20 articles to study the application of TAM in the healthcare domain.
(McGinn et al. 2011)	-	-	PubMed, EMBASE, CINAHL, Business Source Premier, Science Citation Index, Social Sciences Citation Index, Cochrane	1999 - 2009	Systematic review for 60 studies to explore the barriers and facilitators to EHR implementation.

			Library, ABI/Inform, and PsychINFO		
(Gagnon, Desmartis, et al. 2012)	-	✓	MEDLINE, EMBASE, CINAHL, Cochrane, Ovid, DARE, Biosis Previews, PsycINFO, HSTAT, ERIC, ProQuest, ISI Web of Knowledge, LILACS, and Ingenta	1990 - 2007	Systematic review for 101 studies to explore the factors that facilitate or limit the implementation of ICTs in clinical settings.
(Mair et al. 2012)	-	✓	MEDLINE, EMBASE, CINAHL, PSYCINFO, and the Cochrane Library	1995 - 2009	Systematic review for 37 review studies to identify the barriers and facilitators to e-health implementation and outstanding gaps in the literature.
(YUCEL, GULBAHAR & Yasemin 2013)	-	✓	Science Direct, Springer, TÜBĐTAK EKUAL, Taylor & Francis, EBSCO Host, and Blackwell	1999 - 2010	Qualitative review to analyze 50 articles to study the possible predictors of TAM.
(Peek et al. 2014)	✓	✓	ACM Digital Library, CINAHL, IEEE Xplore, MEDLINE, PsycINFO, Scopus, and Web of Science	Not Specified	Systematic review for 16 studies to provide an overview of factors that influence the acceptance of electronic technologies that support older adults.
(Gagnon et al. 2016)	-	-	PubMed, EMBASE, CINAHL, PsychINFO	2000 - 2014	Systematic review for 33 studies to explore the factors influencing healthcare professionals' adoption of mobile health applications.
(Yusif, Soar & Hafeez-Baig 2016)	-	-	Google Scholar	2000 - 2015	Systematic review for 44 studies to review the main barriers to adopt assistive technologies by older adults.
			Med-line, Embase, CINAHL, PsycINFO, and Scopus	1976 - 2015	
(Rahimi et al. 2018)	-	✓	Web of Science, PubMed, and Scopus	1989 - 2017	Systematic review to analyze 134 TAM-based studies in the health information systems. The study aims to understand the existing research and debates as relevant to TAM in the healthcare domain.
(Vaezipour et al. 2019)	✓	✓	Medline, Embase, CINAHL, Cochrane, Scopus, and Web of Science	1998 - 2018	Systematic review for 13 studies to identify the methods utilized to assess the users' acceptance of rehabilitation technologies for adults with moderate to severe Traumatic Brain Injury.
This Review	✓	✓	PubMed, IEEE Xplore, Springer, ACM, Science Direct, and Google Scholar	2010 - 2019	Systematic review that includes 142 studies for technology acceptance in healthcare to classify the studies based on the technology acceptance models, the studied information technologies, participants, and countries of implementation. The study also aims to identify the prevailing acceptance models, most utilized factors, and the most confirmed relationships to address

					the literature gaps and help to build integrated models for technology acceptance in the healthcare domain.

2.3.1. Systematic Review Methodology

This thorough review is based on the findings obtained from studies published in different digital journals and databases to empirically discuss and explore technology acceptance in healthcare. As presented in Figure 1, the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) have been applied to conduct this review (Moher et al. 2009, 2015; Al-Emran et al. 2018; Abu Saa, Al-Emran & Shaalan 2019). The methods used to identify and collect the relevant studies in this review included different phases: define the inclusion/exclusion criteria, determine the sources and digital databases, specify the search strategies, and conduct the classification analysis for the retrieved studies.

2.3.1.1. Inclusion / Exclusion Criteria

The inclusion and exclusion criteria are defined to set the selection rules for studies before the analysis phase (see Table 2). The specified criteria are crucial to decide whether the study is valid to be included in the next stages of analysis and ensure consistency in the reviewed studies.

Table 2. Inclusion and Exclusion Criteria.

ID	Inclusion Criteria	Exclusion Criteria
1	The objective of the study should be related to the application of technology acceptance theories in healthcare.	The study is related to the application of technology acceptance or adoption but not in healthcare (e.g., banking).
2	The research model and its related hypotheses were empirically evaluated.	The research model was evaluated using a qualitative method or not even evaluated.
3	The study type to be a journal article, conference paper, book chapter, Ph.D. dissertation, or master's thesis.	The study type is a review, position paper, editorials, etc.
4	The study must be published in the English Language.	The study is published in languages other than English.

2.3.1.2. Data Sources and Search Strategy

The studies have been identified through the exploration of six digital databases, including PubMed, IEEE Xplore, ACM digital library, Springer, Science Direct, and Google Scholar. The selected databases were searched to collect studies that have been published between January 2010 and December 2019 (10 years), where the search was conducted in January 2020. A search strategy was developed using specific search keywords, as presented in Table 3. By following the developed search keywords and strategy, the results of the initial search showed a total number of 1768 studies, as seen in Figure 1 and Table 4. In that, the inclusion and exclusion criteria were applied and the refinement stages as per the PRISMA were followed.

Table 3. Summary of Search Keywords.

Search Keywords	
1	("Technology Acceptance") AND (Healthcare OR Health OR Medical OR Physician OR Nurse OR Patient)
2	("Technology Adoption") AND (Healthcare OR Health OR Medical OR Physician OR Nurse OR Patient)
3	("Technology Acceptance") AND (Healthcare OR Health OR Medical OR Physician OR Nurse OR Patient) AND ("Intention to use" OR "Actual use")
4	("Technology Adoption") AND (Healthcare OR Health OR Medical OR Physician OR Nurse OR Patient) AND ("Intention to use" OR "Actual use")

Table 4. Initial Search Results.

ID	Digital Library	Code	Frequency
1	Google Scholar	GS	244
2	Springer Link	SPL	527
3	ACM Digital Library	ACM	280
4	Science Direct	SD	315
5	PubMed	PM	174
6	IEEE Xplore	IEX	228
Totals			**1768 Studies***

*Final search has been conducted on 10th of January 2020

2.3.1.3. Data Abstraction and Analysis

All citations have been downloaded into Mendeley reference manager (Mendeley Ltd 2020). The characteristics of the research methodology have been coded to include (i) the studied technology acceptance model, (ii) the included factors in the study, (iii) the confirmed relationships between the factors as hypothesized in the research model (main findings), (iv) types of the studied information technologies, (v) participants, (vi) digital library (database), (vii) year of publication, and (viii) country (direction of research). The filtration process for the studies started by quick screening the title, then the abstract. If the study has passed the first two rounds of screening, then the full papers will be obtained and recorded in a different folder for the full and final round of review. The data were extracted through three stages. The first phase was to determine the used theory to explore the factors that impact the acceptance of specific technology in healthcare requirements. The second phase was to categorize the studies based on the year of publication, type of publication, country of origin. The third stage was to obtain the studied factors, understand the developed hypotheses between these factors, and analyze the findings.

After the removal of 549 duplicates, 1219 publications were sent out to the screening process. The titles and abstracts were assessed for the 1219 publications. The results of screening confirmed the exclusion of 916 records due to their incompatibility with the inclusion criteria, as seen in Figure 1. The full-texts of 303 studies were then scanned to ensure their relevance to the subject of this study. The final number was 142 studies, which were found eligible to be analyzed and included in the study.

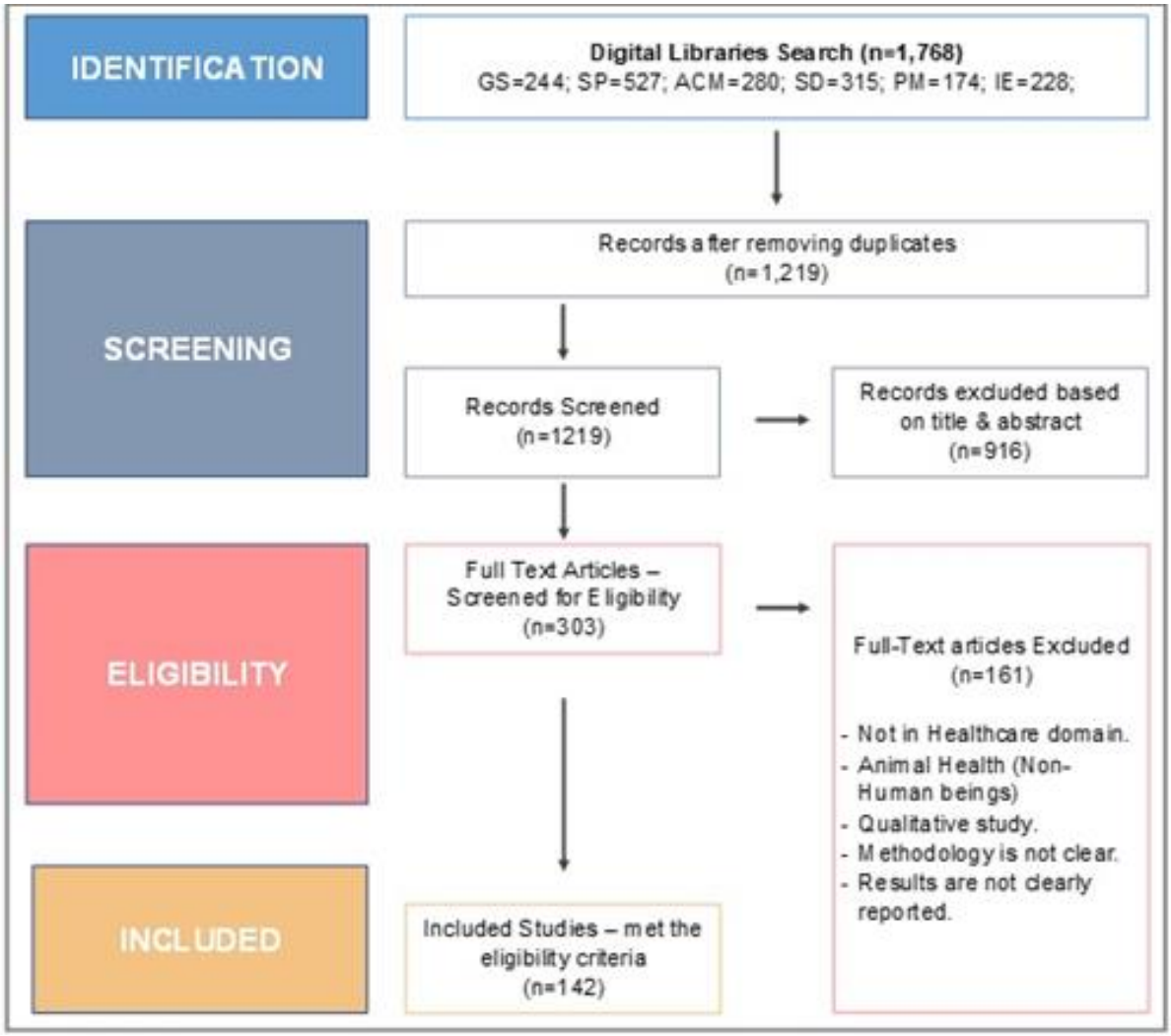

Figure 1. The Prisma Flow Diagram for Selection Process of Studies.

2.3.1.4. Quality Assessment

It is crucial to assess the quality of the collected studies (Al-Emran, Mezhuyev & Kamaludin 2018). Therefore, a quality assessment checklist was designed to include seven items to evaluate the quality of the eligible research studies (N=142). As seen in Table 5, the checklist had no intention to criticize the work of any researcher (Kitchenham & Charters 2007). The designed checklist was conformed to what was suggested in prior research (Kitchenham & Charters 2007; Al-Emran et al. 2018; Al-Qaysi, Mohamad-Nordin & Al-Emran 2020). The checklist is based on a 3-point scale from 0 to 1, where 0 means No, 0.5 as Partially, and 1 as Yes. A snapshot for the results of the quality assessment can be seen in Table 6. The full set of

results is presented in Appendix A. In general, all the included studies have passed the quality assessment (above 50%), and were considered valid to be furtherly analyzed.

Table 5. Quality Assessment Checklist.

Sr.	Question
1	Does the research have clear aims and objectives?
2	Do the technology model and its constructed hypotheses, are well-specified?
3	Are the data collection methods appropriately detailed?
4	Does the study explain the reliability and validity of the measures?
5	Are the statistical techniques utilized to analyze the data well-clarified?
6	Do the findings add to the literature?
7	Does the study add to the readers' knowledge or understanding?

Table 6. Snapshot for the Results of Quality Assessment.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	Percentage	Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	Percentage
S1	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S72	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S2	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S73	1	1	0.5	0.5	0.5	1	1	5.5	78.6%
S3	1	1	0.5	0.5	0.5	1	1	5.5	78.6%	S74	1	1	1	1	1	0.5	0.5	6	85.7%
S4	1	1	1	1	1	0.5	0.5	6	85.7%	S75	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S5	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S76	1	1	0.5	1	0.5	1	1	6	85.7%
S6	1	1	0.5	1	0.5	1	1	6	85.7%	S77	1	1	0.5	1	1	0.5	0.5	5.5	78.6%
S7	1	1	0.5	1	1	0.5	0.5	5.5	78.6%	S78	1	1	0.5	0.5	1	0.5	0.5	5	71.4%
S8	1	1	0.5	0.5	1	0.5	0.5	5	71.4%	S79	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S9	1	1	0.5	1	0.5	1	0.5	5.5	78.6%	S80	1	1	1	1	1	0.5	0.5	6	85.7%
S10	1	1	1	1	1	0.5	0.5	6	85.7%	S81	1	1	1	0.5	0.5	0.5	0.5	5	71.4%

2.3.2. Results of Systematic Review

The results of the review provided a detailed classification analysis of the recent literature on technology acceptance in healthcare. Table 7 presents a snapshot of the included studies, the comprehensive list for all the included studies can be found in Table 34 in Appendix B. Appendix C presents the summary of the factors and confirmed relationships in the studies that based on TAM, while Appendix D presents the summary of the factors and confirmed relationships in the studies that based on acceptance models other than TAM.

Table 7. Summary of the Included Publications.

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
1	Bennani & Oumlil (Bennani & Oumlil 2010)	2010	Conference	ICT Appropriation	111	Physicians & Nurses	Morocco	TAM
2	Lai & Li (Lai & Li 2010)	2010	Conference	Computer Assistance Orthopedic Surgery System	115	Healthcare Professionals	Taiwan	Integrated Model: TAM & TPB
3	Kim et al. (Kim et al. 2010)	2010	Journal Article	Tele-homecare Technology (Telemedicine)	40	Physicians	USA	Compare Two Models: TAM & TPB
4	Holtz (Holtz 2010)	2010	PHD Dissertation	Electronic Medical Records	113	Nurses	USA	UTAUT
5	Pai & Huang (Pai & Huang 2011)	2011	Journal Article	Healthcare Information Systems	366	Nurses, Head Directors, and other related personnel	Taiwan	Integrated Model: TAM & IS success model
6	Orruño et al. (Orruño et al. 2011)	2011	Journal Article	Tele-dermatology System	171	Physicians	Spain	Modified TAM
7	Maarop et al. (Maarop et al. 2011)	2011	Conference	Teleconsultation Technology	72	Healthcare Providers	Malaysia	Extended TAM
8	Schnall & Bakken (Schnall & Bakken 2011)	2011	Journal Article	Continuity of Care Record (CCR) with Context-specific Links	94	HIV Case Managers	USA	Extended TAM
9	Kowitlawakul (Kowitlawakul 2011)	2011	Journal Article	eICU Telemedicine Technology	117	Registered Nurses	USA	Telemedicine TAM (TTAM) – Extended TAM
10	Damanhoori et al. (Damanhoori et al. 2011)	2011	Conference	Breast Self-Examination Teleconsultation	279	Female Citizens	Malaysia	TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
11	Lim et al. (Lim et al. 2011)	2011	Journal Article	Mobile Phones to seek Health Information	175	Female Citizens 21+	Singapore	Extended TAM

According to the analyzed 142 studies, the findings of the study can be summarized based on the previously mentioned questions:

1. **Prevailing technology acceptance models and theories in the healthcare domain**

   As mentioned earlier, many technology acceptance models have been discussed in different domains, including healthcare. In table 7, the reviewed studies have been classified based on the studied acceptance model. As seen in Figure 2, the TAM, its extensions, and modifications are leading the research of technology acceptance in healthcare in the last 10 years (N= 76) (Gajanayake, Sahama & Iannella 2013; Hsu & Wu 2017; Lin et al. 2018; Özdemir-Güngör & Camgöz-Akdağ 2018). It was also found that a number of studies (N=21) have discussed the integration between TAM and other technology acceptance models (e.g., UTAUT, TPB) (Sarlan, Ahmad, Ahmad, et al. 2013; Li et al. 2019; Tsai et al. 2019). The analysis also shows that the UTAUT and its extensions were widely employed to explore the user's acceptance of technology in the healthcare domain (N=26) (Kalavani, Kazerani & Shekofteh 2018; Idoga et al. 2019). Further, the results showed that the number of studies related to the employment of the TPB model is reasonable (N=12).

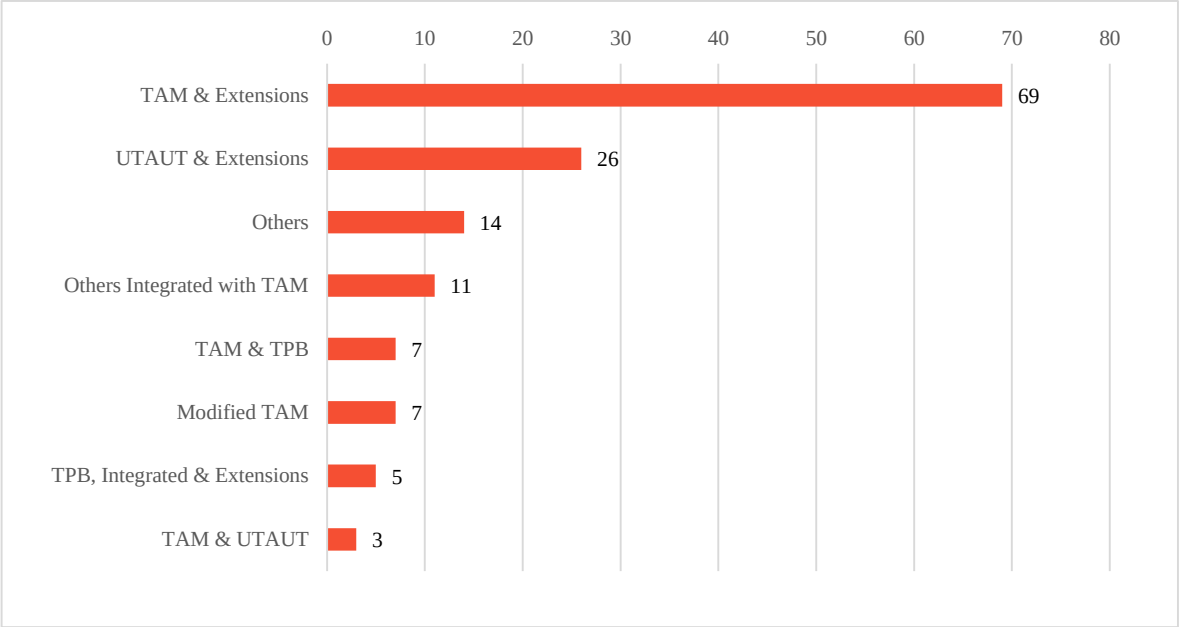

Figure 2. Most Studied Acceptance Models.

2. Key factors affecting technology acceptance in the healthcare domain

As being the key constructs of TAM, perceived ease of use (N=98) and perceived usefulness (N=105) have been explored and utilized in many studies to assess the acceptance of various technologies in healthcare (Beldad & Hegner 2018; Lin et al. 2018; Liu & Lee 2018; Nadri et al. 2018). Other studies confirmed that those two constructs could explain about 40% of user's acceptance and intention to use specific technologies (Peek et al. 2014) in various domains, including healthcare (Legris, Ingham & Collerette 2003; King & He 2006; Holden & Karsh 2010). Instead, the UTAUT was found to be capable to extend the explanatory power by 20% to 30% more than TAM regarding user's behavior intention (Kim et al. 2016). The capability of UTAUT to explain the intention to use specific technology can reach 70 percent, especially with the injection of facilitating conditions and social influence factors, along with age, gender, experience, and voluntariness as moderators (Peek et al. 2014). The TAM and the UTAUT and their core constructs are powerful to clarify the acceptance of various technologies through different users.

With evidence from 125 different studies, the analysis indicated that behavioral intention to use technology is the most used factor in evaluating the acceptance of technology in healthcare in the recent ten years (see Figure 3). Although such a result is expected, it is significant to confirm the deep need for behavioral intention within the theory and practice of technology acceptance. Consequently, providers of information technologies and healthcare organizations have to focus on the users' intentions, regardless of whether they are professional staff or patients.

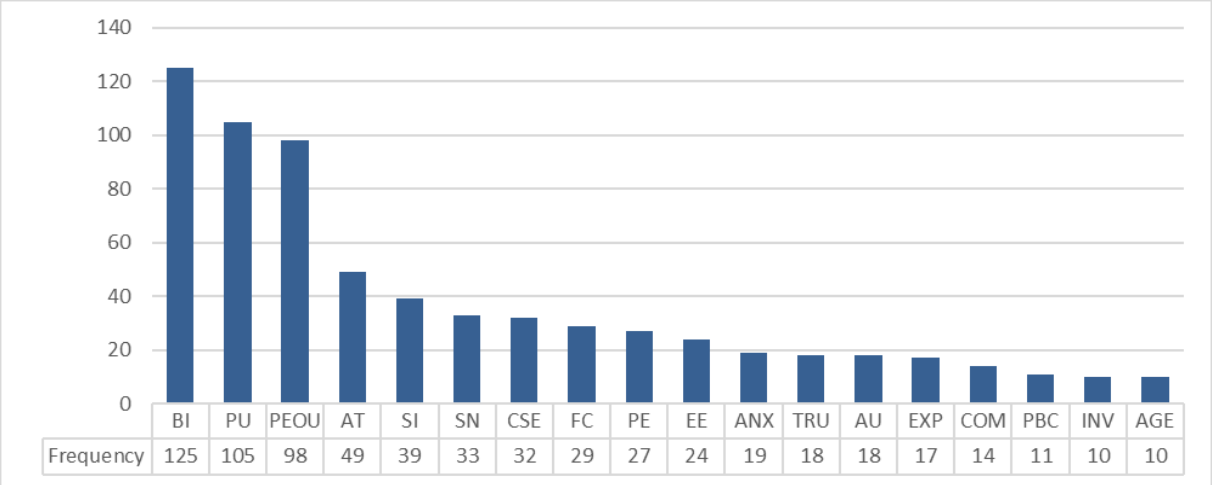

Figure 3. Key factors affecting technology acceptance in healthcare.

Another aspect that needs to be considered is the user's performance and the related expected positive gain that have been investigated extensively, as per the findings in Figure 3. Those expected positive performance gains are linked with the perceived usefulness construct and its equivalent performance expectancy (Venkatesh et al. 2003; Kim et al. 2016; Ahmadi et al. 2017). A similar case with the perceived ease of use factor and its equivalent effort expectancy, as they appeared in the analysis for 98 and 24 times, respectively. These results indicate that it is mandatory to extend the levels of convenience in information technologies and make them more user-friendly. In addition, it is obvious that there is a noticeable utilization for the factor of "attitude towards" using technology, facilitating conditions and its equivalent factors "compatibility" and "perceived behavioral control", and social influence and its equivalent factor "subjective norm".

Apart from the factors of TAM and UTAUT, the results showed that other factors had been extensively utilized to understand the acceptance of technology in healthcare. These factors include anxiety (N=19) and computer self-efficacy (N=32) from the social cognitive theory (Bandura 1977, 1986; Taherdoost 2018), innovativeness (N=10) (Agarwal & Prasad 1998a), and trust (N=18) (Gefen, Karahanna & Straub 2003) as external factors.

3. Main confirmed relationships among the influential factors

The classification analysis in this research included an investigation for the most confirmed hypotheses as per the recent literature. Those hypotheses were developed as a part of the proposed models within various studies, confirmed by several scholars, and considered significant for the technology acceptance in the healthcare domain. It is crucial to understand those common hypotheses to let researchers understand the potential correlations between the factors within the model. Similar to the determination of key factors, understanding the potential significant correlations can help to develop and enhance acceptance theories based on the experience and findings of previous studies. The recognition of the factors and their confirmed correlations can provide a better view for decision-makers and scholars and help them to determine the strengths and weaknesses in a particular technology, and therefore enhance its level of acceptance (Salloum, Qasim Mohammad Alhamad, et al. 2019).

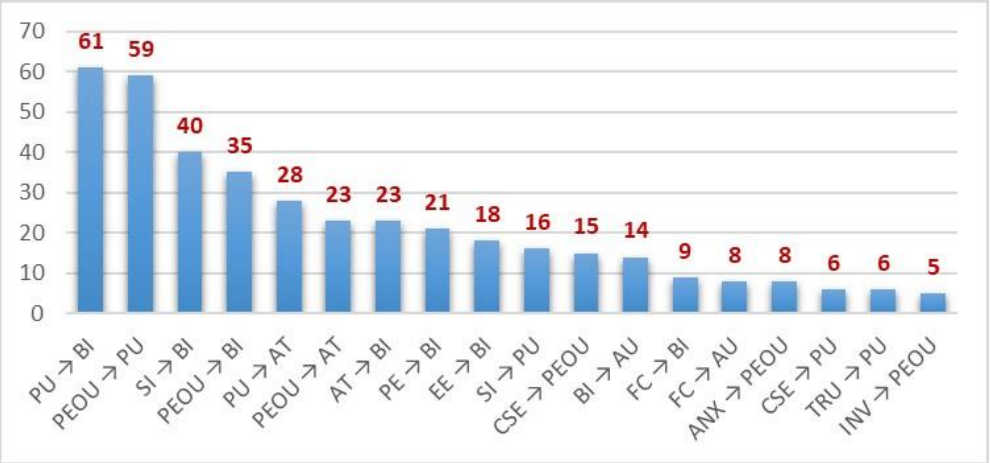

Figure 4. The most confirmed hypotheses in the reviewed literature.

As seen in Figure 4, the most confirmed hypotheses in the recent literature were the significant correlation between the “perceived usefulness” and the “behavioral intention” to use a specific technology (N=61) and between the “perceived ease of use” and “perceived usefulness” (N=59). In general, the results confirmed the key relationships as hypothesized in TAM and UTAUT models. On the other hand, we cannot disregard the extensive impact of social influence, trust, anxiety, innovativeness, and computer self-efficacy factors in technology acceptance in the healthcare domain. In other words, the frequency in Figure 4 presents the number of studies that have confirmed the significance of each hypothesis.

4. Main information technologies and their relationships with countries and participants

Figure 5 presents the distribution of the studied information technologies in the reviewed studies in terms of technology types. As suggested by Rahimi et al. (Rahimi et al. 2018), the categorization of information technologies was performed based on the Medical Subject Headings (MeSH) thesaurus (Medical Subject Headings - Home Page 2021).

With more than 48% (N=69), it is clear that prior research is mainly dominated by five main categories, including telemedicine solutions, HIT systems in general, cloud computing applications, mobile applications, and electronic health records (e.g., health information solutions and electronic medical records). In terms of distribution by country, a quick look at the analysis in Table 8 shows a slight notable lead for Taiwan in cloud computing (N=7) and the USA in telemedicine (N=3). In general, there is no remarkable lead for a country in the studies of acceptance in the healthcare domain for specific information technology.

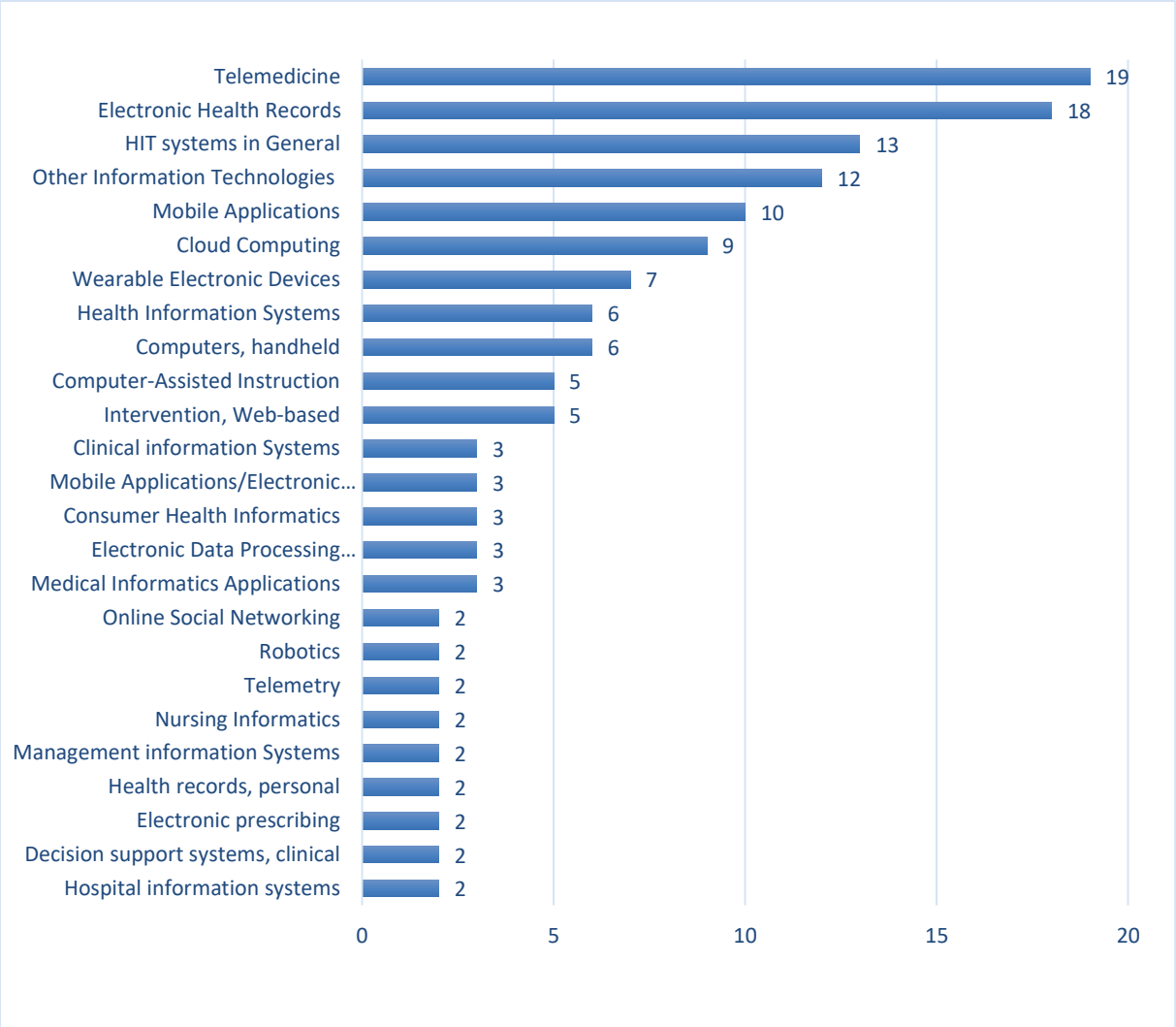

Figure 5. Distribution of studies in terms of technology type.

Table 8. Technology Types and directions of countries.

Technology	Frequency	Directions of Countries
Telemedicine	19	Taiwan (4), USA (3), Germany (2), Malaysia (2), South Korea (2), Spain, India, UK, Slovenia, China, Georgia
Electronic Health Records	18	USA (3), Austria (2), Iran (2), Jordan, India, Turkey, Taiwan, Spain, Saudi Arabia, Singapore, France, Canada, Armenia, Australia
HIT systems in General	13	Morocco (2), South Korea (2), UK & UAE (2), Nigeria, Australia, Thailand, Canada, North Macedonia, Turkey, Germany
Mobile Applications	10	Germany (2), Taiwan (2), China (2), Malawi, Singapore, Spain, UK
Cloud Computing	9	Taiwan (7), Nigeria, one study conducted in: Malaysia, Pakistan & Saudi Arabia
Wearable Electronic Devices	7	Germany (2), Taiwan (2), China (2), USA
Computers, handheld	6	USA (2), China, Turkey, South Korea, one study conducted in: UAE and UK
Health Information Systems	6	Taiwan (3), Canada, Indonesia, Malaysia
Intervention, Web-based	5	Taiwan (2), Belgium, Malaysia, Thailand
Computer-Assisted Instruction	5	Hong Kong (2), Taiwan, Iran, Indonesia
Medical Informatics Applications	3	USA (3)

Electronic Data Processing (Barcode)	3	USA (2), Iran
Consumer Health Informatics	3	USA, Malaysia, Indonesia
Mobile Applications/Electronic Records	3	Taiwan (2), South Korea
Clinical information Systems	3	Malaysia (2), France
Hospital information systems	2	Iran, Indonesia
Decision support systems, clinical	2	Taiwan, Iran
Electronic prescribing	2	USA, Pakistan
Health records, personal	2	USA, China
Management Information Systems	2	India, one study conducted in: USA & Taiwan
Nursing Informatics	2	Taiwan (2)
Telemetry	2	Spain (2)
Robotics	2	USA, Finland
Online Social Networking	2	USA, Uganda
Other information technologies (One study each)	12	Taiwan (2), USA (2), Iran, Jordan, Spain, Saudi Arabia, Turkey, Malaysia, Singapore, UK

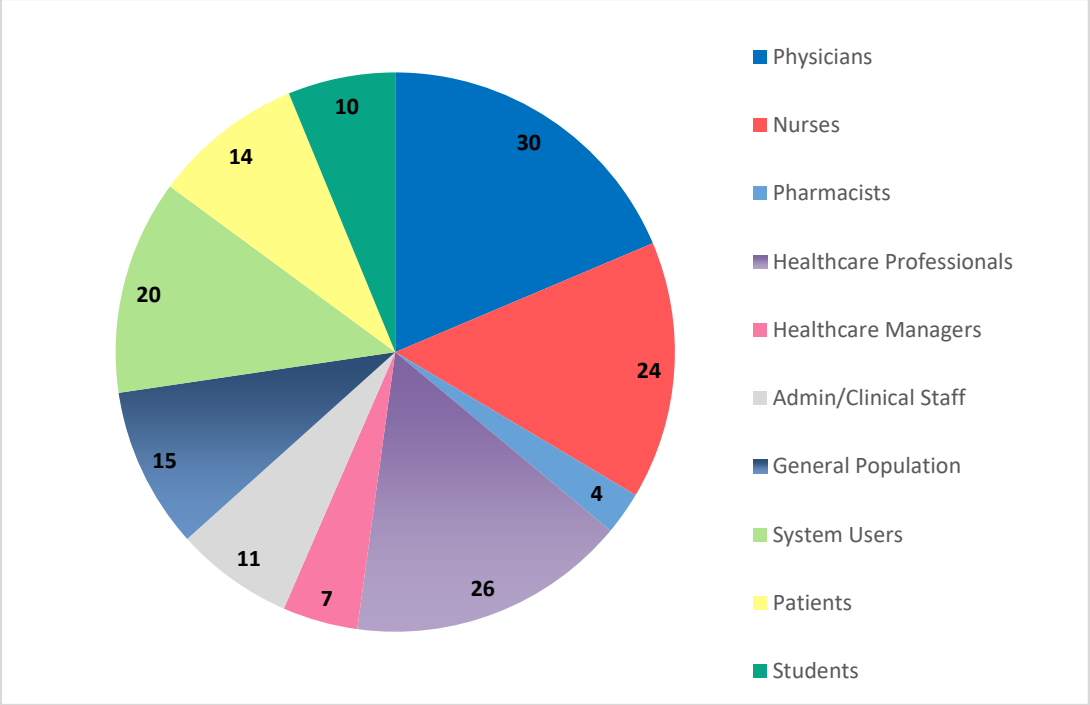

Figure 6. Distribution of studies in terms of participants.

Figure 6 presents the distribution of studies according to the participants (user groups). With almost 56% of the total participants, physicians (N=30), nurses (N= 24), and healthcare professionals in general (N=26) had the core attention of scholars to understand and explore their acceptance of technology. In terms of technology type and participants, it was observed that the focus is scattered with little attention to study the acceptance of electronic health records by the same leading user groups (see Table 9). Also, there are efforts to understand the

acceptance of patients and the general population as non-healthcare workers for various technologies, including telemedicine, mobile applications, cloud computing, and wearable electronic devices.

Table 9. Technology Types and Participants Groups.

Technology	Participant Groups									
	Physicians	**Nurses**	**Pharmacists**	**Healthcare Professionals**	**Healthcare Managers**	**Admin/Clinical Staff**	**General Population**	**System Users**	**Patients**	**Students**
Telemedicine	4	1		5		1	4	1	4	
Electronic Health Records	7	5		2	1	4	1	1		1
HIT systems in General	2	4		1	2	2		1		1
Mobile Applications				2			4	3	1	1
Cloud Computing			1	3			1	1	3	
Wearable Electronic Devices				1			3	1	2	
Computers, handheld	3			2		1			1	1
Health Information Systems		3		1	1	2		1		
Intervention, Web-based				2			1	1	1	
Computer-Assisted Instruction	1	1								3
Medical Informatics Applications		1		1	1					
E - Data Processing (Barcode)		1	1					1		
Consumer Health Informatics								3		
Mobile Apps/Electronic Records	1	1		1						
Clinical information Systems	2							3		
Hospital information systems	1					1		1		
Decision support systems, clinical	2									
Electronic prescribing	2									
Health records, personal							1	1		
Management information Systems	2	1	1							
Nursing Informatics		2								
Telemetry	2	2								
Robotics				2					1	
Online Social Networking		1								1
Other information technologies	1	1	1	3	2			1	1	2
Total	**30**	**24**	**4**	**26**	**7**	**11**	**15**	**20**	**14**	**10**

5. Distribution of studies across regions and countries

As a part of the coding of the characteristics, this study determined the origin country and the region for each analyzed study. As per Figure 7, the majority of publications were conducted

in Asia (N=76), with 53.5% of the whole analyzed studies. In that, Taiwan has recorded 20.27% (N=30) of the entire analyzed studies, as seen in Table 10. Further, the USA as a first runner-up is doing great, with 22 empirical studies (14.86%) to assess the acceptance of technology in healthcare. The geographic heat map, as shown in Figure 8, indicates that there are no publications conducted in the central and south American regions. The rest of the statistics related to country and region are illustrated in Table 10, Figures 7, and 8.

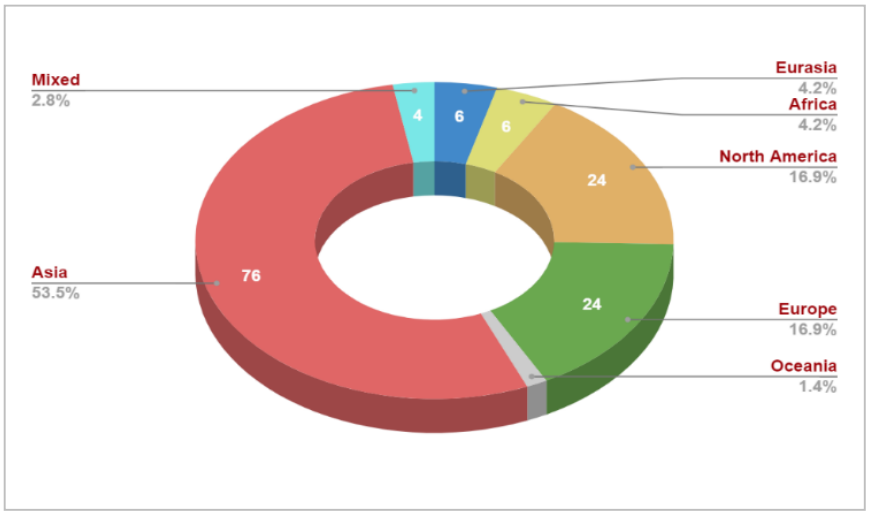

Figure 7. Publication Statistics per Region.

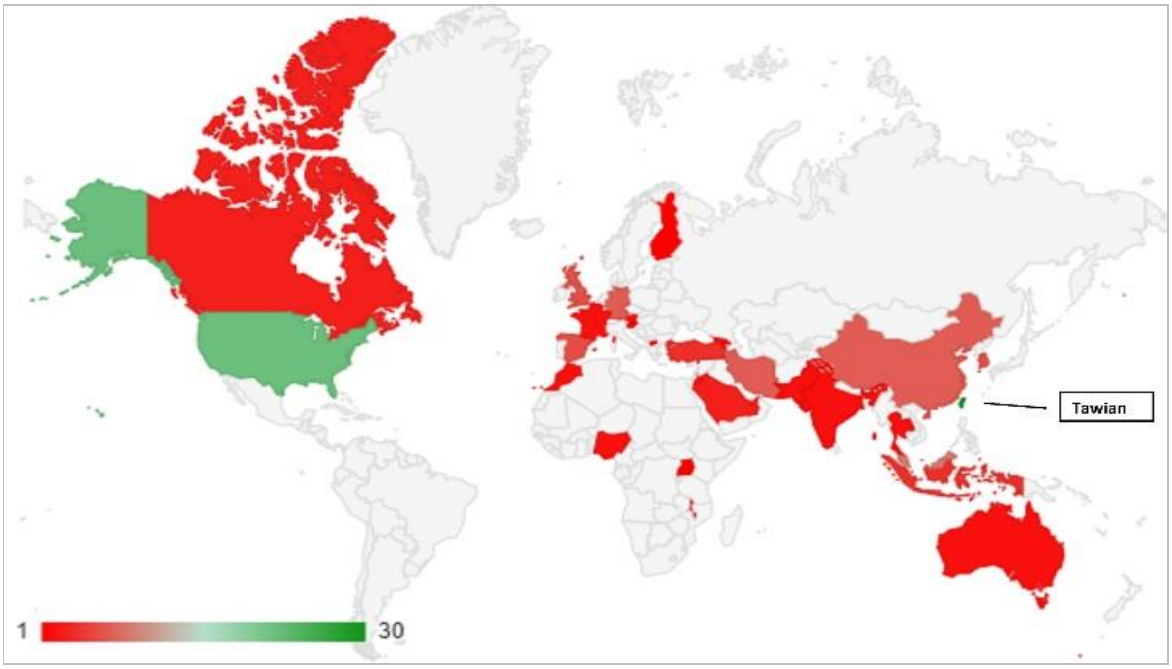

Figure 8. Geographic chart for the studies included in this review.

Table 10. Top Countries by Publication Frequency

ID	Country	Frequency	Percentage (%)
1	China	7	4.73
2	Germany	7	4.73
3	Iran	7	4.73
4	Malaysia	9	6.08
5	South Korea	6	4.05
6	Spain	6	4.05
7	Taiwan	30	20.27
8	United Kingdom	6	4.05
9	USA	22	14.86

6. Progress of technology acceptance studies in healthcare

The analyzed studies in the inspected period were categorized according to the year of publication, as presented in Figure 9. The studies are reflected through more or less constant frequency in the last decade, with a peak in 2013, 2015, and 2016. There is a remarkable drop in the number of studies from 2017, which can maximize the gap in the technology acceptance literature, especially with the ongoing boom in information technology.

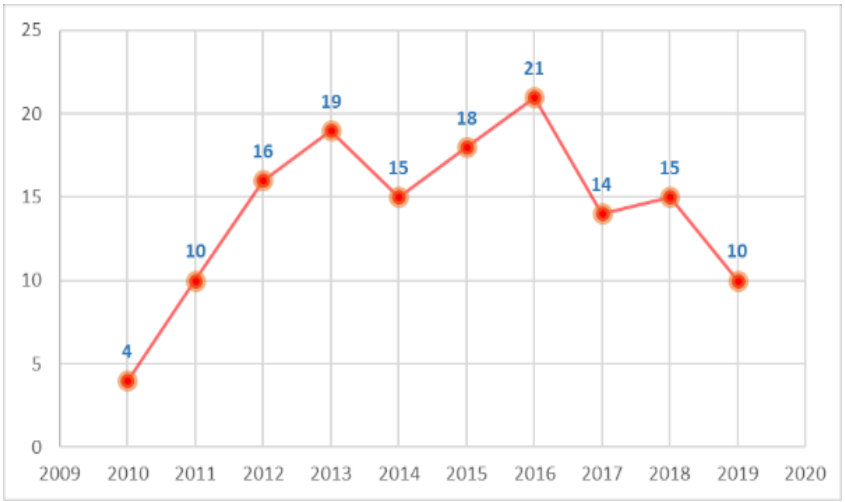

Figure 9. Frequency of Studies Per Year.

2.3.3. Discussion of Results - Systematic Review

The results of this review are believed to add a thorough analysis of the literature on technology acceptance within the healthcare domain. The review covered the studies conducted in the recent decade to explore the acceptance of different technologies using different acceptance theories, various factors, and within diverse healthcare organizations or settings. Figure 10

represents the mind map for the results summary. Concerning the study characteristics, the analysis classified the studies according to the studied model to address the prevailing technology acceptance models in the healthcare domain. The TAM, its extensions, and modifications are leading the research of technology acceptance in healthcare in the last decade. It was also found that several studies discussed the integration between TAM and other technology acceptance models (e.g., UTAUT, TPB). In general, the main aim of the integration in those studies was to improve the explanatory power of the TAM model. These results are aligned with what was proposed by (Marangunić & Granić 2015) regarding the power of TAM in investigating the user's acceptance of technology in general. Moreover, the UTAUT and its extensions were widely employed to explore the user's acceptance of technology in the healthcare domain. This is compatible with the statements of prior studies (Bennani & Oumlil 2013; Perlich, Meinel & Zeis 2018). Also, the results showed that the number of studies, including the TPB model, is reasonable. These findings confirm the importance of studying various models as performed by (Venkatesh et al. 2003; Kim et al. 2016) to better understand the technology acceptance and facilitate building unified models for technology acceptance in the healthcare field.

The review also explored the key factors that were extensively employed in the recent literature to understand the acceptance of various technologies in the healthcare domain. The results showed that behavioral intention was utilized for 125 times in the reviewed studies. This finding is significant to confirm the deep need for behavioral intention within the theory and practice of technology acceptance. Consequently, providers of information technologies and healthcare organizations have to focus on the users' intention to enhance the level of acceptance, regardless of whether they are professional staff or patients. Perceived ease of use and perceived usefulness have been explored in numerous studies to assess the acceptance of technology in

healthcare (Beldad & Hegner 2018; Lin et al. 2018; Liu & Lee 2018; Nadri et al. 2018). The two factors are considered key constructs of the TAM, and other studies confirmed that those two constructs could explain about 40% of user's acceptance and intention to use specific technologies (Peek et al. 2014) in various domains, including healthcare (Legris, Ingham & Collerette 2003; King & He 2006; Holden & Karsh 2010). Instead, the UTAUT was found to be capable of extending the explanatory power by 20% to 30% more than TAM regarding user's behavior intention (Kim et al. 2016). The capability of UTAUT to explain the intention to use specific technology can reach 70%, especially with the injection of facilitating conditions and social influence factors, with age, gender, experience, and voluntariness as moderators (Peek et al. 2014). The TAM, UTAUT, and their constructs are powerful theories to understand the acceptance of various technologies through different users.

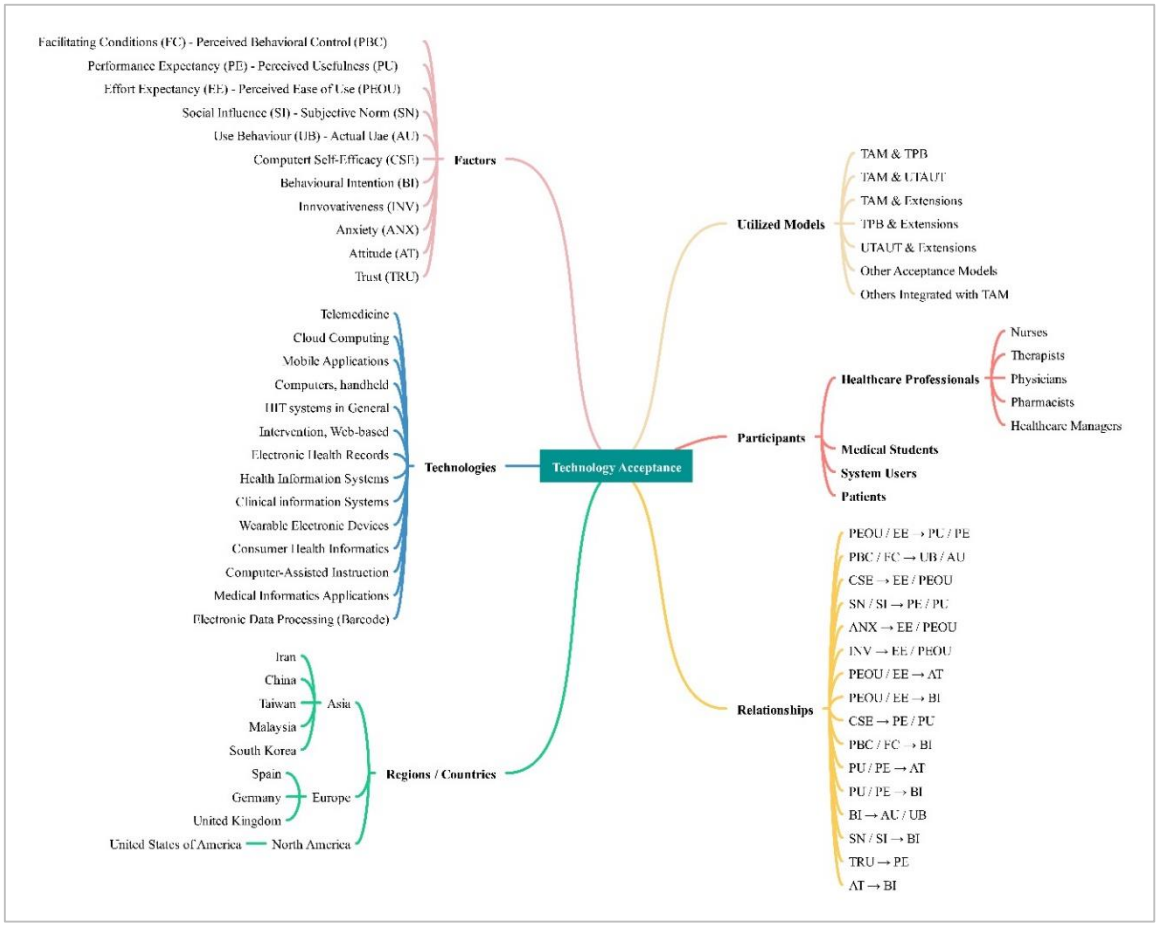

Figure 10. Mind Map for the Results Summary.

The analysis revealed that the user's performance and its related expected positive gain had been investigated extensively. Those expected positive performance gains are linked with the perceived usefulness factor and its equivalent performance expectancy (Venkatesh et al. 2003; Kim et al. 2016; Ahmadi et al. 2017). A similar case with the perceived ease of use factor and its identical effort expectancy. These results indicate that it is mandatory to extend the levels of convenience in information technologies and make them more user-friendly. In addition, the clear presence of the facilitating conditions factor and its equivalent factors "compatibility" and "perceived behavioral control" confirms the users' need for support and motivation to accept and use information technologies in healthcare. Also, scholars have not missed the importance of exploring innovativeness, computer self-efficacy, trust, and anxiety factors. A user will not use technology if he/she does not trust the technology or its creator. Similarly, it sounds reasonable to address the level of users' innovativeness and confidence to use information technology without being fear to make mistakes.

With a link to the extensively studied factors, the analysis investigated the most confirmed hypotheses in the recent literature. It is crucial to understand those common hypotheses to let researchers understand the potential significant correlations between the factors within a specific model. The determination of the most confirmed hypotheses is supportive and can assist researchers to develop or enhance acceptance theories based on the experience and findings of other scholars. The recognition of the factors and their confirmed correlations can provide a better view for decision-makers and help them to determine the strengths and weaknesses of a certain technology and enhance its level of acceptance (Salloum, Qasim Mohammad Alhamad, et al. 2019).

The results found that perceived usefulness and ease of use encourage behavioral intention in healthcare. Such a result suggests that users' behavioral intention is mainly influenced by their

spent efforts to use a specific technology, and their belief regarding the expected benefits from using that technology (Ahmadi et al. 2017; Khan et al. 2018). Also, the results exposed that attitude towards using technology in healthcare is widely influenced by the expected performance results and effort expectancy. This implies that the end-users have a positive attitude regarding using a specific technology to improve their work efficiency (Schaper & Pervan 2007; Kim et al. 2016). It is essential to implement user-friendly solutions in healthcare to expand the positive attitude towards technology adoption (Kim et al. 2016; Özdemir-Güngör & Camgöz-Akdağ 2018). Moreover, the relationship between the social influence and both behavioral intention and perceived usefulness was extensively confirmed. This suggests that users' behavioral intention to use technology is significantly influenced by their social groups (e.g., colleagues), and their belief regarding the expected enhancement in performance.

Regarding the studied information technologies, the analysis classified them by type and directions of countries to explore the booming topics in specific regions and countries in the subject of technology acceptance in healthcare. It is crucial to address if there is a lack or plethora in the literature regarding a specific technology within a specific country. Such classification of technologies can enable scholars to have a look for other technology solutions in healthcare. For instance, the results showed that telemedicine and electronic health records were the most studied technologies in general, but it seems that there is still a room to explore the acceptance of these technologies in different countries and settings, especially that there is no specific country that is leading this niche area of research.

In general, the results indicated that specific technologies dominate the literature but this conclusion is deceptive since the literature is scattered in terms of technology use per country. There is still a gap in discovering the factors that impact the acceptance of many information technology solutions in healthcare. Those solutions can fail due to the uncertainty of adoption

enablers, barriers, and users' acceptance. Therefore, it is recommended to conduct more research in areas that are not covered or neglected because it was noticed that various gaps need to be fulfilled by considering other information technologies, such as picture archiving and communication systems (PACs) (Ahmadi et al. 2017), electronic prescribing solutions (Khan et al. 2018), and robotics (Turja et al. 2019).

Concerning the distribution of the participants across the technologies type, the results indicated that prior research focused on the healthcare workers (e.g., physicians, nurses, and healthcare professionals) to study their acceptance of information technologies in healthcare. This result can be misleading when the technology type is added since the reviewed studies could not confirm a clear focus except for the electronic health records by the aforementioned leading participants, which remains a research gap. Hence, further research may consider this prospective gap and try to discover the acceptance of various technologies by other user groups. Moreover, the literature witnessed extensive work to explore the acceptance of telemedicine, mobile applications, cloud computing, and wearable electronic devices by patients and the general population as non-healthcare workers. This finding can be explained by the need to understand the influence of innovativeness, trust, and anxiety on regular users' acceptance. For instance, a regular user needs to have an innovative sense to try a new smart watch or mobile application without fear of making mistakes and trusting that the technology will not make his/her own data public or breach the confidentiality terms.

As well, addressing the origin of publications can help to recognize a research gap in a specific country or region within particular subject areas. It helps to improve the research directions and create extra motivations for researchers. For instance, the results showed no publications regarding technology acceptance in healthcare within the central and south American regions. This provides a research gap that is required to be filled by the researchers in these regions.

This result can also indicate that technology implementation in the healthcare domain is rare in these two regions. By looking into the developing regions, Arab and African countries need to expand the research in technology acceptance. Despite the advanced healthcare services and the increasing use of information technologies in some Arab countries (e.g., UAE and Jordan), the lack of technology acceptance research exists, specifically when it comes to the healthcare domain.

In contrast, Taiwan has recorded 20.27% of the analyzed studies, which almost poses 40% of the total number of studies in Asia. This might be an outcome for the well-established healthcare systems in Taiwan (Wu, Majeed & Kuo 2010). While the results of China and South Korea are shocking compared to the boom in information technologies in these two countries. These results could be a gap that referred to the language with no assurance, especially that many scholars are publishing their research using their mother-tongue languages. Therefore, more research studies can be carried out to understand the enablers and barriers to adopt various technologies in the healthcare domain in China and South Korea.

Regarding the years of publication, the results indicated that the studies experienced more or less constant frequency. The number of research articles has increased from 4 studies in 2010 to an average of 17 studies from 2012 to 2018. The hike could refer to the increased focus of studies on telemedicine, electronic health records, cloud computing, and mobile applications. With 27 studies conducted in Taiwan and 17 in the USA, both countries have significantly encouraged the observed increase. Finally, the remarkable drop in the number of studies from 2017 to 2019 is not helping the literature of technology acceptance, especially with the current need to adopt new technologies and improve the healthcare services in response to the outbreak of COVID-19 and the ongoing evolution in information technology.

2.4. Overview of Queue Management

Queue is referred to a social phenomenon that is rampant in the contemporaneous societies, due to the lack or insufficiency of facilities or locations that can fulfil the needs of customers of specific good or service (Pardo & de la Fuente 2010; Marin & Rossi 2017; Afolalu et al. 2019). While customers are considered as the arriving units that demand a service or good; and need to be served within a queue (Afolalu et al. 2019).

The issue of long queues happens in various sectors, i.e., hospitals, banks, and retail stores (Davis & Heineke 1994), and the enhancement for the waiting time to get a service is a repeating problem that needs to be solved (Ghazal, Hamouda & Ali 2015). The problem with queues that it can provide high level of distraction from the original values that an organization aim to deliver (Weiss & Tucker 2018; Afolalu et al. 2019). Each organization that have direct interaction with its customers faces the issue of queues (Davis & Heineke 1994). Queues getting increased due to the different patterns of customer needs, and variant times of arrival. Such lengthy queues can motivate customers to look for the required service in another organization or service center, especially that long queues can obviously expose the inability of service providers to meet the various needs of those customers (Afolalu et al. 2019).

These facts provide the need to have a type of queue management to enhance satisfaction and serve customers. Queue Management can be explained as a system that is important to help in managing the flow of customers and organize their queues (WEI 2013). As per the psychology of waiting, the given ticket paper can make customers feel relaxed (Limlawan & Anussornnitisarn 2020). Depends on the psychology of waiting as presented by (Maister 1985), knowing the queue size and the related estimated waiting for a customer can reduce the level of anxiety for that customer. Moreover, queue management is not just important to organize the queues of customers, it is also significant to gather data and conduct statistics

about the queue and to identify the current and future trends; especially in this era of information technology revolution (Gosha 2007).

Over the years, managing the queues is common problem in healthcare and considered significant for the safety and overall satisfaction of patients (Davis & Heineke 1994). long queues in healthcare organizations can produce high levels of distraction for the employees instead of focusing on the original activities (Afolalu et al. 2019). Queue management technology is becoming more popular to be implemented in healthcare organizations to solve the issue of queues, gather data, and generate statistical reports about the current and future flow trends (Gosha 2007).

(WEI 2013) have presented the main concept of queue management solutions where the arriving customer will press on a kiosk to take a ticket paper. The ticket paper contains various details, as the waiting number and current number that is being served. When the customer press on the button, the kiosk will generate the ticket using a unique number and trigger the database to add the customer to the waiting list. Eventually, the number will be called to be displayed on a screen, along with the serving counter to guide the customer where to go.

2.5. Waiting Times in Healthcare

The standards of life and healthcare services for people have been increased due to the development of the economy and the changes in medical systems (Shan et al. 2013). People are looking for a higher level of healthcare services with less time to wait. Waiting is not likeable by people (Davis & Heineke 1994), and in general waiting time is the most frequent complaint by all patients (Boos et al. 2017). Waiting time is considered important sign for the efficiency and quality of medical services (Li et al. 2021). Taking a long time to book an appointment, get treatment, or take medicine can negatively impact the satisfaction of patients and their safety (Shan et al. 2013; Ghazal, Hamouda & Ali 2015; Boos et al. 2017; Coyle et al. 2019; Handayani,

Mustafid & Surarso 2020; Abusair et al. 2021; Kuiper et al. 2021). For instance, long waiting times in the emergency department can raise the rates of deaths and admission to hospitals, increase patients' complaints and reduce productivity (Coyle et al. 2019). Therefore, it is essential to have proper solutions for those long queues in healthcare organizations, where these solutions help to manage the queues along with their related statistics.

Waiting times are significant to assess the patient's satisfaction and quality of service (Safdar, Emrouznejad & Dey 2020; Kuiper, de Mast & Mandjes 2021). Thus, different initiatives regarding the waiting time in healthcare facilities were discussed and applied to solve the issue of long queues, suggest innovative solutions, and facilitate managing the queues with respect to the satisfaction and safety of patients. A survey study was conducted by (Boos et al. 2017) to evaluate the patients' satisfaction through using electronic kiosks, and confirmed that waiting time is a common complaint by all patients. Also, it confirmed the importance of waiting time for overall patient satisfaction, along with the staff's courtesy and the level of cleanliness. On the other hand, a recent study by (Coyle et al. 2019) took place to provide a proof of concept for achieving early identification for patients in the emergency department, using a kiosk for self-check-in. Through a trial with control and intervention weeks, the study could prove that the proposed early identification solution could significantly reduce the waiting time for patients before getting the treatment in the emergency department.

There is a gap in the literature that discusses and solves the issue of long waiting times in the outpatient department. A quick review of the literature shows that various studies have discussed and proposed different methods and solutions for the issue of waiting times, but the main focus of these studies was only in the emergency departments (Spaite et al. 2002; Choi 2006; Morgan 2007; Ieraci et al. 2008; Kwa & Blake 2008; Coyle et al. 2019). Also, the discussed solutions were more related to medical management or business administration.

In general, the previously proposed solutions depend on methods for process re-design and management solutions with minimum illustration for the technology with no focus on the technical perspectives. For instance, a quality project to improve the waiting times has took a place at the pharmacy in a public hospital in the UAE (Sadi et al. 2021). The project proposed an optimization for the use of hospital information system by sending the electronic prescription to the pharmacy once it is generated by the clinic. The initiative was successful to minimize the waiting time from 21.5 to 4 minutes and to enhance the patients' satisfaction. However, the study did not discuss the technical specifications of the proposed solution. As well, the work of (AlHammadi 2019) has assessed the satisfaction of patients (N=552) with their waiting time experience in the healthcare facilities in the UAE. Also, the study has discussed the strategies to minimize the waiting times in the cases of appointments and walk-ins. The study did not involve any type of technologies, and has recommendations to encourage patients to arrive on-time and to have more resources to reduce the waiting times. Similarly, the study of (Aburayya et al. 2020) has utilized questionnaires to collect responses regarding the root cause for the long waiting times from 938 healthcare employees in Dubai. The study did not include any reasons that are related to the need of technologies. The study findings focused on the high workload level, availability of facilities, work procedures, and interaction with management as the main causes for the long waiting times in healthcare facilities.

Moreover, smart queue management solutions were suggested by the work of (Ghazal, Hamouda & Ali 2015; Ghazal, Mohammed, Hamouda, Rania, Ali 2016) with an objective to reduce the level of dissatisfaction for patients at hospitals in UAE. The two articles have discussed the proposed system's workflow along with the technical aspects of the queue management system on smartphones. Both studies confirmed that the overall satisfaction of patients relies on the spent waiting times.

2.6. Health Level Seven International (HL7) and Integration

Nowadays, software applications are mandatory for healthcare professionals to achieve their daily tasks. Information technology reducing the processing times and standardization of protocols to integrate and exchange data are becoming significant in the healthcare domain. That's why there is a need to have fast, secured reliable methods and tools for clinical data transmission within medical informational systems (Bogdan et al. 2010).Various EMR solutions are available in the market (e.g., Epic (*Epic | ...with the patient at the heart* 2021), Cerner (Cerner Corporation 2021). Nevertheless, the same EMR solution is different when it is installed in different healthcare facilities due to its tailored clinical processes, integration with other healthcare solutions (Ben-Assuli 2015), and various usage types by healthcare professionals (McGinn 2016). The identification of common integration processes is possible but these processes are not able to be replicated from one facility to others, so customizations are obligatory (Scalia et al. 2021). Scholars in (Scalia et al. 2021) could successfully integrate EMR with patient decision aids (PDAs) using HL7 protocols. Also, they confirmed that integration with electronic medical records is complex due to the unforeseen software issues that can be found while troubleshooting, the concerns of data flow security with third party solutions, and the periodic updates of EMR that can cause functionality issues. Integration between information systems is difficult because it needs to fulfil the business interoperability requirements (López & Blobel 2010) and this is what is offered by HL7 standards.

HL7 standards are messaging standards where "Level Seven" represents the seventh level (application-level) in the seven-layer communications model for Open Systems Interconnection (OSI) in the International Organization for Standardization (ISO). HL7 protocols provide a beneficial standardization for communication interfaces, especially if we consider the variety of applications, different data formats, and the need to transfer and exchange data (Bogdan et

al. 2010). HL7 standards are implemented in the healthcare domain and simply work as an application protocol to exchange electronic data. The standards are beneficial for both: healthcare providers and IT vendors and provide the support to exchange, share, integrate, and retrieve the electronic clinical data located in different systems, along with the central patient care solution (HL7 International 2021).

HL7 was established in 1987 as a non-profit standards development organization in the healthcare domain. HL7's key goal is to give everyone the ability to access and utilize accurate health data at the right time and place in a secure manner. HL7 standards arguably are the most widely implemented and used standards with HL7 V2 and V3 standards. HL7 V2.x versions are too popular as they were implemented in 35 countries worldwide, within 95% of the healthcare organizations in the USA; and they were accredited in 1994 (Bogdan et al. 2010) by the American National Standards Institute (ANSI 2021). The standards are being supported by more than 1600 corporate in 50 different countries with 500+ members who represent government authorities, pharmaceutical corporations, healthcare providers, and consulting firms (HL7 International 2021). Although the HL7 standards were applied and utilized in most of the healthcare facilities, still there is a notable lack of software solutions that rely on HL7 standards to exchange data among the medical applications (Bezerra, de Araújo & Times 2020; AlQudah, Al-Emran & Shaalan 2021a).

2.7. Summary and Research Gaps

Several reviews were conducted to analyze the technology acceptance models and their related factors in healthcare. However, most of the studies have focused on a specific technology acceptance model instead of various acceptance models. Also, the studies have discussed particular technology. This research focused on exploring various technology acceptance

models to provide an overall insight about the literature of technology acceptance in the healthcare domain.

As well, the conducted systematic review could provide a comprehensive idea about the trending technologies in terms of user types and directions of research (countries) from a comparison point of view. This will help to focus on exploring new technologies (i.e., queue management solution, and internet of things) in different settings and countries and eliminate having a lack or plethora in the literature. Despite the advanced healthcare services and the boom of technology implementations in some developing and Arab countries (e.g., UAE and Jordan), it is clear that still there is a lack of research when it comes to technology acceptance in the healthcare domain. This gap needs to be fulfilled by studying the acceptance of various technologies in the healthcare field in the UAE.

On the other hand, many scholars have discussed the issue of long waiting times in the healthcare facilities and provide different solutions. Nevertheless, most of these studies focused on the emergency departments (Spaite et al. 2002; Choi 2006; Morgan 2007; Ieraci et al. 2008; Kwa & Blake 2008; Coyle et al. 2019). As well, the suggested solutions were more related to medical management or business administration. In general, the previously proposed solutions depend on methods for process re-design and management solutions with minimum technological solutions. There is a need to propose technology solutions to solve the issue of prolonged waiting times in the healthcare facilities.

Chapter 3

QMS and EMR – Integration Case Study

Objectives

- Present the current state of the implemented QMS.
- Present the proposed optimizations and patient's self-check-in as an innovative solution.
- Clarify the methodology to integrate QMS and EMR.
- Discuss the cases of optimizations and patient's self-check-in: success/fail.

3. QMS and EMR – Integration Case Study

3.1. Overview

This chapter will clarify the key features of queue management solution as implemented in a healthcare organization in the UAE. Also, the chapter will provide a thorough analysis for a set of optimizations in the current QMS, and the integration between QMS and EMR. The main goal of integration is to implement the patient's self-check-in feature to achieve the patient's early identification. Patient's self-check-in is important to minimize the spent time and efforts to identify the patients by the healthcare providers and complete the journey in a smooth manner.

The queue management solution was implemented in order to help in managing the patients' journey in a healthcare organization in UAE. QMS system is significant to provide the ability to manage the patients' visits from the moment they arrive the hospital's lobby till they get treatment and leave. QMS is responsible to identify the patients, and move them smoothly from one service point to another in a friendly stress-free environment. It increases the efficiency of the clinical staff along with the objective performance measures.

The implemented QMS has different integrated features that work to manage the queues of patients. The solution provides a unique ticket number for each patient, that will be flickering once it is called on a liquid crystal display (LCD) screens along with the room number. The solution includes a recall feature in case the patient didn't show in the clinic after specific time, along with a voice announcement for the called number. As well, the solution has the ability to capture the time intervals for every process within the patient's journey (Identification, Triage, Assessment). In addition, the solution provides the capability to add notes to be read by the

physician, generate the statistical and performance reports, and to have centralized management and control for the process by the department heads and the system's admins.

3.2. Patients' Journey – Current Process

Currently, the patients are identified by receptionists using the pre-triage process. The pre-triage process starts when number of patients are waiting in a queue in front of the clinic's reception desk to be sent to triage rooms. The clinic has desk-based kiosk and ticket printer. The receptionist has to call each patient manually in order to check his Emirates ID, appointment details, and give him/her a ticket (number). The given number is used to call the patient by the triage nurse using the Queue solution. In case of appointments, the patients will be prioritized due the time of arrival regardless the time of appointment which may create high levels of confusion and dissatisfaction for the patients.

After checking all patient's documents and details, the receptionist will ask the patient to be seated in the waiting area till he/she can see the ticket number on the LCD screen to proceed to the triage room for vital signs. The triage nurse will take the vital signs, write the medical notes, types of allergies that the patient has. Then the patient will be given another ticket that will be called by the physician, so the patient has to wait again to see the new ticket's number on the LCD. The number will be called by the physician using the QMS, in order to perform the required consultation and treatment. When he completes the treatment, the physician should close the visit in QMS to indicate that the patient's journey is completed in that clinic.

Regardless the abovementioned features, there are some challenges that were observed and related to the current process and state of QMS. These challenges need to be resolved by applying various optimizations and alter the current utilized business and clinical processes. The observed challenges include the followings:

- It takes the patient long time to be identified by the clinical staff, because the patient should go to the clinic and wait to take the ticket number.
- QMS is not capturing the patient's identification time, which is the time interval between the patient's arrival and the time of identification by the hospital system. Patient identification time is vital to capture the number of patients waiting for triage, identify the time that a specific patient needs for the triage process, provide statistical reports for decision-making, and minimize the time of the whole journey.
- The solution is not providing a transfer feature between rooms, so the triage nurse has to take the vital signs and give another ticket for the patient to be called by the physician, which may cause anxiety and confusion for the patient.
- The triage nurses and physicians are not sure who is the next patient. The system only provides the ticket number, the number of appointments, and the number of walk-in-patients.
- Once the patient is in the triage room, the triage nurse has to manually change the status in the EMR system from "Checked in" to "Seen by the nurse", which is subject to human error. If the status is not changed, the physician will not know the accurate status, the number of patients in the queue, and who is already available for consultation or treatment.
- High levels of confusion and complaints because the current solution is prioritizing the walk-in patients as per the time of arrival regardless of their level of severity or patient's case, i.e., pregnant patients, older patients, etc.
- In the case of appointments, some patients are coming before their booked appointments, which makes the clinic crowded, causes confusion for the staff, and affects the right of other patients.

- The ticket number format in QMS is alphanumeric, with one letter and one number only, i.e., “A0”. Each clinic has various types of patients and services that cannot be included due to the limited number of English letters (26). Such limitation maximizes complaints because patients think that someone has taken their turn. For instance, if a patient with an appointment and ticket number “A2” has been called before another patient “A1” who is coming as a walk-in patient, then A1 will complain since there is no differentiation for the types of services or patient.
- All patients are to be seated in one common waiting area before getting routed to the clinics. Patients need to ask where to find the specific clinic or room.

3.3. Patients’ Journey – “To Be” Process

Business brainstorming sessions took place to discuss and solve the aforementioned challenges. The sessions included representatives (business consultants) from the implementers of QMS and EMR, project managers, integration and business consultants from the IT department, and head of clinics in the OPD. As agreed, there is a need to have business process re-engineering with adding optimizations on the application’s level to be in line with the new process (To state). The new suggested optimizations included the followings:

- Implement the patient’s self-check-in feature (early identification) by integrating QMS with the EMR solution, so QMS can query the patient’s appointment using the Emirates ID cards, and process the patient’s check-in automatically in EMR.
- Install stand kiosks in the entrance of OPD that are equipped with smart card-readers to be used by the patients with appointments.
- To minimize the crowdedness in the clinics, an enhancement will be implemented in QMS to restrict the allowance time for check-in. A patient will not be able to check-in unless the remaining time for the appointment is 30 minutes or less.

- Walk-in patients to be identified in the clinics using Emirates ID cards to obtain their information. Each reception to be equipped with smart card-reader keyboards. This enhancement will help triage nurses and physicians to identify the name and details of next walking patient.
- Add the ability to transfer patients automatically from the triage rooms to the physicians' rooms. Once the process of taking vital signs is completed, the triage nurse will click on the finish button so the patient will be automatically transferred to the physician's list in QMS, and the patient's status will be automatically changed from "checked-in" to "seen by nurse" in EMR. In case of appointments, the patient will be transferred automatically to the room of a specific physician as per the pre-booked appointment (Smart routing). For walk-in patients, the room will be selected earlier (during check-in) by the receptionist as per the appropriate empty slots.
- In the case of walk-in patients, there will be new identifiers for pregnant ladies and old patients. Those patients will have priority, and to be automatically called first by QMS. QMS will highlight those special types of patients, so it can be recognized by the clinic staff.
- The format of the tickets to be enhanced by adding 2 more letters. This will give more flexibility of symbols combination, and ability to define unique symbols for each service in different clinics. The new format to be: "x1x2x3 – nnn"., where x1 to be "W" in Walk-in case and "A" in appointment case, x2x3 represent service/clinic symbols, and "nnn" represent the ticket number, i.e., "WOR – 001" for Walk-in patient in orthopedics clinic.
- Extending the digital signage module by customizing the LCD screens to include more details, bilingual (Arabic/English) information, clinic-corridor number, and the name of the doctor. Such customizations will help to guide the patients where to go with less

confusion. Adding the physician's name, corridor number, and room numbers to the given ticket to help in guiding the patient.

3.3.1. Patients with Appointments

Patient's self-check-in process will be utilized in case of appointment patients. The process is supposed to minimize the human intervention which means fewer human errors, by using the electronic transfer of information between different clinical systems including EMR. Self-check-in expected to facilitate in capturing the number of patients waiting for triage, and less time to identify the arrival of patients which means more satisfaction. The self-check-in was suggested as a solution for the issue of long queues and waiting times in clinics. The appointment patient who already called the call center and took appointment should not have to wait on the clinic's reception for long time before getting his ticket number and go to triage.

The proposed process to identify the patients with appointments contains two main steps. Those two steps are checking the validity (status) of patient and appointment(s) as in figure 11, and the check-in step using the Emirates ID as in figure 12, in case the first step was succeeded.

The first step will start when a patient arrives at the lobby of the outpatient department (OPD), he/she has to use the stand kiosk that has a "How-to" video to know how to use the Emirates ID and the process to check-in. The patient has to insert the Emirates ID card into the attached smart card reader. Then, the patient's information will be obtained to check the availability (registration) of the patient in the database of the EMR along with his/her appointment(s). The first step will be succeeded if the patient is registered in the EMR, all details are updated, and has at least one booked appointment. Consequently, a list of the booked appointment will be presented on the kiosk's screen, and the patient can click on the desired appointment so the status of the appointment will be updated automatically in the EMR from "Booked" to "Checked-in", and finally a ticket number will be printed. Otherwise, an error message will be

shown on the screen, as seen in figure 12, so the patient has to visit the clinic's reception asking for assistance.

In case of successful check-in (Step 2), the patient has to wait until the given ticket number is called by the triage nurse and shown on the TV screen. After completing the routine triage activities, the nurse will click on the "finish" button so the patient's profile will be automatically transferred to the physician's account, without providing another ticket number as in the current process. Finally, the patient will be called by the physician to perform the anticipated treatment or consultation.

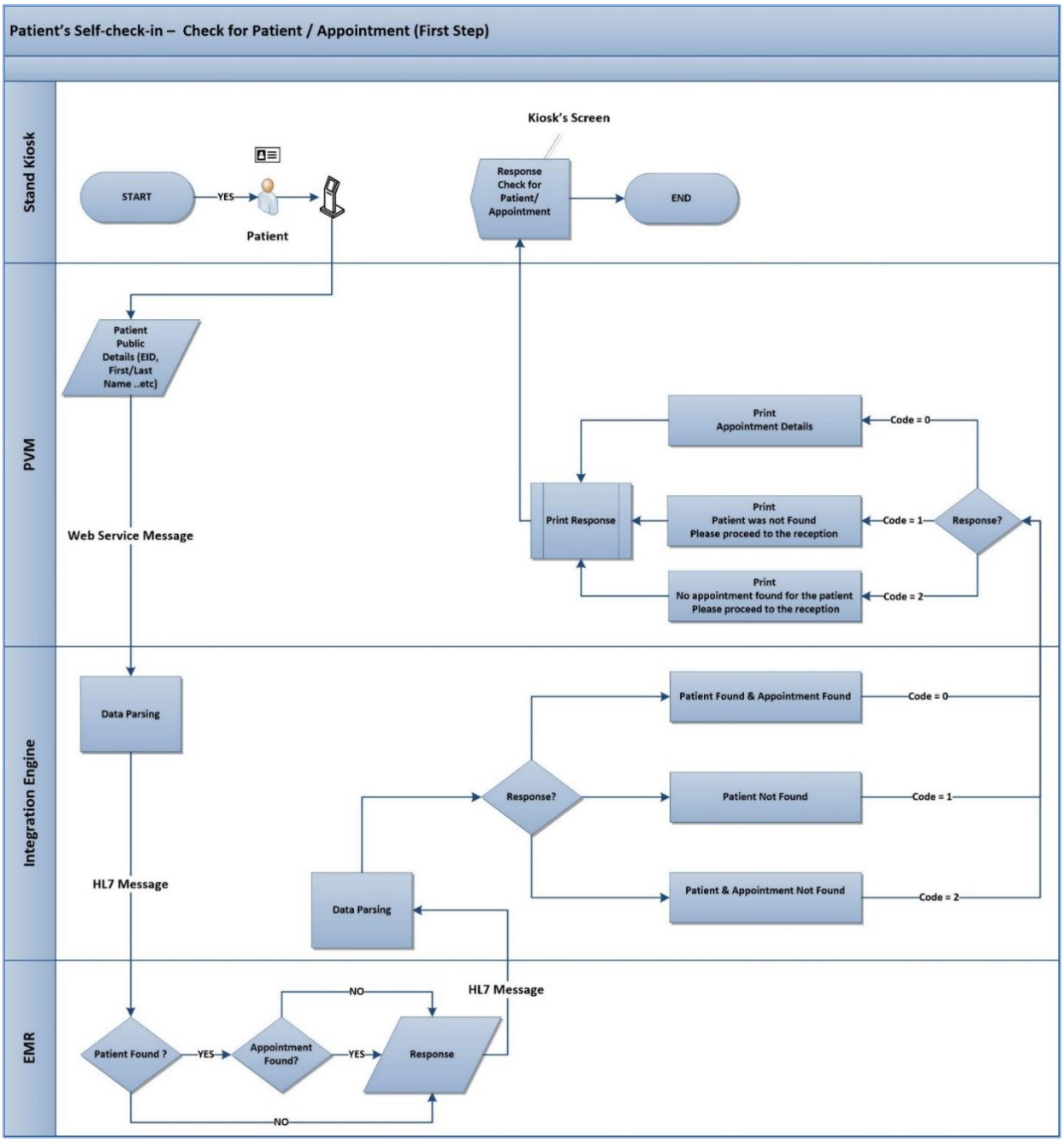

Figure 11. First Step – Check for Patient/Appointment Validity.

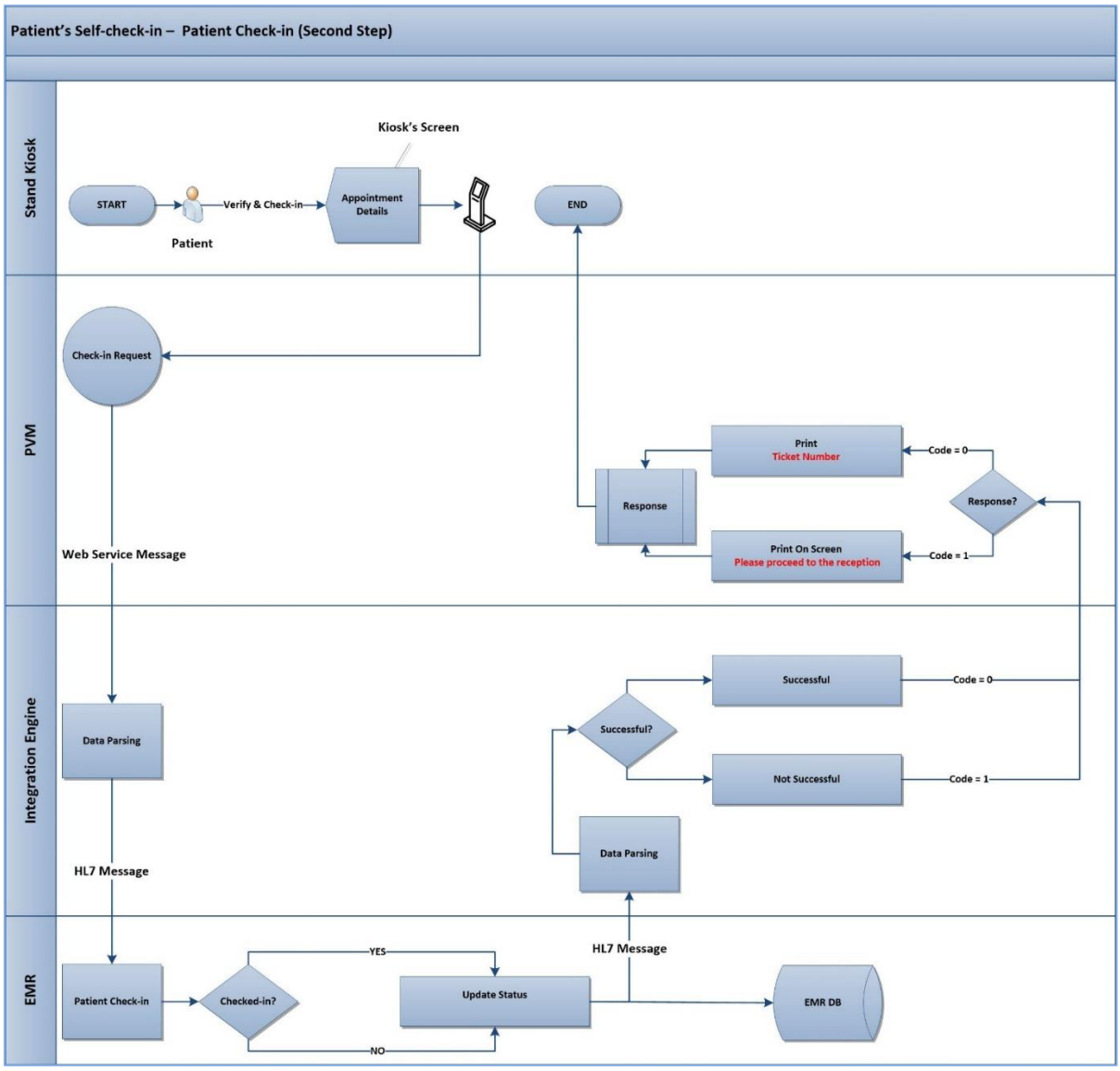

Figure 12. Second Step - Patient Check-in.

3.3.2. Patients without Appointments (Walk-in)

In the case of walk-in's patients, the patient has to proceed directly to the reception of the clinic and provide the Emirates ID card to the receptionist. In case of new patient, the patient's record has to be created in EMR along with the required treatment. Otherwise, the receptionist only has to enter the details of the treatment in EMR.

Then, the receptionist has to select "walk-in" type in QMS, the physician, and the patient's type (i.e., regular, pregnant, or old patient). Later, the nurse has to insert the Emirates ID into the

keyboard's built-in smart card reader, and click on the "read EID" button in QMS to retrieve the patient's data, and check the patient in. Finally, the patient will be given a walk-in ticket to reserve the right of other appointment's patients and the same process of appointments will be followed to call the patients.

3.3.3. Technical Perspective of the Proposed Solution

The solution of patient's self-check-in was designed to enhance the current implemented QMS, and integrate it with the EMR solution. The goal of the solution is to achieve interoperability between QMS and EMR to minimize the spent time to identify the patients, triage them, and reduce the time for the patient's whole journey in healthcare organizations. The solution was implemented using HL7 standards and an integration engine as a middleware solution. The role of the integration engine is to include the developed integration interfaces and routes as per the specifications, and to work as translator for the sent and received messages between QMS and EMR.

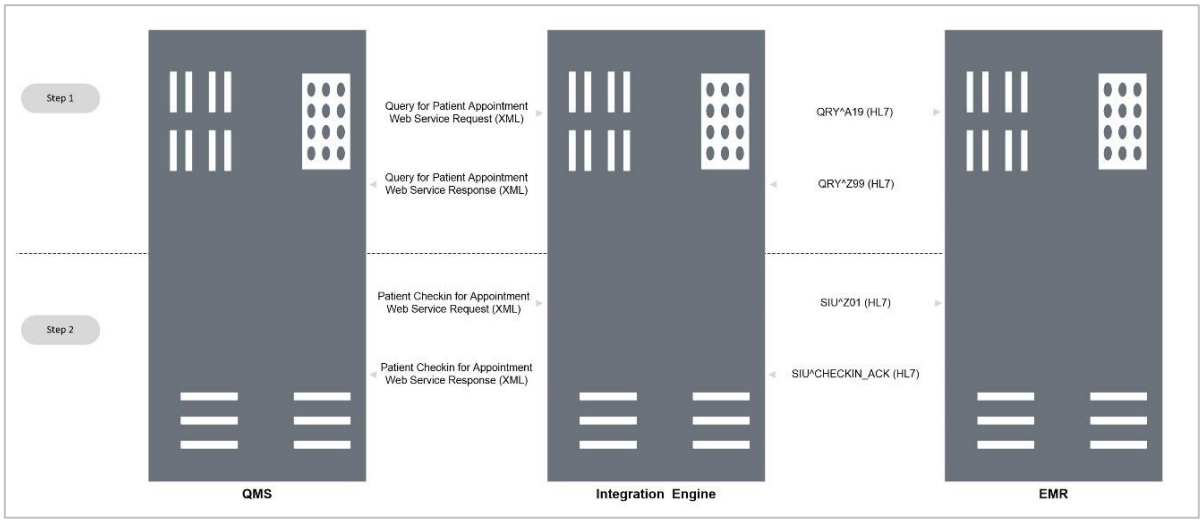

Figure 13. Integration Architecture Between QMS And EMR.

The designed integration is process-driven, the integration interfaces were designed to exchange the data between QMS, EMR, and the integration engine through two different and main steps as seen in figure 13. Each step to have a query-response mechanism with various

messages. Where QMS will send and receive XML messages, EMR will send and receive HL7 messages, while the integration engine sends and receives both messages depending on the purpose. Moreover, the solution was built based on the patient's Emirates ID as a unique identifier for each patient, to ensure the right process of patient's self-check-in.

Once the patient inserts the Emirates ID card into the built-in smart card-reader, QMS will collect the patient's information, send them through a request (XML message) to the integration engine as seen in figure 13, and the sample message in Table 12. Then the integration engine will parse the request, transform it to HL7 message and send to EMR as in step 2 in Table 12 (QRY^A19). EMR will process the ID number, check if it is available in its database, check the booked appointment(s), and reply back to the integration engine with HL7 message, as in step 1 (QRY^Z99) in Table 13. The reply message will include an acknowledgment code and the text message depends on the result of the process.

Table 11. First Step: Request Patient and Appointment Details for Verification.

1. Request from QMS to Integration Engine (XML).

```
<soap:Envelope xmlns:soap="http://www.w3.org/2003/05/soap-envelope" xmlns:hco="HCO">
  <soap:Header/>
  <soap:Body>
    <hco:getPatientAppointments>
      <hco:Identifier>784-1234-1234567-1</hco:Identifier>
      <hco:IdentifierType>National ID</hco:IdentifierType>
      <hco:FullNameEN>Adi AlQudah</hco:FullNameEN>
      <!--Optional:-->
      <hco:Clinic></hco:Clinic>
      <hco:MaritalStatus></hco:MaritalStatus>
      <hco:CardNumber></hco:CardNumber>
      <hco:DOB>01-01-1980</hco:DOB>
      <hco:Sex>Male</hco:Sex>
      <hco:Nationality>Jordan</hco:Nationality>
      <hco:ArabicNationalityAR>الأردن</hco:ArabicNationalityAR>
      <hco:CardHolderName>عدي القضاة</hco:CardHolderName>
    </hco:getPatientAppointments>
  </soap:Body>
</soap:Envelope>
```

2. Request from Integration Engine to EMR (HL7).

Message Template

MSH|^~&|Sending Application| Sending Facility|Receiving Application|Receiving Facility|Date/Time of Message| |QRY^A19|Message Control ID|D|2.3\r
QRD|QueryDate/Time|Query Format Code|Query Priority|Query ID| | |Quantity Limited Request|ID Number^Family Name^Given Name^^^^^^^^^Identifier type Code|What Subject Filter\r

- "Query Format Code" was hard-coded to "R": Response is in record-oriented format.
- "Query Priority" was hard-coded to "I": Immediate.
- "Quantity limited request" was hard-coded to "1^RD ": To contain maximum one record
- **QRY^A19**: to serve the patient query from another system (EMR).
- **QRD.8**: Who Subject Filter, **QRD.8.1**: ID Number, **QRD.8.2**: Family Name, **QRD.8.3**: Given Name, **QRD.8.13**: Identifier type Code.

Sample Message

MSH|^~&|ENGINE|HCO|EMR|HCO|20200401122430| |QRY^A19|5431ddb4-d0f9-fera-92a6-8341f83c6d50|D|2.3\r
QRD|20200401122430|R|I|Q123456| | |1^RD|784-1234-1234567-1^AlQudah^Adi^^^^^^^^^National ID|DEM|

Table 12. Second Step: Response with Details of Patient and Appointments.

1. Response from EMR to Integration Engine (HL7).

Message Template

MSH|^~&|Sending Application|Sending Facility|Receiving Application|Receiving Facility|Date/Time of Message| |QRY^Z99\r
MSA|Acknowledgment Code|Message Control ID|Text Message\r
QRD|QueryDate/Time|Query Format Code|Query Priority|Query ID| | |Quantity Limited Request|ID Number^Family Name^Given Name^^^^^^^^^Identifier type Code|What Subject Filter\r
PID|Set ID|Patient National ID| |Patient MRN|FullNameEn^FullNameAr| |Date of Birth|Sex| | | | | |Primary Language| | | | | | | | | | | |Nationality\r
ZAP|1|Appointment ID|Appointment Type|Clinic Name|Appointment Start Date/Time|Start Time|END Time|Appointment Resource\r

- **MSA.1**
  - AA: Record found
  - AE: for any error and the error text to be in MSA.3
- **ZAP**: Repetitive – One per appointment.
  - **ZAP.2**: Appointment ID.
  - **ZAP.3**: Appointment Type.
  - **ZAP.4**: Clinic Name.
  - **ZAP.5**: Appointment start date time format DD-MM-YYYY HH:MM:SS.
  - **ZAP.6**: Start time format HH:MM.
  - **ZAP.7**: End Time format HH:MM.
  - **ZAP.8**: Appointment Resource (Physician's name).

Sample Message

MSH|^~\\&|EMR|HCO|ENGINE|HCO|20200401122431| |QRY^Z99\r
MSA|AA|5431ddb4-d0f9-fera-92a6-8341f83c6d50|1 Appointment found in the system\r
QRD|20200401122431|R|I|Q123456| | |1^RD|784-1234-1234567-1^AlQudah^Adi^^^^MR^^^^^^^National ID|DEM \r
PID|1|784-1234-1234567-1| |121212 |Adi AlQudah^عدي القضاة| |19800101|Male| | | | | |Arabic| | | | | | | | | | | |Jordan\r
ZAP|1|2134732|Internal Medicine FU|HCO Internal Medicine OP|2020-0401-12:30:00|12:30|12:50|Khaled Shaalan

2. Response from Integration Engine to QMS (XML).

```
<soapenv:Envelope xmlns:soapenv="http://www.w3.org/2003/05/soap-envelope">
<soapenv:Body><hco:getPatientAppointmentsResponse xmlns:hco="HCO">
   <hco:ResponseCode>0</hco:ResponseCode>
   <hco:AppointmentCount>1</hco:AppointmentCount>
   <hco:Patient>
      <hco:MRN>121212</hco:MRN>
      <hco:EmiratesID>784-1234-1234567-1</hco:EmiratesID>
      <hco:FirstName>Adi</hco:FirstName>
      <hco:LastName>AlQudah</hco:LastName>
      <hco:PatientArabicName>عدي القضاة</hco:PatientArabicName>
      <hco:Gender>MALE</hco:Gender>
      <hco:DateOfBirth>19800101</hco:DateOfBirth>
      <hco:Language>Arabic</hco:Language>
   </hco:Patient>
   <hco:Appointment>
      <hco:AppointmentID>2134732</hco:AppointmentID>
      <hco:AppointmentType>Internal Medicine FU</hco:AppointmentType>
      <hco:ClinicName>HCO Internal Medicine OP</hco:ClinicName>
      <hco:AppointmentStartDateTime>2020-0401-12:30:00</hco:AppointmentStartDateTime>
      <hco:StartTime>12:30</hco:StartTime>
      <hco:EndTime>12:50</hco:EndTime>
      <hco:AppointmentResource>Khaled Shaalan</hco:AppointmentResource>
      <hco:AppointmentResourceID>Khaled.Shaalan</hco:AppointmentResourceID>
   </hco:Appointment>
</hco:getPatientAppointmentsResponse></soapenv:Body></soapenv:Envelope>
```

Depending on the received result from EMR (acknowledgment code), the integration engine will parse the message and transform it back to an XML message. Based on the received result, the new XML message will include a code and other patient and appointment(s) details (if any). The new XML file will be sent to QMS, as in step 2 in Table 13 to show a specific message on the kiosk screen. If the patient was found and appointment details were retrieved successfully, then the appointment details will be shown on the kiosk's screen, and the patient has to click

on the appointment to start the second step (check-in). Otherwise, the kiosk will show an error message to clarify the case and ask the patient to proceed to the reception counter to solve the encountered issue.

If the first step was successful, the second step would begin when the patient selects the appointment to be checked-in, then QMS will send a new XML request to the integration engine as presented in figure 12, and the first step in Table 14. The XML file will be transformed by the integration engine to HL7 with custom trigger-event for appointment check-in “SIU^Z01”, the new HL7 message to be sent to EMR as in step 2 in Table 14.

Finally, the EMR will receive the message, the selected appointment will be checked-in automatically in EMR, and the status will be changed to "checked-in" and updated in the database. The EMR will reply with HL7 response that includes the acknowledgment message and successful HL7 message will be sent to the integration engine, as in step 1 in Table 15, that will pass the code ”0” through XML message to QMS as in the step 2 in Table 15, so the kiosk to print the ticket. Otherwise, the kiosk will show a message requesting the patient to proceed to the clinic’s reception for additional assistance.

Table 13. Third Step for Check-in Request.

1. Request to Check-in from QMS to Integration Engine (XML).

```
<soap:Envelope xmlns:soap="http://www.w3.org/2003/05/soap-envelope" xmlns:hco="HCO">
  <soap:Header/>
  <soap:Body>
    <hco:patientCheckIn>
      <hco:Patient>
        <hco:MRN>121212</hco:MRN>
        <hco:EmiratesID>784-1234-1234567-1</hco:EmiratesID>
        <hco:LastName>AlQudah</hco:LastName>
        <!--Optional:-->
        <hco:PatientArabicName>عدي القضاة</hco:PatientArabicName>
        <hco:Gender>MALE</hco:Gender>
        <hco:DateOfBirth>19800101</hco:DateOfBirth>
        <!--Optional:-->
        <hco:Language>Arabic</hco:Language>
      </hco:Patient>
      <hco:Appointment>
        <hco:AppointmentID>2134732</hco:AppointmentID>
        <hco:AppointmentType>Internal Medicine FU</hco:AppointmentType>
        <hco:ClinicName>HCO Internal Medicine OP</hco:ClinicName>
        <hco:StartTime>12:30</hco:StartTime>
        <hco:EndTime>12:50</hco:EndTime>
        <hco:AppointmentStartDateTime>2020-0401-12:30:00</hco:AppointmentStartDateTime>
      </hco:Appointment>
    </hco:patientCheckIn>
  </soap:Body>
</soap:Envelope>
```

2. Request to Check-in from Integration Engine to EMR (HL7).
Message Template
MSH|^~&|Sending Application|Sending Facility|Receiving Application|Receiving Facility|Date/Time of Message| |SIU^Z01|Message Control ID|D|2.3\r **SCH**|Appointment ID| | | | | |Appointment Type|||Appointment Timing Quantity:^^^Start Date/Time^ End Date/Time\r **PID**|Set ID|Patient National ID| |Patient MRN|FullNameEn^FullNameAr| |Date of Birth|Sex| | | | | |Primary Language| | | | | | | | | | | |Nationality\r
• **SIU^Z01**: Custom trigger for appointment check-in.
Message Sample
MSH|^~&|ENGINE|HCO|EMR|HCO|20200401122433| |SIU^Z01|08574b23-0bbd-7d80-c1fe-cfad87b5d3a0|D|2.3\r **SCH**|2134732||||||Internal Medicine FU||||^^^20200401123000^20200401125000\r **PID**|1|784-1234-1234567-1| |121212 |Adi AlQudah^عدي القضاة| |19800101|Male| | | | | |Arabic| | | | | | | | | | | |Jordan\r

Table 14. Final Step to Acknowledge the Success of "Check-in" Request.

1. Response to Check-in from EMR to Integration Engine (HL7).
Message Template
MSH|^~&|Sending Application|Sending Facility|Receiving Application|Receiving Facility|Date/Time of Message| |ACK|Message Control ID|D|2.3\r **MSA**|Acknowledgment Code|Message Control ID\r

• **ACK**: General acknowledgment.
• **MSA.1**
  – AA: Record found
  – AE: for any error and the error text to be in MSA.3

Message Sample
MSH|^~&|EMR|HCO|ENGINE|HCO|20200401122436||ACK|08574b23-0bbd-7d80-c1fe-cfad87b5d3a0|D|2.3\r **MSA**|AA|08574b23-0bbd-7d80-c1fe-cfad87b5d3a0\r
2. Step 8: Response to Check-in from Integration Engine to QMS (XML).
<hco:patientCheckInResponse> <hco:ResponseCode> 0 </hco:ResponseCode> </hco:patientCheckInResponse>

Chapter 4

Experiment Simulation

Objectives

- Present the pre- optimization and post-optimization experiments.
- Report experiments results and discuss findings.

4. Experiment Simulation

4.1. Overview

This chapter will present the conducted experiments that will assess the new optimizations, especially the patient's self-check-in solution and its feasibility, before it can be used widely in the healthcare organization as an innovative solution. As well, the chapter will present the simulation experiments and the approach to achieve these experiments. Finally, the chapter will report the findings of the simulation experiments along with the related implications.

4.2. Simulation Methodology

In the recent years, discrete-event simulation approach has been recognized as a significant tool to enhance the healthcare services (Brailsford et al. 2016; Perez, Anandhan & Novoa 2020). This research has employed a discrete-event simulation (DES) approach by breaking-down the process into five different stages as seen in Table 15.

In March 2020, the simulation experiments have taken place for two different weeks: control and intervention weeks. For more accurate and broader range of results, it was decided to conduct the solution experiments as a pilot in three of the busiest clinics. These clinics include, internal medicine, orthopedics, and ENT clinics. In addition, 9 AM till 1 PM are peak hours, so the included appointments in the experiment were booked in these hours and for two physicians from each clinic.

Table 15. The Stages in the Patient's Journey.

Stage	Code	Description
Time to Identification	**TID**	The time interval between the patient's arrival and the identification for him/her by the hospital system.
Wait to Triage	**WTRG**	The time interval between the completion of patient's identification and the beginning of triage process.

Triage	**TRG**	The time interval required to complete the triage process
Wait to Treatment	**WTRT**	The time interval between the completion of triage and the beginning of treatment process.
Treatment	**TRT**	The time interval required to complete the treatment process
Whole Journey	**WJR**	The time interval between patient's arrival till the completion of physician assessment.

4.2.1. Design and Settings

4.2.1.1. Control Week

The first experiment (control) took place for one week, where the patient will be identified using the usual identification and triage processes (routine). The primary goal of the first experiment is to identify and record the time spent to complete each stage within the patient's journey in the hospital; before applying the new solution. In the control week, the patient's identification stage is the time interval between the patient's arrival and the identification by the clinical staff. The patients are identified by receptionists using the regular pre-triage process. Usually, there are three receptionists in the internal medicine and orthopedics clinics, along with three triage nurses, at any time to serve patients. While the ENT clinic has two receptionists and only one triage nurse. Each receptionist has a ticketing solution installed on the computer, while all computers are connected to one thermal ticket printer. The receptionist has to call each patient manually in order to check Emirates ID, documents, and appointment details before giving him/her a ticket (number). Then the process will be followed as illustrated earlier in the current state of QMS. Regularly, patients are given appointments from 8 am to 5 pm, but it was found that there are four peak hours in those selected clinics, from 9 am till 1 pm. So, these busy hours were considered eligible hours to conduct the study, and any appointment booked during these peak hours was included in the study.

4.2.1.2. Intervention Week

The second experiment is simply a simulation that took place for one intervention week, where the patient will be requested to bring the Emirates ID and use the self-check-in kiosk. Two kiosks were installed in the lobby of OPD, and each kiosk has a built-in smart card reader. The "To Be" process is to be followed, as discussed earlier. The primary goal of the simulation is to identify and record the spent time to complete each clinical stage within the patient's journey; after using the new solution. The patient's identification stage in intervention week can be defined as the time interval between entering the ID to the kiosk's reader and the identification for the patient by the EMR solution. Similar to the control week, the simulation took place in the same three selected clinics and considered any appointment that was booked from 9 am till 1 pm.

4.2.2. Data Collection

In the control week, the time of the patient's arrival to clinic reception was recorded manually by the researcher with the help of one receptionist in each clinic. The total identification time was calculated from the time of patient's arrival till obtaining the ticket printing time from QMS. The time to complete other stages was collected and recorded for each patient through QMS. During the intervention week, the data were completely extracted from QMS.

4.2.3. Data Analysis

Prior to the statistical analysis, the collected data were studied to classify each stage in each appointment as "within the target" and "out of target"; as per the set of targets recommended by the quality department. Those targets were studied in order to evaluate if the proposed solution will help to improve the performance and achieve targets. Also, a score was given to each stage in each appointment depends if the stage met the target or not. A score of "2" in case

the stage has met the required target and score of "1" if it failed to meet the target. The required target for each stage can be found in Table 16.

Table 16. Required Targets of Patient's Journey Stages.

Stage	Code	Target (minutes)
Time to Identification	**TID**	**5**
Wait to Triage	**WTRG**	**7**
Triage	**TRG**	**3**
Wait to Treatment	**WTRT**	**10**
Treatment	**TRT**	**15**
Whole Journey	**WJR**	**40**

Data statistical analysis was performed using SPSS v.25 (SPSS® Statistics 25.0 - Overview | IBM 2017). Nonparametric tests were used to overcome any issues related to the non-normality distribution (Marusteri & Bacarea 2010). So, a comparison for "meeting the target" as categorical data (1,2) was achieved using the classical Chi^2 test, and the results were presented as percentages (Kwa & Blake 2008). The two groups (control and intervention) are independent, so the Mann-Whitney U test was employed (Marusteri & Bacarea 2010) to compare the differences in median time to complete each stage, along with interquartile ranges (Kwa & Blake 2008).

4.3. Simulation Results and Discussion

After the exclusion and analysis for collected appointments' data, a total of 517 appointments were considered valid to be added to the experiment. Out of 306 total appointments booked in the peak hours for the six physicians in the control week, only 273 (89.22%) were found to be eligible appointments and included in the study. On the other hand, intervention week reported 338 total booked appointments for the six physicians in the peak hours, but only 244 (72.19%)

were found to be eligible appointments. There was a total of 94 eliminated appointments, 11 were not included because patients did not bring their Emirates ID, 7 due to staff mistake, while the rest were excluded due to the "No show" state. The high rate of "No show" (22.49%) was driven by the situation of the Covid-19 virus and the precautionary measures and recommendations. All appointments' characteristics can be seen in Table 17.

Table 17. Characteristics of Appointment.

Characteristic	Control	Intervention
Total Appointments	306	338
Average Appointment / Day	61.2	67.6
Total Valid Appointments	273 (89.22%)	244 (72.19%)
Valid Appointment / Day	54.6	48.8
Target – Patient Journey		
Within Target	2 (0.73%)	136 (55.74%)
Out of Target	271 (99.27%)	108 (44.26%)
Gender		
Female	96 (35.16%)	116 (47.54%)
Male	177 (64.84%)	128 (52.46%)

The results in Table 18 show that there is a significant rise in the percentage of "met target" (5 minutes for the identification stage from 0% to 100%. Although the target was set to be 5 minutes, the mean value for identification stage in the intervention week was only (μ =18, σ=1) in seconds. This indicates a peerless success for the self-check-in solution in the matter of reducing the time to identify the patients. Consequently, the percentage of "met target" for the whole patient's journey got increased to reach 55.74% in the intervention sample, instead of only 0.73% in the control sample. As well, the improvement of the whole journey in "met target" was achieved because of the significant improvement in "met target" in the "Wait to Triage" and "triage" stages. Although it is hard to determine the exact cause of these significant improvements, it is likely referred to the new self-check-in solution. During the intervention week, it was observed that the triage nurses were busy all the time and could call the patients more quickly. There was no need for the triage nurse to sit inactive awaiting the next patient to be checked-in as in the regular process.

Table 18. Performance Targets – Comparison.

Stage	Control		Intervention		Target (min)	Absolute Difference % (95% CI)	**P_{value}
	Total*	Met Target % (95% CI)	Total*	Met Target % (95% CI)			
TID	0	0 (0,0)	244	100 (100, 100)	≤ 5	100 (100, 100)	.000***
WTRG	73	26.74 (21.46, 32.02)	99	40.57 (34.37, 46.77)	≤ 7	13.83 (5.70, 21.96)	.001**
TRG	96	35.17 (29.47, 40.87)	177	72.54 (66.90, 78.18)	≤ 3	37.37 (29.37, 45.37)	.000***
WTRT	49	17.95 (13.37, 22.53)	38	15.57 (10.99, 20.15)	≤ 10	- 2.38 (-8.84, 4.08)	.471
TRT	125	45.79 (39.84, 51.74)	118	48.36 (42.05, 54.68)	≤ 15	2.57 (-6.08, 11.22)	.558
WJR	2	0.73 (-0.29, 1.75)	136	55.74 (49.46, 62.01)	≤ 40	55.01 (48.65, 61.36)	.000***

**Total Number of appointments that met the target.*
Significance level at p<0.001, p**<0.01, p* <0.05.*

Figure 14. Total Appointments that Met the Target (Control vs Intervention).

On the other hand, the analysis found that the median time to identify patients was 0.3 (0.28 – 0.32) minutes in the intervention instead of 10.37 (8.90 – 12.88) minutes for the control patients, so the difference is 10:04 minutes. In addition, it was found that applying the new solution had a significant positive effect on the median time to complete the patients' journey. The difference in median time for the patients' journey was found to be 14:11 minutes as in Table 19.

Table 19. Median Time to Complete – Comparison.

Stage	Control	Intervention	Difference (min)	*P_{value}
	Median time to complete (IQR)	Median time to complete (IQR)		
TID	10.37 (8.90 – 12.88)	0.3 (0.28 – 0.32)	- 10:04	.000***
WTRG	8.57 (7.00 – 11.17)	7.57 (5.55 – 8.93)	- 01:01	.000***
TRG	3.20 (2.57 – 3.52)	2.48 (1.93 – 3.12)	- 00:43	.000***
WTRT	13.92 (11.53 – 18.37)	13.60 (11.53 – 16.79)	- 00:19	.0.259
TRT	16.07 (14.00 – 18.87)	15.37 (13.23 – 17.87)	- 00:42	0.023*
WJR	53.45 (49.65 – 58.38)	39.26 (36.18 – 44.13)	- 14:11	.000***

Significance level at p*<0.001, p**<0.01, p* <0.05.*

Figure 15. Median Time to Complete (Control vs Intervention).

Despite the drop of 19 seconds in the median time to complete the "wait to treatment" stage as in Table 19, the analysis found that there is also a drop of 2.38 in the percentage of appointments that could meet the target for "wait to treatment" as in Table 18. Although the results are not significant, it is worth to understand the root cause. The spent time waiting to see the physician is a complex variable that depends on other factors, the specialty of each physician, appointment type (new, follow up, referral…etc.), and the availability of assistant nurse. Moreover, A significant improvement was observed in the median time to complete the treatment stage (-

00:42, P=0.023), but the treatment stage could not significantly be improved to meet the recommended target (≤ 15 min), and the difference was (2.57, P=0.558).

4.4. Conclusion of the Simulation

The main goal of conducted simulation experiments was to assess the new optimizations, especially the patient's self-check-in solution and its feasibility. Self-check-in as a novel innovative solution could enhance the experience of patients during their journey in the outpatient department. The abovementioned findings could prove that the solution is feasible to minimize the time to complete the whole patient's journey and other stages. Finally, the simulation model and experiments were built based on real appointments in OPD that can be similar in other healthcare facilities in the UAE or other developing countries. Therefore, the experiments can be simply adapted to study other technology solutions in the outpatient departments. Besides, the computational outcomes could provide insights regarding the ability of generalization in other healthcare facilities.

Regardless the success of the simulation experiments, it is mandatory to address the faced limitations of those experiments. Firstly, collecting the required business and workflow specifications to change the identification and check-in processes. Secondly, although the sample size was sufficient to perform significant statistical analysis but it was not very large, which may impact the accuracy of the results. The sample size was affected by the limited time (2 weeks) to conduct the experiment. Moreover, the limited time of the experiment was mandatory to ensure that the investigation will not affect the health services or distract the staff from their tasks. Finally, the study took place in March 2020, and the number of appointments was negatively impacted by the precautionary measures of the Covid-19 virus.

Chapter 5

Research Model and Hypotheses

Objectives

- Present the relationships between the extensively studied constructs.
- Discuss the concept of each construct.
- Develop the research hypotheses.
- Construct the research model.

5. Research Model and Hypotheses

5.1. Overview

As per the findings of the conducted systematic literature review, TAM and UTAUT are the extensively used technology acceptance models in the healthcare field in the recent decade (See Figure 2). Several studies have utilized integrated models based on various acceptance models (Hsieh, Lai & Ye 2014; Sezgin & Özkan-Yıldırım 2016; Ku & Hsieh 2018). This chapter aims to study those most used constructs from different technology acceptance models, integrate them along with injecting the external factors that have been extensively used as per the analyzed studies (Table 7) through the conducted systematic literature review.

The key purpose of this chapter is to develop an integrated theoretical model based on the extensively used factors, and their most confirmed relationships within the technology acceptance of the healthcare domain as in the recent literature.

5.2. Research Framework

The integrated theoretical model was developed based on the constructs of UTAUT (Venkatesh et al. 2003), and included the attitude towards use from the technology acceptance model (TAM) (Davis 1989), computer self-efficacy, and computer anxiety from social cognitive theory (SCT) (Bandura 1977, 1986), trust (Gefen, Karahanna & Straub 2003), and innovativeness (Agarwal & Prasad 1998a) as external factors. Apart from the healthcare, TAM was recognized as the gold standard (Holden & Karsh 2010; Kim et al. 2016), but UTAUT has shown (20-30%) better explanatory power than TAM, which means (40-50%) of the explanatory power regarding the behavior intention of end-users (Venkatesh et al. 2003; Kim et al. 2016). These were the core reasons to choose UTAUT as a base model to explore the

technology acceptance in the healthcare domain. The developed model was inspired by the work of Kim et al. that presented a comparison model (Kim et al. 2016) between TAM and UTAUT in the healthcare domain. The comparison based on the intersections between constructs of technology acceptance models as seen below in Table 20. The comparison confirmed the similar concepts of performance expectancy (PE) and perceived usefulness (PU), effort expectancy (EE) and perceived ease of use (PEOU), use behavior (UB) and actual use (AU), and behavioral intention to use (BI) in both models. As well, the developed model in this research included the "attitude towards use" factor from TAM, so it has the basic concept in which the usage attitude of end-users is related to their behavioral intention to use the technology at the actual site (Price & Lau 2014; Kim et al. 2016).

To expand its predictive power, the integrated theoretical model concentrated on the users' beliefs by adding trust factor as it influences the user's confidence to obtain better performance results while using the technology (Beldad & Hegner 2018). Also, computer self-efficacy and computer anxiety are considered significant determinants of ease of use (Venkatesh 2000; Venkatesh & Bala 2008). Therefore, the injection of factors from SCT was essential to explore the user's confidence level to perform his/her tasks while using the technology (computer self-efficacy), and to understand whether he/she is worried about making mistakes during the usage of the technology (computer anxiety) (Venkatesh et al. 2003). Finally, user's behavior towards technology acceptance and adoption is influenced by particular technological personality variables such as innovativeness (Agarwal & Prasad 1998b; Rajanen & Weng 2017), which is related to a person's willingness to try and use new technology (Beglaryan, Petrosyan & Bunker 2017).

5.3. Relationships Between Technology Acceptance Constructs

Several intersections and similarities between constructs are exist within various technology acceptance models, where these constructs have similar definitions, concepts and effect on the user's acceptance of technology (Venkatesh et al. 2003). Determination for such intersections between constructs can help to build more accurate technology acceptance model, without repetition for similar concepts.

In details, (Venkatesh et al. 2003) have achieved a thorough comparison between various technology acceptance models and their constructs. In brief, the following concepts were pointed out:

- ✓ The constructs from other technology acceptance models that pertain and relate to Performance Expectancy (PE) include: "Perceived Usefulness" in TAM/TAM2 and C-TAM-TPB, "Job Fit" in (MPCU), "Outcome Expectations" in SCT, "Extrinsic Motivation" in MM and "Relative Advantage" in IDT.
- ✓ The constructs from other technology acceptance models that capture the similar concept of Effort Expectancy (EE) include: "Perceived Ease of Use" in TAM/TAM2, "Ease of Use" in IDT and "Complexity" in MPCU.
- ✓ Social Influence (SI) construct is represented in other technology acceptance models by other constructs include: "Subjective Norm" in TRA, TAM2, C-TAM-TPB and TPB/DTPB, "Image" in IDT and "Social Factors" in MPCU.
- ✓ Facilitating Conditions (FC) construct is denoted in other technology acceptance models by other constructs include: "Perceived Behavioral Control" in C-TAM-TPB and TPB/DTPB, "Compatibility" in IDT and "Facilitating Conditions" in MPCU.

Similarly, (Kim et al. 2016) have presented a comparison model between the constructs of technology acceptance model (TAM) (Davis 1989), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) in the healthcare domain. The comparison has presented the following thoughts:

- ✓ Performance Expectancy (PE) from UTAUT and Perceived Usefulness (PU) from TAM have similar concept and impact.
- ✓ Effort Expectancy (EE) from UTAUT and Perceived Ease of Use (PEOU) from TAM have similar idea and effect.
- ✓ Behavioral Intention to Use (BI) factors in UTAUT and TAM present same concept and definition.
- ✓ Use Behavior (UB) from UTAUT and Actual Use (AU) from TAM have mutual idea and definition.

TAM as proposed in (Davis 1989), is the most widely employed acceptance model to solve the research issue; whether end users are willing to actively accept and use new technology. However, the model lacks the variety of variables that impact the situation, so it was modified to fulfill the needs of any specific research before its application (Kim et al. 2016). The work of (Venkatesh et al. 2003) has presented an integrated model and suggested UTAUT with better and more explanatory power than other models. Additionally, the healthcare domain is actively conducting researches on the acceptance of end-users involving the hypotheses that were proposed by UTAUT (Holden & Karsh 2010; Gagnon, Desmartis, et al. 2012; Esmaeilzadeh et al. 2015; Maillet, Mathieu & Sicotte 2015; Perlich, Meinel & Zeis 2018; Venugopal et al. 2019).

Consequently, this research will utilize UTAUT as a basic framework to develop the integrated theoretical model that will be used to understand the intention and actual use of healthcare staff to use technology. Also, the mutual constructs of UTAUT and TAM will be covered by UTAUT

constructs. Table 20 below shows the technology acceptance constructs and their similarities as were extensively studied in the healthcare domain through the recent decade.

All constructs presented in this research were identified, and the external factors that were frequently utilized were defined in all the valid papers from the systematic literature review. To increase the level of confidence regarding the power of association, the relationship between any two constructs was also evaluated and verified in three or more valid studies from the conducted systematic literature review. The intersections (similarities) concept between the constructs was taken into account while evaluating those relationships, as presented in Table 21. Thus, the same concept will be applied later in this research to develop the research hypotheses.

Table 20. Most Used Constructs and Their Similarities from Other Models.

Sr.	Code	Construct	Source Model	Similar Construct(s)	
				Construct	Model
1	PE	Performance Expectancy	UTAUT	Perceived Usefulness	TAM/TAM2, C-TAM-TPB
				Job Fit	MPCU
				Outcome Expectations	SCT
				Extrinsic Motivation	MM
				Relative Advantage	IDT
2	EE	Effort Expectancy	UTAUT	Perceived Ease of Use	TAM/ TAM2
				Ease of Use	IDT
				Complexity	MPCU
3	SI	Social Influence	UTAUT	Subjective Norm	TRA, TAM2, C-TAM-TPB TPB/DTPB
				Social Factors	MPCU
				Image	IDT
4	FC	Facilitating Conditions	UTAUT	Perceived Behavioral Control	TPB/DTPB, C-TAM-TPB
				Facilitating Conditions	MPCU
				Compatibility	IDT
5	AT	Attitude Towards	TAM	Attitude Towards	TPB, TRA
6	INV	Innovativeness	EXTERNAL	(Agarwal & Prasad 1998a)	
7	TRU	Trust	EXTERNAL	(Gefen, Karahanna & Straub 2003)	
8	CSE	“Computer” Self-Efficacy	SCT	(Taherdoost 2018)	
9	ANX	“Computer” Anxiety	SCT	(Taherdoost 2018)	
10	BI	Behavioral Intention	UTAUT	Behavioral Intention	TAM, TPB, TRA
11	UB	Use Behavior	UTAUT	Actual Use	TAM

Table 21. Confirmed Relationships as Per the Systematic Literature Review.

Sr.	Confirmed Relationships	Compatible Relationships
1	PEOU → PU	EE → PE
2	PEOU → AT	EE → AT
3	PEOU → BI	EE → BI
4	PU → AT	PE → AT
5	PU → BI	PE → BI
6	AT → BI	AT → BI
7	BI → AU	BI → UB
8	FC → BI	FC → BI
9	FC → AU	FC → UB
10	SI → PU	SI → PE
11	SI → BI	SI → BI
12	CSE → PEOU	CSE → EE
13	CSE → PU	CSE → PE
14	INV → PEOU	INV → EE
15	ANX → PEOU	ANX → EE
16	TRU → PU	TRU → PE

5.4. Constructs of Research Model

5.4.1. Performance Expectancy (PE)

Performance Expectancy was clarified as the point where someone is confident that using an information technology can facilitate to obtain more gains in the job performance (Venkatesh et al. 2003; Topacan, Basoglu & Daim 2008; Ahmadi et al. 2017). It was confirmed that performance expectancy positively influences behavioral intention in healthcare (Ahmadi et al. 2017; Khan et al. 2018; Venugopal et al. 2019; Farhady, Sepehri & Pourfathollah 2020; Pagaling et al. 2021). Furthermore, the concept that perceived usefulness positively influences attitude towards using a technology was applied to this research model as proposed in TAM (Davis 1989). Therefore, it was hypothesized that attitude is positively affected by performance expectancy since it denotes a similar concept of perceived usefulness. So, the following hypotheses have been developed:

H1a: Performance expectancy is positively influencing the behavioral intention to use QMS in healthcare domain.

H1b: Performance expectancy is positively influencing the attitude towards using QMS in healthcare domain.

5.4.2. Effort Expectancy (EE)

Effort Expectancy was described as the point of ease linked or extent of convenience when using the technology solution (Venkatesh et al. 2003; Ahmadi et al. 2017). It was verified that effort expectancy positively influences the behavioral intention in the healthcare domain (Ahmadi et al. 2017; Khan et al. 2018; Venugopal et al. 2019; Farhady, Sepehri & Pourfathollah 2020; Shiferaw et al. 2021). The concepts that ease of use positively influences perceived usefulness and attitude towards use were applied as suggested in TAM (Davis 1989). So, it is assumed that performance expectancy is positively influenced by effort (Spatar et al. 2019; Yavuz et al. 2021) since effort expectancy and performance expectancy denote similar concepts of perceived ease of use and perceived usefulness, respectively. This is in addition to the positive impact of effort expectancy on users' attitudes (Spatar et al. 2019). Therefore, the following hypotheses are proposed:

H2a: Effort expectancy is positively affecting the performance expectancy of QMS in healthcare domain.

H2b: Effort expectancy is positively affecting the behavioral intention to use QMS in healthcare domain.

H2c: Effort expectancy has a positive effect on the attitude towards using QMS in healthcare domain.

5.4.3. Social Influence (SI)

Social influence and subjective norms have a similar concept that signifies the insight of someone regarding the importance of social actors who expect him/her to use technology (Basak, Gumussoy & Calisir 2015; Rajanen & Weng 2017; Pagaling et al. 2021). Social influence concerns about the opinion of people that an individual respects or cares about

(Mansur, Fatma 2016). It was confirmed that perceived usefulness is sensitive to the social influence (Li et al. 2019; Hsiao & Tseng 2020). Also, social influence was found to be a positive influencer for the behavioral intention to use technology in the healthcare environments (Khan et al. 2018; Venugopal et al. 2019; Alam et al. 2020). Therefore, the following hypotheses were developed:

H3a: Social influence positively influences the performance expectancy of QMS in healthcare domain.

H3b: Social influence positively influences the behavioral intentions of healthcare staff to use QMS.

5.4.4. Facilitating Conditions (FC)

Facilitating conditions are related to the state when an individual has the required helpful sources and materials, the users including top management who can provide support and guidance, instructions or manuals to use the information technologies (Ifinedo 2012; Mansur, Fatma 2016; Lee, Tsai & Ruangkanjanases 2020). It was verified by (Devine 2015; Khan et al. 2018; Wang, Tao, et al. 2020) that the behavioral intention of healthcare staff to use technology could be pushed forward (positively) by facilitating conditions factor. Also, the work of (Ifinedo 2012; Khan et al. 2018; Garavand et al. 2019; Alam et al. 2020; Aljarboa & Miah 2020) could confirm that facilitating conditions positively impact the usage behavior of information systems in healthcare. Accordingly, the following hypotheses are put forward:

H4a: Facilitating conditions positively influence the healthcare staff's behavioral intentions to use QMS.

H4b: Facilitating conditions positively influence the healthcare staff's use behavior of QMS.

5.4.5. Attitude Towards Use (AT)

Attitude signifies the degree of someone's evaluative effect or feelings regarding performing a target behavior as defined by (Davis 1985; Davis, Bagozzi & Warshaw 1989), who could confirm that attitude towards using technology positively affects the behavioral intention of using technology. Similarly, it was verified by (Tao et al. 2019; Dogan Kumtepe et al. 2021) that attitude towards using a technology is motivating the behavioral intention in the healthcare field. Moreover, (Venugopal et al. 2019; Alam et al. 2020) found that behavioral intention to use technology has a positive influence on the use behavior of that technology in healthcare. Hence, this leads to the following hypotheses:

H5: Healthcare users' attitude towards using technology has a positive effect on the behavioral intention to use QMS.

H6: Healthcare users' behavioral intention has a positive effect on the use behavior of QMS.

5.4.6. Computer Self-efficacy (CSE)

Computer self-efficacy is considered a crucial determinant to ensure the comprehension of the user's acceptance and system usage (Venkatesh & Davis 1996). Such comprehension can easily and effectively use the technology (i.e., ease of use and usefulness). Computer self-efficacy has a direct positive effect on perceived ease of use, which results in an indirect positive significant impact on the intention to use technology by physicians (Sarlan et al. 2012; Basak, Gumussoy & Calisir 2015). Although the results, as reported by Gagnon (Gagnon et al. 2014) didn't prove the direct positive impact of computer self-efficacy on the technology usage intention by physicians, but the direct positive impact towards the ease of use has been examined and proved by the same scholars. As well, the work of (Alhasan et al. 2020) could confirm the significant influence of computer self-efficacy on the perceived ease of use. On the other hand, it has been discussed and confirmed by (Chow et al. 2012; Rho, Choi & Lee 2014; Alhasan et al. 2020)

that self-efficacy in the healthcare domain retains a direct positive influence on perceived usefulness. Consequently, the following hypotheses have been developed:

H7a: Computer self-efficacy positively influences the performance expectancy of QMS.

H7b: Computer self-efficacy positively influences the effort expectancy of QMS.

5.4.7. Trust (TRU)

Many models of technology acceptance have included trust construct since trust, privacy concerns, and usefulness affect the attitude towards using e-health technologies (Sun & Rau 2015). Trusting the creator of a technology can impact the user's intention to use that technology, especially in the case of using location sharing or online exchanges (Beldad & Hegner 2018). It was also confirmed by (Mohamed, Tawfik, Norton, et al. 2011; Beldad & Hegner 2018; Dhagarra, Goswami & Kumar 2020) that trust has a positive impact on the perceived usefulness. Thus, this leads to the following:

H8: Trust has a positive effect on the performance expectancy of QMS.

5.4.8. Computer Anxiety (ANX)

Computer Anxiety is related to the apprehension, worries, and fears of people that include being worried about making mistakes or losing data when using information systems or technology based on computers (Sarlan et al. 2012; Vitari & Ologeanu-Taddei 2018). As proposed by Tung and Chang (Tung & Chang 2008), computer anxiety has a negative effect on the duration of using computers, where a user with a higher level of anxiety will reject to use information technologies. Besides, researches point out that it is significant to consider the users' emotions into account by developing user-friendly interfaces (Demirkol et al. 2020). Also, it was verified that there is a negative correlation between computer anxiety and the perceived ease of use (Sarlan, Ahmad, Ahmad, et al. 2013; Beglaryan, Petrosyan & Bunker 2017; Tsai et al. 2020; Al-Maroof, Alshurideh, et al. 2021). Accordingly, the following hypothesis is proposed:

H9: Computer anxiety has a negative effect on the effort expectancy of QMS.

5.4.9. Innovativeness (INV)

As stated by (Agarwal & Prasad 1998b; Beglaryan, Petrosyan & Bunker 2017), innovativeness is related to a person's willingness to try and use new technology. In other words, an individual with a higher degree of personal innovativeness may have a larger desire and more positive influence to use new innovative technologies regardless of the level of risks or uncertainties. Higher innovativeness can cause positive opinions regarding using a particular system (Lewis, Agarwal & Sambamurthy 2003; Alsyouf 2021). As it was confirmed, the innovativeness of a person can positively influence the ease of use of technologies in healthcare (Wu, Li & Fu 2011; Huang 2013; Basak, Gumussoy & Calisir 2015; Beglaryan, Petrosyan & Bunker 2017; Sun et al. 2019; Octavius & Antonio 2021). So, the following hypothesis has been developed:

H10: The user's innovativeness has a positive effect on the effort expectancy of QMS.

5.5. Research Model

From the above developed hypotheses, the research model for technology acceptance in healthcare has been constructed as presented in Figure 16.

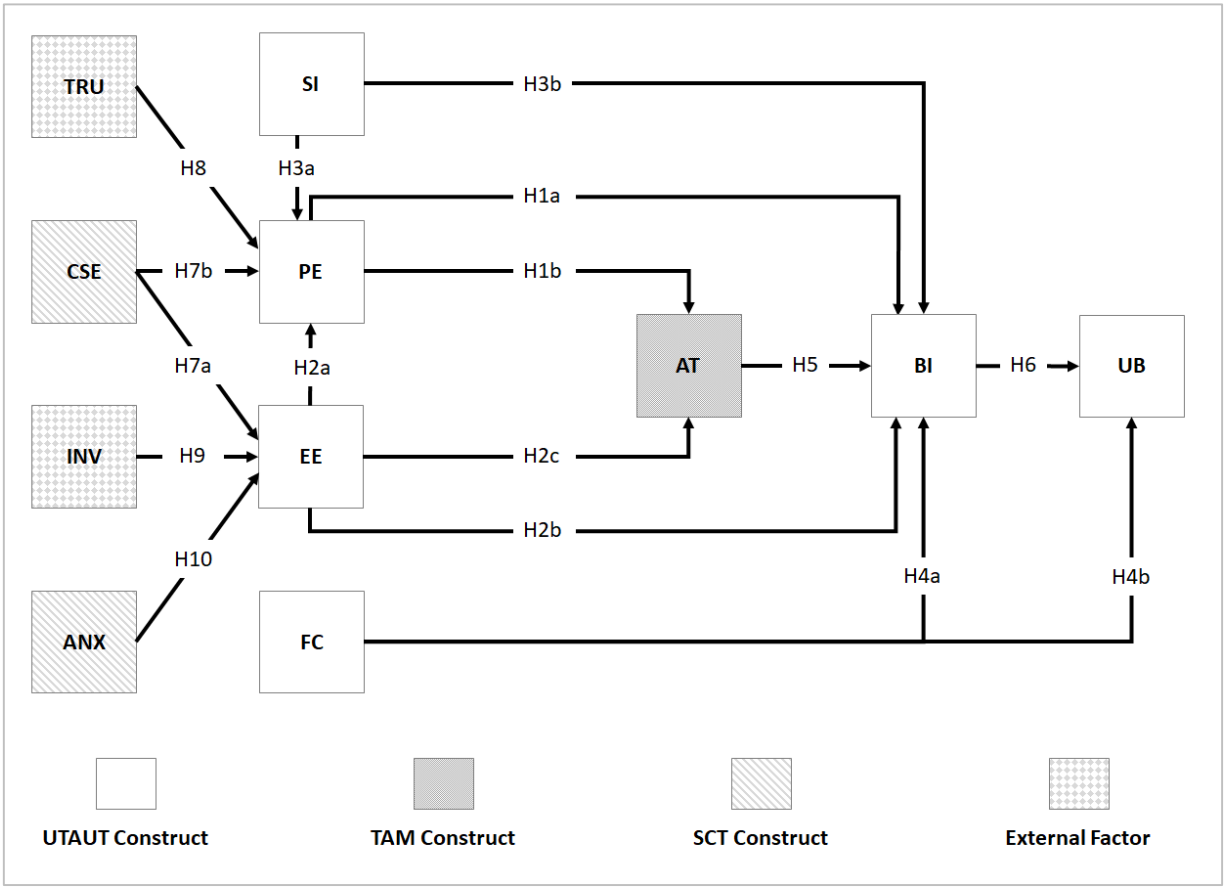

Figure 16. Research Model – The Integrated Theoretical Model.

Chapter 6

Research Methodology

Objectives

- Explain the professionals' acceptance to use QMS in the healthcare.
- Clarify the target population and data collection process.
- Develop the research instrument and clarify its structure.

6. Research Methodology

6.1. Overview

This chapter will explain the used methodology to analyze the professionals' acceptance and actual use of QMS in the healthcare domain in UAE. The research main purpose was to build an integrated theoretical model for the technology acceptance in healthcare. The integrated model included UTAUT core constructs, (i.e., performance expectancy, effort expectancy, social influence and facilitating conditions, behavioral intention to use, and usage behavior). As well, the model has considered the "attitude towards usage" construct from TAM, computer anxiety and computer self-efficacy from SCT. Finally, two additional external factors were added, innovativeness and trust their influence were noticed through the conducted systematic literature review.

In order to evaluate the constructed integrated model, the research has employed an online survey with a 5-point Likert scale, to collect responses from healthcare professionals in healthcare organization that have different clinics and successfully implemented QMS. The objective is to evaluate the acceptance to use QMS by healthcare professionals. The valid collected questionnaires were analyzed by utilizing the structure equation modelling (SEM) to examine the constructed hypotheses as clarified in the previous chapter. The participants are presented and the surveys structure is clarified below in detail.

6.2. Participants and Method

The data collection process was conducted between February 2020 and March 2020. The data were collected using an online survey by healthcare professionals working in a healthcare organization in the UAE. A non-probability sampling with a convenience sampling technique was employed because the target population is known, and the healthcare domain has strict

policies to ensure privacy and data protection (Karno & Purwanto 2017; Ujang Sumarwan,, Muhammad .H. Rasyidha, Mukhamad Najib 2020). The sample was selected based on the occupation type and departments. The selected occupation types included physicians, nurses, pharmacists, clinical technicians, and clinical receptionists. The selected departments were pharmacy, orthopedics, ear/nose/throat (ENT), internal medicine, and family medicine.

The survey was provided in English and designed using Google forms (Google 2021). The participation was voluntary with no given rewards as a result of completing the survey. The survey did not request personal details such as names, emails, or mobile numbers to ensure anonymous answers. A total of 318 surveys were sent to all prospective participants using their professional emails. The total number of responses was 267, with 83.96% as a response rate. While the total number of valid responses was 242 after removing the straight-lined responses and outliers as it will be discussed later in the results chapter.

Krejcie and Morgan sampling method is commonly used approach to estimate sample sizes (Chua & Penyelidikan 2006). According to (Krejcie & Morgan 1970), the approximate accepted sample size for a population of N = 300 – 320 is S = 169 – 175. In this case, the sample size is 242, which is significantly larger than the minimum requirements. Thus, the sample size is acceptable to be part of the analysis that can be achieved using to test the developed hypotheses.

6.3. Pilot Study

The pilot study was executed before conducting final survey, to calculate the reliability of each item in the questionnaire along with solving any weaknesses in the instrument prior to actual data collection (Sekaran & Bougie 2016). In the case of experimental studies, it is recommended to use 30 samples or more to conduct the pilot study (Hill 1998). Accordingly, 50 samples were chosen randomly from the target population and the internal consistency for construct's items were tested using Cronbach's alpha. A value of 0.70 for reliability coefficient is recognized as

acceptable and over 0.80 is good (Sekaran & Bougie 2016). Also, (Hair et al. 2019) confirmed that values within range of (0.70 - 0.90) are considered satisfactory to good. As presented in Table 22, all the results of Cronbach's alpha are larger than the suggested threshold (0.70). Thus, all constructs were reliable to be added in the further analysis.

Table 22. Reliability Results for Pilot Study.

Constructs	Cronbach's alpha
Performance Expectancy	.836
Effort Expectancy	.814
Facilitating Conditions	.879
Social Influence	.783
Behavioral Intention	.881
Use Behavior	.776
Attitude Towards Using	.864
Computer Self-Efficacy	.823
Computer Anxiety	.934
Innovativeness	.875
Trust	.872

6.4. Development of Instrument

The instrument was designed to include an online survey to assess the developed hypotheses and contains three main sections. The first section contains the ethical and consent forms as seen in Appendix E and F. The second section includes six questions to collect the personal and demographic details of the participants (see Table 23). The third section includes forty-four different items distributed over eleven subsections to examine the constructs in the developed integrated model. A 5-point Likert scale from strongly disagree (1) to strongly agree (5) was utilized to measure the items of each construct. The constructs and their related items are presented in Table 23. Referring to the other prior studies, each item was extracted from various preceding studies involved in technology acceptance within the healthcare domain and altered to be compatible with the requirements of this study (Salloum, Al-Emran, Khalaf, et al. 2019). All items were reviewed and approved by the quality department in the target organization.

Table 23. Constructs and Their related Items as in the Research Instrument.

Constructs	Items	Content	Source
Performance Expectancy	PE1	"QMS enables me to accomplish tasks more quickly and easily."	(Huang 2013; Sarlan, Ahmad, Ahmad, et al. 2013; Sarlan, Ahmad, Fatimah, et al. 2013; Cimperman, Makovec Brenčič & Trkman 2016; Amin et al. 2017; Khan et al. 2018; Boon-itt 2019; Li et al. 2019)
	PE2	"Using QMS improves my job performance."	
	PE3	"Using QMS increases my chances of getting a raise."	
	PE4	"Using QMS in my job increases my productivity."	
	PE5	"Overall, usage of QMS is useful in my job."	
Effort Expectancy	EE1	"It is easy to use QMS."	
	EE2	"It would be easy for me to become skilful at using QMS."	
	EE3	"My interaction with QMS is clear and understandable."	
	EE4	"It would be easy for me to perform my job using QMS."	
	EE5	"Overall, I find that using QMS is convenient for me."	
Facilitating Conditions	FC1	"I have the knowledge necessary to use QMS."	
	FC2	"I think that using QMS would fit well with the way I like to work."	
	FC3	"If I need support to use QMS, assistance is obtainable."	
	FC4	"In my job, usage of QMS is important."	
Social Influence	SI1	"People that affect my behavior think that I have to use QMS."	
	SI2	"People that are important to me think that I have to use QMS."	
	SI3	"If QMS has become a trend among people around me, I would consider using it."	
	SI4	"The senior management has been helpful to use of QMS."	
Behavioral Intention	BI1	"Suppose I have access to QMS, I plan to use it to finish my clinic management activities."	
	BI2	"I will recommend using QMS by other colleagues."	
	BI3	"I intend to continue using QMS in the future."	
	BI4	"Overall, I am highly willing to use QMS."	
Use Behavior	UB1	"I plan to use QMS, given the opportunity"	
	UB2	"I use QMS frequently."	
	UB3	"I depend on QMS in my work."	
Attitude Towards Use	AT1	"Using the QMS would be a good idea."	(Ortega Egea & Román González 2011; Sarlan et al. 2012; Huang 2013)
	AT2	"My attitude towards the use of the QMS is positive."	
	AT3	"Using QMS my work more interesting."	
	AT4	"Overall, I consider using QMS to be just right."	
Computer Self-Efficacy	CSE1	"If I had only QMS manuals for reference, I could complete my job using QMS."	(Sarlan et al. 2012; Basak, Gumussoy & Calisir 2015; Dou et al. 2017)
	CSE2	"If I had seen someone else using it before I do, I could complete the job using QMS."	
	CSE3	"I am able to use QMS without much time and energy."	
	CSE4	"I get the best value from using QMS."	
Computer Anxiety	ANX1	"Using QMS makes me feel uncomfortable."	(Sarlan et al. 2012; Sarlan, Ahmad, Ahmad, et al. 2013; Sarlan, Ahmad, Fatimah, et al. 2013; Vitari & Ologeanu-Taddei 2018)
	ANX2	"I have avoided QMS because it is unfamiliar to me."	
	ANX3	"Working with QMS makes me anxious."	
	ANX4	"I feel alone facing QMS."	
Innovativeness	INV1	"I am open to hear new ideas of information technology."	(Huang 2013; Basak, Gumussoy & Calisir 2015)
	INV2	"If I hear about new technologies, I would like to find a way to experiment with them."	
	INV3	"I like to try new technology."	
	INV4	"I am the first one to try new technology among my colleagues."	

Trust	TRU1	"I feel confident to rely on the benefits provided by QMS."	(Ortega Egea & Román González 2011; Guo, Zhang & Sun 2016; Boon-itt 2019)
	TRU2	"I find QMS trustworthy."	
	TRU3	"Overall, QMS is capable and proficient."	

6.5. Data Analysis

The integrated model will be measured by conducting a thorough analysis of the collected data. The analysis will include the utilization of the Structural Equation Modelling (SEM) using Smart PLS V.3.2.9 (SmartPLS, Ringle, C. M., Wende, S., and Becker 2015) and SPSS Software v.25 (SPSS® Statistics 25.0 - Overview | IBM 2017) to collect the demographic details. Compared to other techniques, PLS-SEM is the least restrictive technique (Briz-Ponce et al. 2017) which fits the purpose of this research. Two principal reasons are standing behind the decision to apply PLS-SEM (variance-based SEM). Firstly, this research develops an integrated model through the combination of three different theories (i.e., TAM, UTAUT, and SCT). Thus, PLS-SEM works better than CB-SEM in such situations (Hair, Ringle & Sarstedt 2011). Secondly, PLS-SEM is more suitable than CB-SEM when the research leads to exploration instead of confirmation (Hair, Ringle & Sarstedt 2011) which is the synopsis of this research. The analysis contains two stages to evaluate the measurement and the structural models as a part of the PLS-SEM technique (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016).

6.6. Summary

This chapter explained the research method and instrument to evaluate the acceptance and actual use of QMS by healthcare professionals in UAE. The study implemented a quantitative methodology through an online questionnaire survey. The survey structure included three main sections as explained in the previous section. A total number of 242 healthcare professionals have participated in the online survey. Finally, the chapter has clarified the key motivations to use SEM technique to evaluate the final developed model.

Chapter 7

Results and Discussion

Objectives

- Analyze data and examine the model.
- Verify the analysis of hypotheses of the study.
- Discuss the implications of the findings.

7. Results and Discussion

7.1. Overview

In this chapter, the theoretical integrated model was examined by conducting thorough analysis for the collected data. The analysis included a successful utilization for the Structural Equation Modelling (SEM) (SmartPLS, Ringle, C. M., Wende, S., and Becker 2015), and IBM SPS Statistics Software v.25 (SPSS® Statistics 25.0 - Overview | IBM 2017) as it was used to obtain the demographic details of the participants. The structural and measurement models (Inner and Outer, respectively) will be introduced along with the constructs and indicators

As per the findings, 12 hypotheses out 16 were confirmed and the proposed integrated theoretical model seemed to be valid to understand the acceptance of technology by healthcare professionals in UAE, QMS in the case of this study.

7.2. Data Screening and Preliminary Analysis

7.2.1. Missing Data

Missing data are observations that have been lost or not recorded within the measuring instrument. The best method to prevent and reduce the chance of the missing data is to ensure the proper study design (Smuk 2015). Consequently, a preventive strategy was employed through using Google forms (Google 2021) to eliminate the negative impacts of missing data. Google forms provide the ability to design all questions as mandatory to answer, so all returned questionnaires were considered valid since there was no missing data.

7.2.2. Straight-lining Behavior

Straight-lining behavior can reduce the data quality, and relates to the occurrence when the respondent (participant) provides similar answers for a list of a Likert-scale survey questions (Kim et al. 2019; Gogami et al. 2021; VanDerSchaaf, Daim & Basoglu 2021). In other words,

the participant is mentally disengaged from the survey but still, he has to complete it. The participant's provided responses can be considered not useable as they are not answering the question properly, so the affected answers will be coded as missing (Mirzaei et al. 2021). In the case of this study, 4 responses were dropped due to the straight-lining behaviour (variance = 0). This result can be explained by the high levels of education ($\mu = 2.98$, $\sigma = .527$) and experience ($\mu = 3.29$, $\sigma = .972$), because people with less experience and less education are more likely to straight-line their answers (Kim et al. 2019). Therefore, the dataset after removing the straight-lined responses will be N = 263.

7.2.3. Analysis of Outliers

Outliers are observations that are breaking the pattern as exposed by the majority of the observations (Møller, von Frese & Bro 2005). They are cases with extreme values that can statistically misrepresent the data where value on one variable as "univariate outlier" or odd values of two or more variables as "multivariate outliers" (Aguinis, Gottfredson & Joo 2013). (Aguinis, Gottfredson & Joo 2013) have classifed the outliers into various categories such as error outliers, model fit outliers, and interesting outliers. They have introduced the error outlier as data points that in a distance from other points and include observations that are not within the possible range of values. Model fit outliers include the influential cases that may impact the fit of the model.

In this research, there were no error outliers due to the strict Likert-scale and the functionality of Google forms to select the answer with no need to enter any value. On the other hand, 21 cases as influential outliers were recognized using the Mahalanobis Distance within the linear regression method in SPSS as recommended by (Tabachnick & Fidell 2013) to handle the multivariate outliers and followed by computing the value to calculate the probability of the outlier. Various critical Chi^2 values for each variable, where $p < .001$ and df is 1, less than the

quant and df as the degree of freedom for the number of variables against the dependent variable.

The 21 cases were eliminated as a recommended handling technique for the influential outliers (Aguinis et al. 2010; Aguinis, Gottfredson & Joo 2013; Mahapatra et al. 2020). Therefore, the dataset without considering the outliers for analysis will be N = 242.

7.2.4. Normality Testing

Testing normality is crucial procedure and relies on the normal distribution (Doornik & Hansen 2008; Field 2013). However, PLS-SEM method does not require testing for normality (Rönkkö et al. 2016; Hair et al. 2019). In this research, the normality was tested to eliminate any doubts regarding the normal distribution of the received responses. The normal distribution is presented by two measures: Skewness (to measure the symmetry of a distribution) and Kurtosis (to measure the peakiness or flatness of a distribution) (Field 2013). The acceptable ranges for both measures are (-2 and +2) (Field 2013; Tabachnick & Fidell 2013). According to (Kline 2011), the acceptable range for kurtosis can be (-3 and +3).

The results in Table 24 shows that the data for all constructs are normal distributed since all the values of skewness and kurtosis are within the acceptable threshold. The negative results of kurtosis measure indicate that the distribution of cases is relatively flat with thin tails (Platykurtic distributions), while the negative skewness results indicate the left side of the distribution is longer (Doornik & Hansen 2008; Tabachnick & Fidell 2013).

Table 24. Summary of the Descriptive Statistics.

	Mean	Std. Deviation	Skewness	Kurtosis
PE	3.3066	1.07358	-.338	-1.339
EE	3.3975	1.13320	-.563	-.865
FC	3.2531	1.25310	-.381	-1.255
SI	3.4050	1.22485	-.708	-.809
BI	3.3202	1.16982	-.490	-1.355
UB	3.2562	1.23329	-.373	-1.208

AT	3.4990	1.15668	-.674	-.671
CSE	3.4545	1.20015	-.636	-.863
ANX	2.4804	1.33493	.555	-1.301
INV	3.3492	1.21986	-.628	-1.056
TRU	3.3320	1.16484	-.548	-.979

7.2.5. Analysis of Common Method Bias (CMB)

In the context of PLS-SEM, common method bias is a phenomenon that is caused by the measurement design as in the study instead of the studied model (Kock 2015). For instance, the instructions before starting the questionnaire can affect the participants and how to respond to each question. The CMB can be examined through automated procedure using SmartPLS by considering the calculation of variance inflation factor (VIF). VIF is a measure to calculate the amount of multicollinearity for a set multiple regression variables (Kock & Lynn 2012). All the values as shown in Table 25 shows that the VIF for the latent variables in the model are lower than the suggested threshold (3.3), which is an indication that the model is not contaminated by common method bias (Kock 2015).

Table 25. Results of VIF (CMB).

	ANX	**AT**	**BI**	**CSE**	**EE**	**FC**	**INV**	**PE**	**SI**	**TRU**	**UB**
ANX					**1.7045**						
AT			**2.0322**								
BI											**2.4214**
CSE					**1.8761**			**2.9403**			
EE		**2.0454**	**2.8825**					**2.9191**			
FC			**2.5597**								**2.4214**
INV					**1.7483**						
PE		**2.0454**	**2.9059**								
SI			**3.1646**					**3.0530**			
TRU								**2.1690**			
UB											

7.3. Demographic Details for Participants

The demographic characteristics of the participants were calculated using the frequencies analysis in SPSS as presented in Table 26. According to Table 26 and Figure 17, it can be

noticed that females represent 67.4% of total participants, while only 32.6% for males. This is generally related to the high number of participated nurses (53.3%), who are mainly females. From the age perspective, 33.5% of the participants were between 30 and 39, which is close to the percentage of age category from 40 to 49 (36.4%). As well, almost 80% of the participants have completed their bachelor's degree, while only 3 participants (1.2%) hold a doctorate degree. In terms of departments, the internal and family medicine departments could show a marked advantage over the other departments. In general, the participants are experienced (μ = 3.29, σ = .972). Having older and experienced sample of users is a double-edged sword since the users will have better understanding for the technology but with the risk to be less interested to use new technologies. The same will be more clarified later in this research.

Table 26. Participants' demographic characteristics.

Characteristics	**Values**	**Frequency**	**(%)**
Gender	Female	163	67.4
	Male	79	32.6
Age	18 to 29	21	8.6
	30 to 39	81	33.5
	40 to 49	88	36.4
	50 to 59	47	19.4
	60+	5	2.1
Education	High School	3	1.2
	Diploma/Advanced	24	9.9
	Bachelor	193	79.8
	Master	19	7.9
	Doctorate	3	1.2
Occupation	Physician	63	26
	Nurse	129	53.3
	Technician	8	3.3
	Pharmacist	25	10.3
	Receptionist	17	7
Department	Orthopedics	52	21.5
	Internal Medicine	60	24.8
	Family Medicine	67	27.7
	ENT	38	15.7
	Pharmacy	25	10.3
Experience	0 - 5	14	5.8
	6 - 10	26	10.7
	11 - 15	99	40.9
	16 - 19	82	33.9
	20+	21	8.7

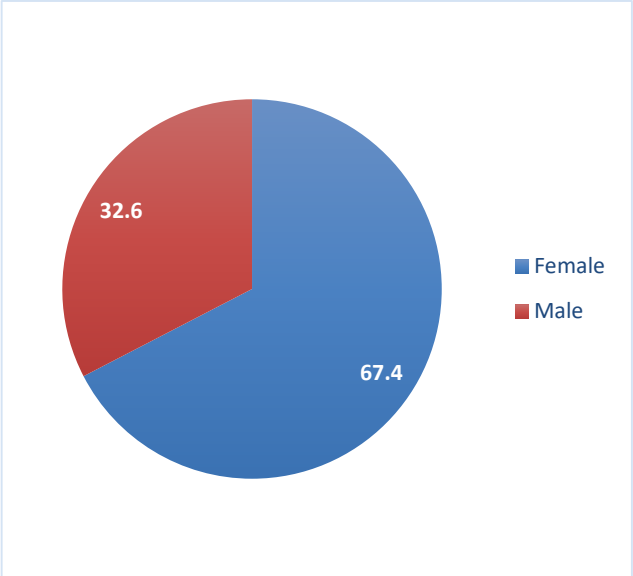

Figure 17. Gender Distribution as per the Sample.

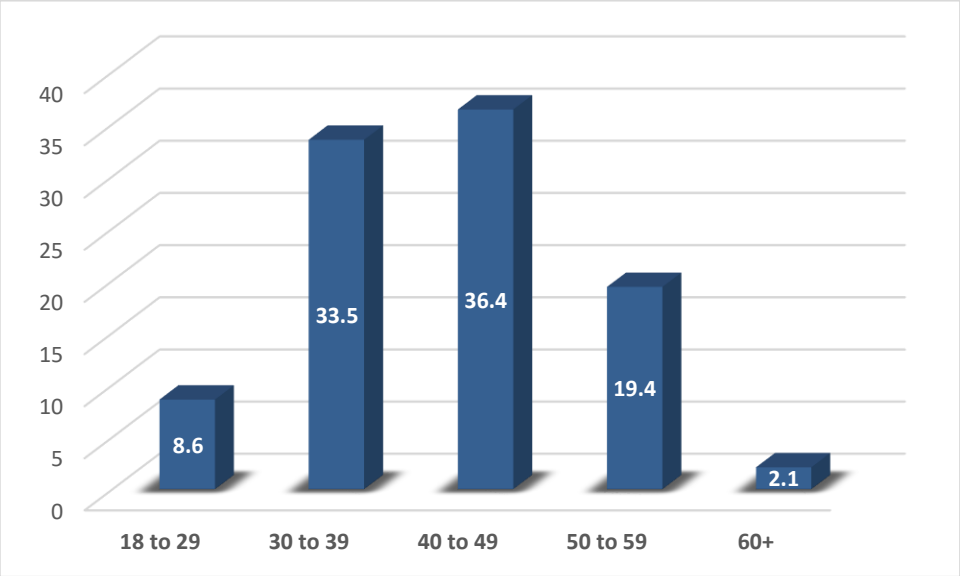

Figure 18. Age Distribution as per the Sample.

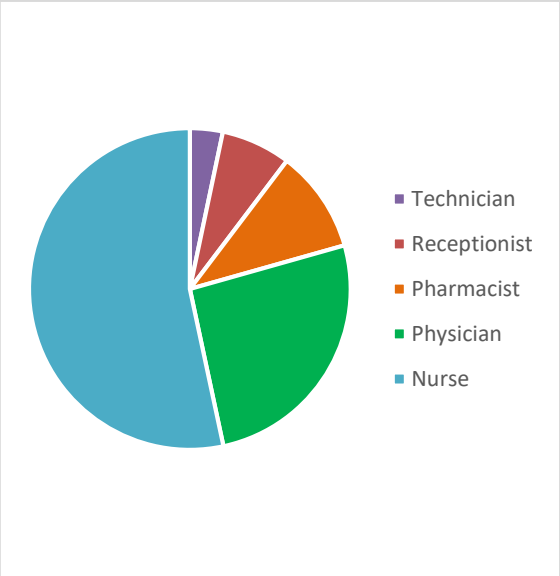

Figure 19. Occupation Distribution as per the Sample.

7.4. Partial Least Square Analysis Methodology

Partial least square (PLS) is powerful analysis, because it is not demanding when it comes to the measurement scales: sample size, measure type, residual distributions and normality (Chin 1998; Hair, Ringle & Sarstedt 2011). Apart from its ability to confirm theories, PLS can be utilized to specify the existence of relationships, and suggest propositions for later testing (Chin 1998). As it was developed by (Ringle, Wende & Will 2005) , SmartPLS is considered as distinguished application for the Partial Least Squares Structural Equation Modelling (PLS-SEM). SmartPLS became popular since 2005, because it is available to be freely used by the researchers, its interface is user-friendly, and it provides advanced innovative reporting features (Wong 2013).

7.4.1. Assessment of the Measurement Model

The measurement model is representing the association between indicators and latent construct as it is measure. The convergent and discriminate validities (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016) are essentials in order to assess the measurement model (Salloum, Al-Emran, Shaalan, et al. 2019). The two validities can provide the measurement model with

the required indicator for “goodness of fit” (Joo, Lee & Ham 2014). The convergent validity suggests the degree to which there is a high association between the constructs, that are theoretically identical. While, the discriminant validity provides the extent to which a specific construct can be different from other constructs (Rahman et al. 2013).

7.4.1.1. Convergent Validity

As it was recommended by (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016), internal consistency reliability and validities (convergent and discriminant) are mandatory to be measured to evaluate the measurement model. The reliability was measured through Cronbach’s alpha and composite reliability (CR) (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016; Salloum, Al-Emran, Khalaf, et al. 2019). Table 27 presents the results for factor loadings, composite reliability, Cronbach’s alpha, and values of average variance extracted (AVE). The results for composite reliability and Cronbach’s alpha have been found larger than 0.70 as a suggested value (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016; Sekaran & Bougie 2016; Kundu & Gahlawat 2018). Consequently, all measures are adequate in terms of reliability and the internal consistency reliability was confirmed.

Moreover, the convergent validity (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016) was assessed as a part the validity for the measurement model (Roky & Meriouh 2015). The convergent validity was evaluated by exploring the values of AVE (Hair et al. 2017). As seen in Table 27, the values of AVE for all constructs exceed the recommended value of 0.5, so the construct can create at least 50 percent of the variance of its items (Fornell & Larcker 1981; Hair et al. 2019). Therefore, the convergent validity of the measurement model was confirmed.

7.4.1.2. Discriminant Validity

On the other hand, the cross-loadings, Fornell-Larcker criterion, and the Heterotrait-Monotrait ratio (HTMT) were measured to ensure the existence of discriminant validity (Fornell & Larcker 1981; Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016). In Fornell-Larcker scale as presented in Table 28, the bold diagonal values represent the square root of AVE scores that are larger than the off-load diagonal values (its correlations amongst constructs) (Tsai et al. 2019). So, the Fornell-Larcker criterion was ascertained. Also, the cross loadings criterion was ascertained because the results of cross loadings (see Table 29) for all items were larger than the loading of its corresponding items.

Further, the Heterotrait-Monotrait ratio (HTMT) was calculated to ensure the discriminant validity. It denotes the average value of the item's associations across constructs, that are comparative with the mean associations for the items that measure same construct (Hair et al. 2019). HTMT was proposed by Henseler et al. in (Henseler, Ringle & Sarstedt 2015), as a replacement technique for Fornell-Larcker criterion (Voorhees et al. 2016; Hair et al. 2019). It was proved by that Fornell-Larcker method is not performing accurately all the time, especially when the loadings on specific construct are slightly different (Henseler, Ringle & Sarstedt 2015).

Table 27. Results Of Convergent Validity and Internal Consistency Reliability.

Constructs	Items	Loading	Cronbach's Alpha	Composite Reliability	(AVE)
Computer Anxiety	ANX1	0.894	0.928	0.948	0.821
	ANX2	0.887			
	ANX3	0.912			
	ANX4	0.931			
Attitude Towards	AT1	0.929	0.925	0.947	0.817
	AT2	0.871			
	AT3	0.912			
	AT4	0.903			
Behavioral Intention	BI1	0.887	0.892	0.925	0.755
	BI2	0.836			
	BI3	0.869			
	BI4	0.881			
Computer Self-Efficacy	CSE1	0.936	0.923	0.946	0.814

	CSE2	0.833			
	CSE3	0.913			
	CSE4	0.922			
Effort Expectancy	EE1	0.822	0.900	0.926	0.715
	EE2	0.801			
	EE3	0.887			
	EE4	0.885			
	EE5	0.828			
Facilitating Conditions	FC1	0.904	0.928	0.949	0.822
	FC2	0.893			
	FC3	0.902			
	FC4	0.926			
Innovativeness	INV1	0.918	0.929	0.949	0.824
	INV2	0.900			
	INV3	0.897			
	INV4	0.915			
Performance Expectancy	PE1	0.816	0.885	0.916	0.686
	PE2	0.742			
	PE3	0.854			
	PE4	0.819			
	PE5	0.903			
Social Influence	SI1	0.902	0.920	0.943	0.806
	SI2	0.856			
	SI3	0.904			
	SI4	0.928			
Trust	TRU1	0.909	0.894	0.934	0.824
	TRU2	0.903			
	TRU3	0.911			
Use Behavior	UB1	0.922	0.881	0.926	0.807
	UB2	0.859			
	UB3	0.913			

***Note**: Factor Loadings > (0.7), Composite reliability > (0.7), AVE > (0.5)*

Some issues may appear if the values of HTMT are at the peak. For instance, if the value of HTMT is above 0.90, then the discriminant validity does not present (Hair et al. 2019). But if the constructs of a structural model are conceptually very similar, the proposed threshold value of 0.90 is acceptable (Henseler, Ringle & Sarstedt 2015). Otherwise, if the constructs are more distinct, then the suggested threshold should be lower and more conservative and the value is 0.85 (Hair et al. 2019). Table 30 illustrates the values of Heterotrait-Monotrait ratio of the correlations (HTMT). It is noticeable that all HTMT values were less than the suggested threshold, and the target was met. In conclusion, the results of cross-loadings, Fornell-Larcker criterion, and the Heterotrait-Monotrait ratio could confirm the existence of discriminate validity with no concerns (Hair et al. 2019).

Table 28. Fornell-Larcker Scale.

	ANX	AT	BI	CSE	EE	FC	INV	PE	SI	TRU	UB
ANX	**0.906**										
AT	-0.631	**0.904**									
BI	-0.736	0.722	**0.869**								
CSE	-0.555	0.758	0.567	**0.902**							
EE	-0.574	0.770	0.610	0.665	**0.846**						
FC	-0.580	0.639	0.699	0.506	0.529	**0.906**					
INV	-0.516	0.586	0.474	0.567	0.562	0.383	**0.908**				
PE	-0.632	0.730	0.754	0.563	0.644	0.701	0.451	**0.828**			
SI	-0.555	0.744	0.571	0.706	0.708	0.495	0.547	0.556	**0.898**		
TRU	-0.519	0.665	0.532	0.628	0.593	0.442	0.619	0.558	0.605	**0.908**	
UB	-0.638	0.742	0.734	0.608	0.630	0.679	0.471	0.719	0.638	0.556	**0.899**

Table 29. Cross-loadings Results.

Items	ANX	AT	BI	CSE	EE	FC	INV	PE	SI	TRU	UB
ANX1	**0.894**	-0.597	-0.694	-0.522	-0.550	-0.554	-0.454	-0.591	-0.515	-0.469	-0.604
ANX2	**0.887**	-0.555	-0.644	-0.505	-0.482	-0.523	-0.452	-0.559	-0.517	-0.504	-0.558
ANX3	**0.912**	-0.532	-0.656	-0.433	-0.477	-0.488	-0.462	-0.561	-0.450	-0.404	-0.545
ANX4	**0.931**	-0.598	-0.669	-0.542	-0.560	-0.533	-0.501	-0.576	-0.526	-0.499	-0.598
AT1	-0.583	**0.929**	0.668	0.711	0.739	0.561	0.583	0.671	0.723	0.609	0.673
AT2	-0.522	**0.871**	0.592	0.655	0.665	0.508	0.506	0.630	0.658	0.580	0.631
AT3	-0.642	**0.912**	0.732	0.682	0.692	0.679	0.533	0.722	0.645	0.598	0.729
AT4	-0.527	**0.903**	0.609	0.694	0.687	0.552	0.495	0.610	0.664	0.619	0.643
BI1	-0.637	0.642	**0.887**	0.507	0.521	0.625	0.411	0.659	0.486	0.463	0.661
BI2	-0.641	0.576	**0.836**	0.456	0.507	0.569	0.347	0.635	0.471	0.423	0.589
BI3	-0.623	0.613	**0.869**	0.502	0.512	0.559	0.429	0.626	0.507	0.445	0.606
BI4	-0.656	0.673	**0.881**	0.505	0.578	0.667	0.454	0.694	0.520	0.511	0.688
CSE1	-0.570	0.755	0.585	**0.936**	0.641	0.511	0.538	0.573	0.680	0.617	0.589
CSE2	-0.385	0.580	0.434	**0.833**	0.522	0.379	0.443	0.444	0.523	0.536	0.505
CSE3	-0.527	0.697	0.492	**0.913**	0.617	0.453	0.556	0.480	0.666	0.559	0.542
CSE4	-0.503	0.690	0.524	**0.922**	0.611	0.473	0.502	0.525	0.667	0.552	0.556
EE1	-0.646	0.687	0.674	0.531	**0.822**	0.616	0.477	0.738	0.540	0.501	0.655
EE2	-0.416	0.564	0.399	0.517	**0.801**	0.317	0.454	0.408	0.630	0.437	0.446
EE3	-0.443	0.627	0.505	0.538	**0.887**	0.356	0.421	0.479	0.598	0.462	0.488
EE4	-0.456	0.658	0.496	0.596	**0.885**	0.440	0.530	0.506	0.650	0.528	0.506
EE5	-0.421	0.695	0.458	0.622	**0.828**	0.449	0.487	0.530	0.590	0.563	0.527
FC1	-0.561	0.562	0.625	0.474	0.478	**0.904**	0.401	0.617	0.436	0.379	0.590
FC2	-0.511	0.501	0.597	0.415	0.417	**0.893**	0.285	0.601	0.384	0.349	0.586
FC3	-0.518	0.609	0.643	0.458	0.481	**0.902**	0.339	0.646	0.494	0.426	0.626
FC4	-0.516	0.638	0.665	0.487	0.534	**0.926**	0.361	0.674	0.476	0.442	0.656
INV1	-0.465	0.507	0.401	0.509	0.481	0.311	**0.918**	0.364	0.493	0.574	0.378
INV2	-0.519	0.523	0.480	0.515	0.495	0.379	**0.900**	0.429	0.474	0.532	0.465
INV3	-0.455	0.555	0.451	0.509	0.529	0.371	**0.897**	0.458	0.497	0.554	0.439
INV4	-0.439	0.540	0.389	0.524	0.531	0.328	**0.915**	0.383	0.519	0.586	0.424
PE1	-0.469	0.584	0.595	0.473	0.544	0.520	0.411	**0.816**	0.425	0.425	0.575
PE2	-0.395	0.530	0.550	0.352	0.443	0.494	0.354	**0.742**	0.372	0.408	0.523
PE3	-0.516	0.602	0.675	0.456	0.518	0.626	0.326	**0.854**	0.480	0.489	0.611
PE4	-0.620	0.588	0.637	0.479	0.488	0.600	0.366	**0.819**	0.475	0.479	0.576

PE5	-0.598	0.707	0.659	0.555	0.655	0.650	0.413	**0.903**	0.536	0.503	0.680
SI1	-0.451	0.676	0.483	0.627	0.657	0.410	0.469	0.519	**0.902**	0.535	0.586
SI2	-0.490	0.612	0.443	0.629	0.592	0.381	0.444	0.432	**0.856**	0.493	0.494
SI3	-0.513	0.688	0.557	0.644	0.635	0.493	0.505	0.515	**0.904**	0.548	0.600
SI4	-0.538	0.690	0.557	0.640	0.657	0.483	0.538	0.523	**0.928**	0.589	0.601
TRU1	-0.509	0.640	0.512	0.614	0.570	0.408	0.653	0.517	0.586	**0.909**	0.542
TRU2	-0.485	0.582	0.521	0.529	0.532	0.426	0.497	0.539	0.523	**0.903**	0.532
TRU3	-0.412	0.587	0.404	0.569	0.509	0.363	0.536	0.455	0.538	**0.911**	0.430
UB1	-0.621	0.694	0.704	0.597	0.592	0.648	0.477	0.658	0.617	0.532	**0.922**
UB2	-0.532	0.624	0.605	0.516	0.548	0.524	0.364	0.625	0.539	0.471	**0.859**
UB3	-0.563	0.679	0.665	0.524	0.557	0.649	0.420	0.655	0.560	0.493	**0.913**

Table 30. Results of Heterotrait – Monotrait Ratio (HTMT).

	ANX	**AT**	**BI**	**CSE**	**EE**	**FC**	**INV**	**PE**	**SI**	**TRU**	**UB**
ANX											
AT	0.677										
BI	0.808	0.790									
CSE	0.593	0.817	0.622								
EE	0.614	0.837	0.667	0.726							
FC	0.625	0.684	0.765	0.544	0.562						
INV	0.557	0.630	0.519	0.610	0.612	0.411					
PE	0.693	0.802	0.847	0.616	0.702	0.770	0.498				
SI	0.599	0.805	0.627	0.764	0.781	0.531	0.589	0.611			
TRU	0.565	0.731	0.589	0.692	0.655	0.481	0.679	0.623	0.665		
UB	0.702	0.819	0.824	0.673	0.697	0.746	0.517	0.813	0.704	0.621	

7.4.2. Assessment of the Structural Model

As recommended by (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016), the path significance has to be analyzed and the coefficient of determination (R^2) should be measured to evaluate the structural model.

7.4.2.1. Coefficient Of Determination – R^2

The coefficient of determination (R^2 value) is frequently used to evaluate the structural model (Dreheeb, Basir & Fabil 2016). It can help to determine the predictive accuracy of a model, by computing the squared relationship of a specific endogenous construct's actual and predicted values. Also, the coefficient indicates combined impact of exogenous latent-variables on the endogenous one (Senapathi & Srinivasan 2014; Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016). Therefore, it also helps to signify the variances' degree in endogenous constructs assessed by each exogenous construct that is related to. When the value of R^2 is larger than 0.67, it is considered as high, while the values from "0.33 - 0.67" and from "0.19 - 0.33" are

moderate and weak, respectively. R^2 value will not be acceptable when it is lower than 0.19 (Chin 1998). On the other hand, (Falk & Miller 1992) considered 0.10 as the lowest acceptable value for the R-squared value where low R^2 value such like 0.10 can be considered satisfactory based on the context and discipline of the study.

The values of R^2 for all constructs except AT, are between (0.33 and 0.67). Thus, the constructs' predictive power values are moderate. For Attitude towards construct, the value is higher than 0.67 so it has high predictive power. The model has examined 5 endogenous variables: effort expectancy, performance expectancy, Attitude towards using, behavioral intention, and usage behaviour. Behavioral intention factor was anticipated by effort expectancy, performance expectancy, attitude towards using, facilitating conditions, and social influence, resulting in a value of $R^2 = 0.665$ which indicates that those aforementioned constructs could explain 66.5% of the variance in the behavioral intention to accept the enhanced queue management solution. The results of other endogenous variables can be seen in Table 31.

Table 31. Coefficient of Determination (R^2) Results.

Constructs	R^2	Result
AT	0.687	High
BI	0.665	Moderate
EE	0.528	Moderate
PE	0.475	Moderate
UB	0.593	Moderate

7.4.2.2. Model Goodness of Fit

Measures for goodness-of-fit in PLS-SEM are still at the nascent phases (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016), and the suitability of goodness of fit measures is still being explored (Henseler, Hubona & Ray 2016). Therefore, still there are no clear inferences that are drawn from the model's goodness of fit measures. SmartPLS is providing different measures related to the goodness of fit including the standard root-mean square

residual (SRMR), d_{ULS}, and d_G, Chi^2, normed fit index (NFI), and RMS_{theta} as seen in Table 32.

SRMR is responsible to show the difference amongst detected relationships, and the tacit correlation matrix of the model (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016), where the value below 0.08 means good fit measure (Hu & Bentler 1998). Further, NFI measure explains the Chi^2 value as ratio for the suggested and the benchmark models (Lohmöller 1989), where larger the parameters means larger NFI, and NFI value that is larger than 0.90 shows good model fit (Bentler & Bonett 1980; Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016).

The other two measures, the squared Euclidean distance (d_{ULS}), and the geodesic distance (d_G) are used to show inconsistency among the covariance matrix and the empirical one, as underlying by composite-factor model (Dijkstra & Henseler 2015; Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016). Root mean squared – RMS_{theta} can be valid for the reflective models, to estimate the correlation degree of residuals (Outer Model) (Lohmöller 1989). When the value of RMS_{theta} is close to zero, PLS-SEM model is healthier. If the value of RMS_{theta} is below 0.12 then there is good fit, else no fit (Henseler et al. 2014). Saturated model estimates the association among constructs as proposed by (Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016), while estimated model is taking into account the total effects and model structure. In general, the model shows good fit since all the measures are within the recommended thresholds.

Table 32. Summary of Model Fit.

	Saturated Model	Estimated Model
SRMR	0.0518	0.714
d_{ULS}	2.6553	12.2898
d_G	1.2911	1.5846
Chi-Square	1712.7339	1922.1195
NFI	0.940	0.920
RMS_{theta}	0.114	

7.4.2.3. Test of the Hypotheses - Path Coefficient

The structural equation modelling is considered comprehensive method to test the hypotheses that are related to the correlations between observed and latent variables (Hoyle 1995). Therefore, all developed hypotheses have been evaluated simultaneously by employing SEM technique. The analysis included an evaluation for each hypothesized correlation (level of significance), as in the constructed model in Figure 16.

A PLS-SEM using a nonparametric test of significance - bootstrapping method was conducted with 5000 re-samples to specify the significance levels among path coefficients (Vinzi, Trinchera & Amato 2010; Gil-Garcia 2011; Hair, Ringle & Sarstedt 2011; Hair Jr, Joseph F., G. Tomas M. Hult, Christian Ringle 2016). The model's results presented in Figure 20 show that the model can explain 66.5% of the total variance in the intention to use the enhanced QMS, along with 59.3% of the total variance for the actual use of the enhanced QMS. The results of hypotheses testing can be seen in Figure 20 and Table 33. The results show that twelve hypotheses out of sixteen were supported by the conducted experimental tests, whereas H2b, H3a, H3b, and H7b were rejected.

In details, the findings indicated that performance expectancy has a significant positive influence on behavioral intention (β=0.349, P<0.001) and attitude (β= 0.400, P<0.001). So, the results support H1a and H1b. Also, H2a and H2c are supported because the results pointed out that effort expectancy has a significant positive influence on the performance expectancy while using QMS (β= 0.392, P<0.001), and the attitude towards using QMS (β= 0.513, P<0.001). In contrast with the proposed hypothesis in H2b, there is no significant effect for effort expectancy on the behavioral intention of healthcare professionals to use QMS (β=0.025, P=0.351). Therefore, H2b is rejected. Similarly, the analysis has specified a lack of significant path

between social influence and both factors of performance expectancy (β=0.063, P=0.232) and the behavioral intention (β=0.047, P=0.206). Thus, H3a and H3b are not supported.

In line with H4a and H4b, the results revealed that facilitating conditions construct has a significant positive effect on the behavioral intention of healthcare professionals to use QMS (β=0.260, P<0.001), and their usage behavior (β=0.324, P<0.001). Further, the results presented that computer self-efficacy provides a significant positive influence on effort expectancy while using QMS (β=0.418, P<0.001), which supports hypothesis H7a. Surprisingly, the computer self-efficacy shows an insignificant positive influence on performance expectancy (β= 0.128, P=0.057), so H7b was rejected.

Additionally, the results indicated a significant impact of trust on the performance expectancy of healthcare professionals (β=0.207, P=0.002), which supports H8. Furthermore, H9 and H10 are supported because the two exogenous factors affect effort expectancy, innovativeness as a significant positive effect (β=0.203, P=0.001) and computer anxiety with a significant negative effect (β= -0.237, P<0.001). Finally, the results could verify that behavioral intention to use QMS is significantly influenced by attitude towards using QMS (β=0.247, P<0.001), and the actual use of QMS by healthcare professionals is significantly impacted by the intention of using QMS (β=0.508, P<0.001). These results are consistent with the original hypotheses of TAM and lead to support H5 and H6.

Table 33. Path coefficient results.

Hypothesis	Relationship	Std.Beta	Std.Error	*t*-value	*p*-value	Direction	Decision
H1a	PE → BI	0.349	0.073	4.764	0.000	Positive	Supported***
H1b	PE → AT	0.400	0.065	6.155	0.000	Positive	Supported***
H2a	EE → PE	0.392	0.068	5.801	0.000	Positive	Supported***
H2b	EE → BI	0.025	0.064	0.382	0.351	Positive	Not Supported
H2c	EE → AT	0.513	0.067	7.617	0.000	Positive	Supported***
H3a	SI → PE	0.063	0.086	0.733	0.232	Positive	Not Supported
H3b	SI → BI	0.047	0.058	0.820	0.206	Positive	Not Supported
H4a	FC → BI	0.260	0.065	3.974	0.000	Positive	Supported***
H4b	FC → UB	0.324	0.065	4.957	0.000	Positive	Supported***
H5	AT → BI	0.247	0.073	3.403	0.000	Positive	Supported***
H6	BI → UB	0.508	0.065	7.823	0.000	Positive	Supported***
H7a	CSE → EE	0.418	0.076	5.471	0.000	Positive	Supported***

H7b	CSE → PE	0.128	0.081	1.580	0.057	Positive	Not Supported
H8	TRU → PE	0.207	0.069	2.991	0.002	Positive	Supported**
H9	INV → EE	0.203	0.066	3.084	0.001	Positive	Supported**
H10	ANX → EE	-0.237	0.053	4.462	0.000	Negative	Supported***

*Note: p***<0.001, p**<0.01, p* <0.05*

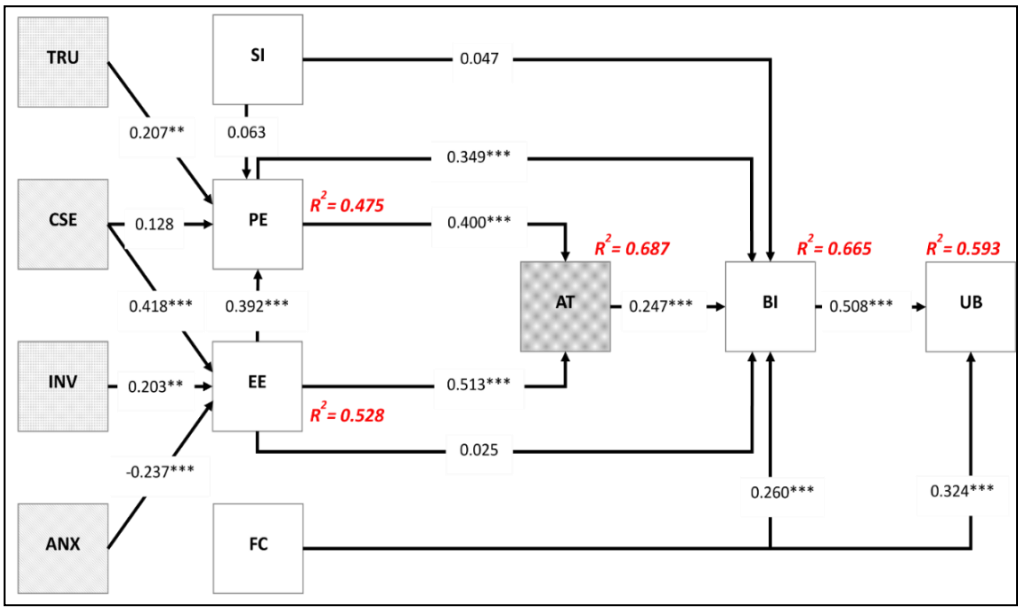

Figure 20. Results of Path Significance Analysis.

7.5. Discussion

It is vital to get users involved and accept the technology to ensure the success of that technology, regardless of the requirements (i.e., additional enhancements or new development) (Taherdoost 2019). Various theoretical models and extensions have been proposed and discussed to realize and evaluate the technology acceptance and users' behavior in different disciplines (Rahimi et al. 2018). The rapid development of information technology has attracted the attention of the healthcare field globally, and gradually motivates the research related to its acceptance. Therefore, many studies have proposed different integrated and hybrid models based on various acceptance models to determine the factors that influence users to accept different technologies in healthcare (Hsieh, Lai & Ye 2014; Sezgin & Özkan-Yıldırım 2016; Ku & Hsieh 2018; Li et al. 2019). This research suggests an integrated theoretical model based on the integration of different constructs extracted from UTAUT, TAM, and SCT, along with

trust and innovativeness as external factors. The research explored the acceptance of queue management solutions as an innovative technology within the healthcare context.

The findings signified that the proposed integrated model is relatively capable of explaining a high proportion of variation regarding the behavioral intention and the actual use of queue management solutions by healthcare professionals. In details, the below hypotheses were examined in order to assess the proposed theoretical technology acceptance model.

7.5.1. The impact of Performance Expectancy on Behavioral Intention

It was found that performance expectancy could positively encourage the behavioral intention to use QMS. Such a result proposes that the behavioral intention of healthcare professionals to use QMS can be enhanced if those professionals believe that QMS can provide more benefits to them. The participated healthcare professionals are expecting better performance results while using QMS. A similar finding was found in other studies as they were conducted in different settings (Ahmadi et al. 2017; Khan et al. 2018).

7.5.2. The Impact of Performance Expectancy on Attitude Towards

Also, the results exposed that attitude is significantly influenced by the expected performance results. This result comes in line with what has been found in earlier studies (Schaper & Pervan 2007; Kim et al. 2016). This implies that the end-users have a positive attitude regarding using QMS to improve their work efficiency and depend on QMS to perform better in their daily tasks.

7.5.3. The Impact of Effort Expectancy on Performance Expectancy

As well, the results pointed out the significant positive influence of effort expectancy on the performance expectancy which is compatible with what was stated by (Ifinedo 2012; Liu & Lee 2018). This indicates that the participated healthcare professionals need hassle-free usage of QMS to motivate their belief to achieve their responsibilities and gain better results from using

QMS. Solution developers and creators should focus on building user-friendly interfaces in the solution. A technology solution must have fewer clicks to perform a particular activity or task.

7.5.4. The Impact of Effort Expectancy on Behavioral Intention

Against what was hypothesized, the significance positive influence of effort expectancy concerning the behavioral intention of healthcare professionals to use QMS was not confirmed, which matches the previous finding of (Francis 2019). Although it is an unexpected finding, it can be explained by the experience level of the participants which is considered high ($\mu = 3.29$, $\sigma = .972$). The participants are mainly knowledgeable with information technologies, and used to practice more complex solutions to achieve their work (i.e., electronic medical records). Also, the participants have relatively high computer self-efficacy, and working with QMS poses no issue.

7.5.5. The Impact of Effort Expectancy on Attitude Towards

It was found that attitude is positively influenced by the effort expectancy of using QMS, and this result confirms the findings reported by (Kim et al. 2016; Özdemir-Güngör & Camgöz-Akdağ 2018). It seems that it is crucial to implement user-friendly solutions in healthcare to expand the positive attitude towards technology adoption. The significant positive attitude means there is a tendency to use the QMS by the healthcare professionals in UAE, and their first impression regarding QMS will lead to its acceptance (Venkatesh et al. 2003).

7.5.6. The Impact of Social Influence on Performance Expectancy

In addition, the analysis has specified a lack of a significant path between social influence and performance expectancy, which is opposite to the findings of (Becker 2016; Li et al. 2019). The result suggests that the participated healthcare professionals do not care about the opinion of their colleagues or social groups regarding the expected performance improvements while using

QMS. It seems that the participants will not be affected by others when it comes to the expected benefits from using technology in the healthcare domain.

7.5.7. The Impact of Social Influence on Behavioral Intention

Likewise, it was discovered that social influence is not significantly impacting the behavioral intention to use QMS, and it is the same as what was declared by (Schaper & Pervan 2007; Francis 2019). The result suggests that the healthcare professionals do not care about the opinion of their colleagues or social groups to decide regarding the intention to use QMS. Social influence decreases with the increasing experience (Venkatesh et al. 2003), and the result may refer to the relatively high levels of experience and age in the sample. In other words, it is expected that the older and more experienced user will have more constant beliefs.

7.5.8. The Impact of Facilitating Conditions on Behavioral Intention

The results of the facilitating conditions construct present that the availability of resources, assistance, and management support can significantly motivate the behavioral intention of the participated healthcare professionals to use QMS. This supports the findings of (Devine 2015; Kim et al. 2016; Khan et al. 2018). Having the right technical support and resources (i.e., system experts, guidelines, and handbooks) for specific information technology, along with the required support from the higher management are significantly crucial to encourage the acceptance of that technology in the healthcare domain.

7.5.9. The Impact of Facilitating Conditions on Use Behavior

Similar to the findings of (Devine 2015; Kim et al. 2016; Khan et al. 2018), it was found that facilitating conditions is significantly influencing the actual use of QMS by the participants in a positive manner. A healthcare professional will be ready to accept and use QMS if he has the essential support in case of any technical issue during the usage of the system to perform his

work activities. The facilitating environment will help to minimize the effort to perform the work and enhance the importance of the technology solution in terms of the expected benefits.

7.5.10. The Impact of Attitude Towards on Behavioral Intention

Consistent with the original hypotheses of TAM and the previous findings (Kim et al. 2016; Ehteshami 2017), the analysis verified that the behavioral intention of professionals to use QMS is significantly influenced by attitude towards using QMS. The leaning to use QMS will enhance the intention to accept the solution.

7.5.11. The Impact of Behavioral Intention on Use Behavior

Additionally, the analysis confirmed that the actual use of QMS by the healthcare professionals is significantly influenced by their behavioral intention to use it. The positive behavioral intention of the participants is a direct predictor for the actual use of QMS as confirmed by other previous studies (Ifinedo 2012; Masyarakat et al. 2019).

7.5.12. The Impact of Computer Self-efficacy on Performance Expectancy

Unpredictably, the computer self-efficacy had no significant impact on performance expectancy, which is similar to the finding of (Chow et al. 2013) but against the findings of (Chow et al. 2012; Rho, Choi & Lee 2014). A plausible explanation is that the professionals' expectations to gain better performance results are not significantly affected by their experience to use the system, regardless of its complexity.

7.5.13. The Impact of Computer Self-efficacy on Effort Expectancy

On the other hand, the computer self-efficacy factor could provide a significant impact on the expected effort to use QMS. Such finding is in congruence with what has been confirmed by (Chow et al. 2012, 2013; Gagnon et al. 2014; Rho, Choi & Lee 2014). Due to their level of experience and being knowledgeable in using technologies, the healthcare professionals have a

high level of comprehension for QMS, and how to use it. A higher level of understanding of a specific technology by its end-users is a key factor to use it effectively with effort-less.

7.5.14. The Impact of Trust on Performance Expectancy

Furthermore, the results indicated that healthcare professionals trust QMS to improve their performance and achieve the tasks proficiently. This result comes in line with the work of (Rajanen & Weng 2017; Beldad & Hegner 2018), who confirmed that the higher the trust, the higher the expected benefits. People will be inclined to use a technology if they trust its creator, and if it has fewer concerns or expected threats (Beldad & Hegner 2018).

7.5.15. The Impact of Computer Anxiety on Effort Expectancy

Besides, the computer anxiety factor is a key determinant for ease of use (Sarlan et al. 2012). Whenever the users have high computer anxiety, they will ignore using the system (Tung & Chang 2008). Thus, less afraid to make mistakes will significantly lead the healthcare professionals to feel that learning and using the system is easier for them without high efforts. The negative impact of computer anxiety on ease of use was confirmed through the empirical analysis which is compatible with the results of (Schaper & Pervan 2007; Venkatesh & Bala 2008; Beglaryan, Petrosyan & Bunker 2017). Trust and anxiety factors seem to be so related. For instance, a user will not trust a technology solution (e.g., Mobile Application) if he has concerns regarding the breach of his personal information.

7.5.16. The Impact of Innovativeness on Effort Expectancy

Furthermore, the QMS's effortlessness of use is positively influenced by the innovativeness of healthcare professionals. This is harmonious with the reported findings by (Huang 2013; Kuo, Liu & Ma 2013) and opposite to the findings of (Sombat, Chaiyasoonthorn & Chaveesuk 2020). Nowadays, individuals are more familiar with novel technologies (Kuo, Liu & Ma 2013), and the healthcare professionals who are early adopters for innovative technology are willing to use

that technology, even when the possible benefits are not explicit (Walczuch, Lemmink & Streukens 2007). Such kind of professionals are considered more convinced with the system due to its high level of innovation and ease of use (Agarwal & Prasad 1999; Huang 2013).

Chapter 8
Conclusions

Objectives

- Summary for the whole study.
- Understand the study implications.
- Explain the limitations, recommendations and future work.

8. Conclusions

8.1. Overview

This chapter includes a summary for the research, the key findings, the research limitations, the theoretical contributions, the practical implications, and conclusions. As well, the chapter provides the suggested recommendations and the work that can be achieved in future studies.

8.2. Research Summary

A systematic review for the literature was conducted in this research with a focus on the studies of technology acceptance in the healthcare area in the recent decade (2010 – 2019). The goal of the systematic review was to build a comprehensive understanding for the current situation of the technology acceptance literature, and achieve a classification analysis based on various coded characteristics. Those characteristics include (i) the studied technology acceptance model, (ii) the included factors in the study, (iii) the confirmed relationships between the factors as hypothesized in the research model (main findings), (iv) types of the studied information technologies, (v) participants, (vi) digital library (database), (vii) year of publication, and (viii) country (direction of research).

In addition, the research has presented a case study for an implemented queue management solution (QMS) in the out-patient department (OPD) in a healthcare organization in UAE. The research has reported the suggested business and technical optimizations to enhance the QMS. Mainly, the suggested optimizations included a process re-engineering activity to enhance the clinical processes in the OPD, and an integration for the QMS with the electronic medical records solution (EMR). The integration was achieved using Health Level Seven (HL7) integration standards, including the exchange of custom-designed Extensible Markup Language (XML) and HL7 messages. The goal of the integration was to implement a novel tool for

patient's self-check-in and enhance the ease of use and usefulness characteristics of QMS. As a pilot implementation, the feasibility of the newly implemented tool was assessed through a simulation experiment in the internal medicine clinic over two different weeks (control and intervention). A total of 127 appointments were identified as eligible and included in the study. The patient's journey was split into five stages: identification, wait to triage, triage process, wait to treatment, and treatment process. The results revealed that the new tool is beneficial, and the median times to finish the processes within the patient's journey have significantly decreased.

Furthermore, the research included a development for an integrated theoretical model for technology acceptance in the healthcare domain. The model was constructed based on the findings of the conducted systematic literature review. The developed integrated model included and integration for the key constructs of UTAUT, TAM, and SCT along with the injection for the innovativeness and trust as external factors. The novel model was applied to assess the acceptance of the enhanced QMS as proposed in this research by 242 healthcare professionals who work in the same healthcare organization in the UAE. The model was empirically validated using a questionnaire survey with a five-point Likert scale and the collected data were analyzed through the partial least squares-structural equation modelling (PLS-SEM) approach.

8.3. Key Findings

This work mainly intended to answer three research questions. The key findings of this research will help to answer the research questions.

8.3.1. What are the research gaps in the existing literature and the common factors influencing the acceptance of technology in the healthcare domain?

As discussed in Chapter 2, several reviews were conducted to analyze the technology acceptance models and their related factors in healthcare. However, most of the studies have focused on a specific technology acceptance model instead of various acceptance models. Also, the studies have discussed particular technology.

As well, there is a need to have comprehensive reference for the trending technologies in terms of user types and directions of research (countries) from a comparison point of view. This will help to focus on exploring new technologies (i.e., queue management solution, and internet of things) in different settings and countries and eliminate having a lack or plethora in the literature. Despite the advanced healthcare services and the boom of technology implementations in some developing and Arab countries (e.g., UAE and Jordan), it is clear that there is still a lack of research when it comes to technology acceptance in the healthcare domain. This gap needs to be fulfilled by studying the acceptance of various technologies in the healthcare field in the UAE.

On the other hand, many scholars have discussed the issue of long waiting times in the healthcare facilities and provide different solutions. Nevertheless, most of these studies focused on the emergency departments (Spaite et al. 2002; Choi 2006; Morgan 2007; Ieraci et al. 2008; Kwa & Blake 2008; Coyle et al. 2019). As well, the suggested solutions were more related to medical management or business administration. In general, the previously proposed solutions depend on methods for process re-design and management solutions with minimum technological solutions. There is a need to propose technology solutions to solve the issue of prolonged waiting times in the healthcare facilities.

In terms of common factors, it was found that the constructs of TAM and UTAUT are the core factors that influence the acceptance of technology in the healthcare domain. These factors include, UTAUT core constructs, i.e., performance expectancy, effort expectancy, social influence and facilitating conditions, behavioral intention to use, and usage behavior, and the "attitude towards usage" construct from TAM. As well, computer anxiety and computer self-efficacy from SCT. Finally, the factors innovativeness and trust are two additional factors were found to be extensively utilized, as their influence were noticed through the conducted systematic literature review.

8.3.2. Which theoretical model is most appropriate for measuring the actual use of queue management solutions in healthcare?

As discussed in Chapter 5, the integrated theoretical model was developed based on the common factors influencing the acceptance of technology in the healthcare domain. As mentioned above, the model includes the core factors of UTAUT, TAM, and SCT along with two additional factors, innovativeness and trust as in Figure 3 and Table 20. Moreover, the sixteen hypotheses in the developed model as in Figure 16 were assumed based on the context and nature of this research and the most confirmed hypotheses as in Figure 4 and Table 21.

8.3.3. How well does the proposed model capture the healthcare professionals' use of queue management solutions?

In brief, the results as discussed in Chapter 7 exposed that the proposed model is successful to explore the acceptance of information technologies in healthcare. The model has explained 66.5% of the total variance in the behavioral intention to use the enhanced QMS, along with 59.3% of the total variance for the actual use of the enhanced QMS. Through the empirical analysis, twelve hypotheses out of sixteen were supported. Whereas H2b, H3a, H3b, and H7b were rejected.

In general, the results showed that the performance expectancy of QMS is positively influenced by the expected effort while using QMS, the trust of the solution, and its creator. Also, the effort expectancy of QMS is positively influenced by the factors of computer self-efficacy and the level of innovativeness, but it is negatively impacted by the anxiety of the healthcare professionals. Finally, the performance expectancy and the facilitating conditions were found to have significant positive influence on the behavioral intention to accept and use the QMS by the participated healthcare professionals.

8.4. Research Contributions and Implications

8.4.1. Theoretical Contributions

The conducted systematic review including the classification analysis provided multiple contributions to technology acceptance models and theories, especially in healthcare. The systematic review is believed to add a significant contribution to the existing literature for several reasons. First, it analyzed all the technology acceptance models instead of focusing on one model or theory (e.g., TAM). Second, the review included the empirically evaluated acceptance models, their extensions, and integrations. Third, the research has reviewed different information technologies instead of considering only one technology (e.g., electronic medical records). Fourth, studies with different settings and types of users were included in the review. Other healthcare professionals like nurses, pharmacists, and clinical technicians are using the information technologies and playing a critical role in the success of those technologies. Fifth, the considered studies in the review were published in the recent decade (2010-2019), which provides a fresh overview of the literature, so the findings are varied from the other existing reviews.

With regard to the enhancement of QMS, the research could clarify the integration between QMS and EMR based on multiple custom-designed HL7 and XML message to help in solving

the issue of waiting times in the healthcare facilities. The previous proposed solutions for waiting times issue concentrated only on the administrative solutions which created a gap in the literature. The proposed integration as an injection for the technology could contribute to the theory in the healthcare domain, and open the door for further technical researches in the area of waiting time within the healthcare facilities.

In terms of the conducted empirical analysis, the research provides multiple contributions to the existing literature. First, this research suggests a new theoretical model based on the integration of different constructs extracted from different theories, including the UTAUT, TAM, and SCT, along with trust and innovativeness as external factors. This integration is significant to expand the explanatory power of the acceptance theories to explore the behavioral intention of professionals to accept technology in healthcare (i.e., QMS). The developed theoretical model can be applied to evaluate the acceptance of QMS or other medical systems in other healthcare organizations, whether in developing or developed countries. Second, the results of the performed analysis could point out that the expected performance benefits of QMS can be enhanced if the end-users trust the creator of QMS. Third, the findings have highlighted the crucial role of users' innovativeness, experience to use technologies, and the level of anxiety on their belief regarding the difficulty to use of the enhanced QMS. Fourth, the developed model was evaluated using different types of healthcare users, and their opinions were considered to strengthen the results. The proposed integrated model can help to fill the research gap in the related literature since it is one of the preliminary steps to evaluate the acceptance of QMS within the healthcare field, in UAE, and other developing countries.

8.4.2. Practical Implications

The conducted systematic review provided various practical implications for the healthcare domain. First, the review differs from the other reviews by including various technology

acceptance models, various technologies, and various users. This diversity is valuable for other researchers and decision-makers in different research areas, countries, and settings. For instance, virtual clinics can have great potential through telemedicine, cloud computing solutions, and mobile applications. Decision makers need to provide the necessary support for implementing these solutions to help physicians and healthcare professionals in providing many healthcare services (e.g., consultation, follow-up) without meeting the patient, especially in rural areas. Second, the review shows a gap in the new technology trends in the healthcare sector. The decision-makers and IT corporations need to employ Internet of Medical Things (IoMT) and virtual reality (VR) solutions. IoMT can help to digitize the process, develop resource allocation, and provide real-time data to drive decisions. Virtual reality solutions can help to train resident physicians and young nurses to feel integrated with situations they may face in reality. Additionally, such augmented solutions can enable the physicians to access the patients' reports without leaving their current location, and using hands-free mode (voice commands). Third, the results would assist policy-makers in reviewing the current regulations and policies concerning data confidentiality and privacy. Additionally, these regulations should be announced and published. So, end-users have to be educated and aware of their roles and responsibilities to enhance their acceptance by improving the levels of trust and anxiety.

Fourth, information technology corporations (system analysts and developers) and healthcare organizations can utilize the findings related to the influential factors as a type of lessons learned. Consequently, this review can help to improve the currently implemented solutions and consider enhancements in future technology to be more user-friendly and innovative. Using information technology solutions with fewer efforts can encourage end-users to gain the maximum benefits without fear of making mistakes. Fifth, the review addressed gaps in the technology acceptance literature by considering the regions of implementation. It has been

observed that inadequate attention is paid to implementing cloud computing, telemedicine, and medical informatics applications in developing countries. Therefore, IT corporations should be prepared to concentrate on the Arab and African countries, as there is potential to implement those new information technologies within the healthcare sector in these countries

With respect to the developed theoretical model and the related empirical analysis, the results also offered various practical implications. First, the theoretical model seems appropriate to investigate the acceptance of technology in the healthcare field. The findings are supportive to ensure successful implementations of new technologies or apply optimizations to the currently implemented technologies. Second, the facilitating conditions have a significant influence on the users' behavioral intention and actual use. Hence, suppliers of IT solutions need to ensure the availability of the required technical support and resources to boost the acceptance levels in the healthcare context. Third, the performance expectancy is found to be a reliable determinant for the attitude towards using technology and the behavioral intention of professionals in healthcare. So, medical managers and decision-makers in healthcare organizations have to motivate the healthcare professionals to use the system and clarify the expected benefits from that usage. Fourth, computer anxiety is negatively impacting the effort expectancy, while the effort expectancy has a positive influence on the performance expectancy of users. The technology users should be motivated to learn how to use the technology to minimize their level of anxiety and enhance the ability for hassle-free practice to facilitate increasing their performance results and improve the clinical activities. Consequently, it will be beneficial to provide the appropriate training for users or even involve them at the earlier stages of technology implementation projects (i.e., brain-storming sessions and design phase).

On the other hand, the research presented the self-check-in as a novel innovative solution to enhance the experience of patients during their journey in the outpatient department. The results

of the conducted simulation experiments could confirm the feasibility of the suggested solution. The solution could minimize the time to complete the whole patient's journey and other stages. The results revealed that it would be beneficial to conduct similar simulation experiments for QMS or even other technology solutions in other healthcare facilities in the UAE or other developing countries. The proposed solution can be considered as an initial step for business analysts and system developers in IT corporations to implement innovative solutions to solve the issue of long queues and minimize the expected waiting time in healthcare facilities. Moreover, the proposed novel solution can help to provide statistical reports for the management of healthcare facilities regarding the patients' journey duration, and the trends. Such statistical reports can be linked with dashboards to facilitate the decision-makers and medical managers in changing the clinical processes to enhance the patients' experience.

8.5. Research Limitations and Future Work

The systematic review in this research was limited to particular digital libraries and databases to collect the research studies (i.e., PubMed, IEEE Xplore, Springer, ACM, Science Direct, and Google Scholar). So, these digital libraries might not provide a complete picture for all empirical studies published on technology acceptance in healthcare. Future research may extend this review by including studies from other digital libraries, such as CINAHL, Cochrane, Scopus, Sage, and Web of Science. Additionally, the review has covered only the empirical quantitative studies. Further studies can include other types of technology acceptance studies (e.g., Qualitative studies). Also, the findings can be employed to produce a thorough meta-analysis for the results of each reviewed study or even by adding other studies.

Finally, this study can be identified as a base to construct a novel acceptance model or integrate the currently available acceptance models to explore the user's acceptance of technology in the healthcare domain.

In terms of the empirical analysis, the key identified limitations include the sample size, time of the survey, the studied factors, and the type of users. The sample included only 242 participants, which can be increased in the future to obtain better results. The sample size was impacted by the time of the survey. The survey was distributed at the early stages of the COVID-19 outbreak in the UAE (January - February 2020). At that time, healthcare professionals were busy with different clinical activities and the precautions related to the pandemic. As well, the research did not explore the influence of the moderating factors (e.g., age, gender, level of experience, and voluntariness) on the relationship between the independent variables and the behavioral intention to accept QMS. Exploring the effect of moderating factors in the future can lead to more interesting results since there is a scarce of knowledge concerning their impact. Besides, the research has only investigated the acceptance of healthcare professionals. It would be an attractive research line to explore the behavioral intention of patients to accept and use the frontend application and kiosks of QMS.

Moreover, the simulation experiments also faced numerous limitations that need to be reported. First, collecting the required business and workflow specifications to change the identification and check-in processes. Second, although the sample size was sufficient to perform significant statistical analysis, but it was not very large, which may impact the accuracy of the results. The sample size was affected by the limited time (2 weeks) to conduct the experiment. Future studies can include more than two weeks to include more appointments. Third, the complexity to record the time of patient's arrival. Moreover, the limited time of the experiment was mandatory to ensure that the investigation will not affect the health services or distract the staff from their tasks. Besides, the study took place in March 2020, and the number of appointments was negatively impacted by the precautionary measures of the Covid-19 virus. The performed simulation can be recognized as a base for other similar studies in UAE, so other simulation

experiments for QMS can be performed in other healthcare facilities in UAE. As well, other technology solutions can be assessed in healthcare facilities in the UAE or other Arab countries.

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Appendices

Appendix A: The Results of Quality Assessment.

Table 34. Quality Assessment – Full Set of Results.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	Percentage	Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	Percentage
S1	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S72	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S2	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S73	1	1	0.5	0.5	0.5	1	1	5.5	78.6%
S3	1	1	0.5	0.5	0.5	1	1	5.5	78.6%	S74	1	1	1	1	1	0.5	0.5	6	85.7%
S4	1	1	1	1	1	0.5	0.5	6	85.7%	S75	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S5	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S76	1	1	0.5	1	0.5	1	1	6	85.7%
S6	1	1	0.5	1	0.5	1	1	6	85.7%	S77	1	1	0.5	1	1	0.5	0.5	5.5	78.6%
S7	1	1	0.5	1	1	0.5	0.5	5.5	78.6%	S78	1	1	0.5	0.5	1	0.5	0.5	5	71.4%
S8	1	1	0.5	0.5	1	0.5	0.5	5	71.4%	S79	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S9	1	1	0.5	1	0.5	1	0.5	5.5	78.6%	S80	1	1	1	1	1	0.5	0.5	6	85.7%
S10	1	1	1	1	1	0.5	0.5	6	85.7%	S81	1	1	1	0.5	0.5	0.5	0.5	5	71.4%
S11	1	1	1	0.5	0.5	0.5	0.5	5	71.4%	S82	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S12	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%	S83	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S13	1	1	0.5	1	0.5	1	0.5	5.5	78.6%	S84	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S14	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S85	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S15	1	1	0.5	0	0.5	1	1	5	71.4%	S86	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S16	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S87	1	1	0.5	0.5	0.5	1	1	5.5	78.6%
S17	1	1	0.5	1	1	1	1	6.5	92.9%	S88	1	1	1	1	1	0.5	0.5	6	85.7%
S18	1	1	1	1	1	0.5	0.5	6	85.7%	S89	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S19	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%	S90	1	1	0.5	1	0.5	1	1	6	85.7%
S20	1	1	0.5	1	0.5	1	1	6	85.7%	S91	1	1	0.5	1	1	0.5	0.5	5.5	78.6%
S21	1	1	0.5	1	1	0.5	0.5	5.5	78.6%	S92	1	1	1	1	1	0.5	1	6.5	92.9%
S22	1	1	0.5	0.5	1	0.5	0.5	5	71.4%	S93	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S23	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S94	1	1	1	1	1	0.5	0.5	6	85.7%
S24	1	1	1	1	1	0.5	0.5	6	85.7%	S95	1	1	1	0.5	0.5	0.5	0.5	5	71.4%
S25	1	1	1	0.5	0.5	0.5	0.5	5	71.4%	S96	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S26	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%	S97	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S27	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S98	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S28	1	1	0.5	1	1	0.5	0.5	5.5	78.6%	S99	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S29	1	1	0.5	1	0.5	1	1	6	85.7%	S100	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S30	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S101	1	1	0.5	0.5	0.5	1	1	5.5	78.6%
S31	1	1	0.5	0.5	0.5	1	1	5.5	78.6%	S102	1	1	1	1	1	0.5	0.5	6	85.7%
S32	1	1	1	1	1	0.5	0.5	6	85.7%	S103	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S33	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%	S104	1	1	0.5	1	0.5	1	1	6	85.7%
S34	1	1	0.5	0	0.5	1	1	5	71.4%	S105	1	1	0.5	1	1	0.5	0.5	5.5	78.6%
S35	1	1	0.5	1	1	0.5	0.5	5.5	78.6%	S106	1	1	0.5	0.5	1	1	0.5	5.5	78.6%
S36	1	1	0.5	0.5	1	0.5	0.5	5	71.4%	S107	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S37	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S108	1	1	1	1	1	0.5	0.5	6	85.7%
S38	1	1	1	1	1	0.5	0.5	6	85.7%	S109	1	1	1	0.5	0.5	0.5	0.5	5	71.4%
S39	1	1	1	0.5	0.5	0.5	0.5	5	71.4%	S110	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S40	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%	S111	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S41	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S112	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S42	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S113	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S43	1	1	0.5	0.5	0.5	0.5	1	5	71.4%	S114	1	1	1	1	1	1	1	7	100.0%
S44	1	1	0.5	1	0.5	1	1	6	85.7%	S115	1	1	0.5	0.5	0.5	1	1	5.5	78.6%
S45	1	1	0.5	0.5	0.5	1	1	5.5	78.6%	S116	1	1	1	1	1	0.5	0.5	6	85.7%

S46	1	1	1	1	1	0.5	0.5	6	85.7%	S117	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S47	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%	S118	1	1	0.5	1	0.5	1	1	6	85.7%
S48	1	1	0.5	1	0.5	1	1	6	85.7%	S119	1	1	0.5	1	1	0.5	0.5	5.5	78.6%
S49	1	1	0.5	1	1	0.5	0.5	5.5	78.6%	S120	1	1	0.5	0.5	1	0.5	0.5	5	71.4%
S50	1	1	0.5	0.5	1	0.5	0.5	5	71.4%	S121	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S51	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S122	1	1	1	1	1	0.5	0.5	6	85.7%
S52	1	1	1	1	1	0.5	0.5	6	85.7%	S123	1	1	1	1	0.5	0.5	0.5	5.5	78.6%
S53	1	1	1	0.5	0.5	1	0.5	5.5	78.6%	S124	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S54	1	1	0.5	0.5	0.5	1	0.5	5	71.4%	S125	1	1	0.5	1	1	0.5	0.5	5.5	78.6%
S55	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S126	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S56	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S127	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S57	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S128	1	1	0.5	1	0.5	0.5	1	5.5	78.6%
S58	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S129	1	1	0.5	0.5	0.5	1	1	5.5	78.6%
S59	1	1	0.5	0.5	0.5	1	1	5.5	78.6%	S130	1	1	1	1	1	0.5	1	6.5	92.9%
S60	1	1	1	1	1	0.5	0.5	6	85.7%	S131	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S61	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%	S132	1	1	1	1	1	1	1	7	100.0%
S62	1	1	0.5	1	0.5	1	1	6	85.7%	S133	1	1	0.5	1	1	0.5	0.5	5.5	78.6%
S63	1	1	0.5	1	1	0.5	0.5	5.5	78.6%	S134	1	1	0.5	0.5	1	0.5	0.5	5	71.4%
S64	1	1	0.5	0.5	1	0.5	0.5	5	71.4%	S135	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%
S65	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S136	1	1	1	1	1	0.5	0.5	6	85.7%
S66	1	1	1	1	1	0.5	0.5	6	85.7%	S137	1	1	1	0.5	1	0.5	0.5	5.5	78.6%
S67	1	1	1	0.5	0.5	0.5	0.5	5	71.4%	S138	1	1	0.5	0.5	1	0.5	0.5	5	71.4%
S68	1	1	0.5	0.5	0.5	0.5	0.5	4.5	64.3%	S139	1	1	0.5	1	0.5	0.5	0.5	5	71.4%
S69	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S140	1	1	0.5	1	1	0.5	0.5	5.5	78.6%
S70	1	1	0.5	1	0.5	0.5	0.5	5	71.4%	S141	1	1	1	0	0.5	0.5	0.5	4.5	64.3%
S71	1	1	0.5	1	0.5	0.5	1	5.5	78.6%	S142	1	1	0.5	0.5	1	0.5	0.5	5	71.4%

Appendix B: Full List of The Included Publications

Table 35. Full List of The Included Publications

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
1	Bennani & Oumlil (Bennani & Oumlil 2010)	2010	Conference	ICT Appropriation	111	Physicians & Nurses	Morocco	TAM
2	Lai & Li (Lai & Li 2010)	2010	Conference	Computer Assistance Orthopedic Surgery System	115	Healthcare Professionals	Taiwan	Integrated Model: TAM & TPB
3	Kim et al. (Kim et al. 2010)	2010	Journal Article	Tele-homecare Technology (Telemedicine)	40	Physicians	USA	Compare Two Models: TAM & TPB
4	Holtz (Holtz 2010)	2010	PHD Dissertation	Electronic Medical Records	113	Nurses	USA	UTAUT
5	Pai & Huang (Pai & Huang 2011)	2011	Journal Article	Healthcare Information Systems	366	Nurses, Head Directors, and other related personnel	Taiwan	Integrated Model: TAM & IS success model
6	Orruño et al. (Orruño et al. 2011)	2011	Journal Article	Tele-dermatology System	171	Physicians	Spain	Modified TAM
7	Maarop et al. (Maarop et al. 2011)	2011	Conference	Teleconsultation Technology	72	Healthcare Providers	Malaysia	Extended TAM
8	Schnall & Bakken (Schnall & Bakken 2011)	2011	Journal Article	Continuity of Care Record (CCR) with Context-specific Links	94	HIV Case Managers	USA	Extended TAM
9	Kowitlawakul (Kowitlawakul 2011)	2011	Journal Article	eICU Telemedicine Technology	117	Registered Nurses	USA	Telemedicine TAM (TTAM) – Extended TAM
10	Damanhoori et al. (Damanhoori et al. 2011)	2011	Conference	Breast Self-Examination Teleconsultation	279	Female Citizens	Malaysia	TAM
11	Lim et al. (Lim et al. 2011)	2011	Journal Article	Mobile Phones to seek Health Information	175	Female Citizens 21+	Singapore	Extended TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
12	Mohamed, Tawfik, Norton, et al. (Mohamed, Tawfik, Norton, et al. 2011)	2011	Conference	Electronic Health Technologies	50	Participants – Not Specified	UAE & UK	E-Health Technology Acceptance Model (E-HTAM) – Extended TAM
13	Ortega Egea & Román González (Ortega Egea & Román González 2011)	2011	Journal Article	Electronic Health Care Records (EHCR)	254	Physicians	Spain	Extended TAM
14	Mohamed, Tawfik, Al-Jumeily, et al. (Mohamed, Tawfik, Al-Jumeily, et al. 2011)	2011	Conference	Smart Mobile Phone in the Medical Domain	229	Students Medical Practitioners, Ministry of Health Staff and Universities Staff	UAE & UK	Mobile Technology Acceptance Model (Mo-HTAM) – Extended TAM
15	Ketikidis et al. (Ketikidis et al. 2012)	2012	Journal Article	Health Information Technology (HIT)	133	Healthcare Professionals: Doctors & Nurses	North Macedonia	Modified TAM2
16	Chong & Chan (Chong & Chan 2012)	2012	Book Chapter	Radio Frequency Identification (RFID)	183	Managers, heads of departments, IT managers, or logistic mangers of the healthcare companies and hospitals	Malaysia	Extended TAM
17	Kim & Park (Kim & Park 2012)	2012	Journal Article	Health Information Technology (HIT)	728	Users of Online Health Information	South Korea	Integrated Model-Health Information Technology Acceptance Model (HITAM): HBM, TPB & TAM
18	Terrizzi et al. (Terrizzi et al. 2012)	2012	Conference	Integrated Electronic Health Records (IEHR)	31	Physicians and Office Staff	USA	Extended TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
19	Chow et al. (Chow et al. 2012)	2012	Journal Article	Online Virtual Health Learning: Rapid Sequence Intubation (RSI)	206	Nursing Students	Hong Kong	Extended TAM
20	Asua et al. (Asua et al. 2012)	2012	Journal Article	Telemonitoring System	268	Nurses, General Practitioners, and Paediatricians	Spain	Extended TAM
21	Khalika Banda & Gombachika (Khalika Banda & Gombachika 2013)	2012	Conference	Mobile Health Services	38	Health Surveillance Assistants	Malawi	Extended TAM
22	Holden et al. (Holden et al. 2012)	2012	Journal Article	Bar-coded medication - dispensing and administration technology	39	Pharmacists and Pharmacy Technicians	USA	Extended TAM
23	Chang & Hsu (Chang & Hsu 2012)	2012	Journal Article	Online Patient-Safety Reporting System	183	Healthcare Professionals	Taiwan	Modified UTAUT
24	Ifinedo (Ifinedo 2012)	2012	Conference	Information Systems	227	Healthcare Professionals	Canada	Modified UTAUT
25	Moores (Moores 2012)	2012	Journal Article	Clinical Management System	346	Clinical Staff	France	Extended TAM - Integrated Model
26	Guo et al. (Guo et al. 2012)	2012	Conference	Mobile Health Services	492	Service Participants	Taiwan	Extended TAM
27	Sarlan et al. (Sarlan et al. 2012)	2012	Conference	Clinic Information System	252	Doctors & Staff	Malaysia	Integrated Model: TAM & TPB
28	Gagnon et al. (Gagnon, Orruño, et al. 2012)	2012	Journal Article	Home Telemonitoring System	93	Doctors & Nurses	Spain	Modified TAM
29	Chua et al. (Jit Chee Chua et al. 2012)	2012	Conference	Home-based Pill Dispensers	21	Patients	Singapore	TAM
30	Su, Tsai & Chen (Su, Tsai & Chen 2012)	2012	Conference	Telecare System	365	Older Resident	Taiwan	TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
31	Chow et al. (Chow et al. 2013)	2013	Journal Article	Clinical Imaging Portal	128	Nursing Students	Hong Kong	Extended TAM
32	Cheng (Cheng 2013)	2013	Journal Article	E-learning System	218	Nurses	Taiwan	Integrated Model: TAM & Flow Theory
33	Bennani & Oumlil (Bennani & Oumlil 2013)	2013	Conference	IT in Healthcare	250	Nurses	Morocco	Extended UTAUT
34	Vanneste, Vermeulen & Declercq (Vanneste, Vermeulen & Declercq 2013)	2013	Journal Article	BelRAI Web Application: web-based system enabling person-centered recording and data sharing	282	Healthcare Professionals	Belgium	Extended UTAUT
35	Huang (Huang 2013)	2013	Journal Article	Telecare	369	Residents 15+	Taiwan	Extended TAM
36	Escobar-Rodríguez & Romero-Alonso (Escobar-Rodríguez & Romero-Alonso 2013)	2013	Journal Article	Automated Unit-based Medication Storage and Distribution Systems	118	Nurse	Spain	Extended TAM
37	Arning, Kowalewski & Ziefle (Arning, Kowalewski & Ziefle 2013)	2013	Conference	Wireless Medical Technologies (WMT)	305	Users/Non-users	Germany	Diffusion of Innovation Theory
38	Sarlan, Ahmad, Fatimah, et al. (Sarlan, Ahmad, Fatimah, et al. 2013)	2013	Conference	Health Information System (HIS)	252	Staff in Private Healthcare Organizations	Malaysia	Integrated Model: TAM & TPB
39	Cocosila (Cocosila 2013)	2013	Journal Article	Mobile Health Applications	170	Smokers (18+)	United Kingdom	Attitude - Perceived Risk-Motivation Model

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
40	Gajanayake, Sahama & Iannella (Gajanayake, Sahama & Iannella 2013)	2013	Journal Article	Electronic Health Record (EHR)	334	Medical, Nursing & Health Students	Australia	TAM
41	Chen et al. (Chen et al. 2013)	2013	Journal Article	E-Appointment System	334	Citizens	Taiwan	Extended TAM
42	Kummer, Schäfer & Todorova (Kummer, Schäfer & Todorova 2013)	2013	Journal Article	Sensor-Based Medication Systems	579	Nurses	Australia	Extended TAM2
43	Kuo, Liu & Ma (Kuo, Liu & Ma 2013)	2013	Journal Article	Mobile Electronic Medical Record (MEMR)	665	Nurses	Taiwan	Extended TAM
44	Krueklai, Kiattisin & Leelasantitham (Krueklai, Kiattisin & Leelasantitham 2013)	2013	Journal Article	E-health Solutions	200	Participants from Government Hospitals	Thailand	UTAUT
45	Manimaran & Lakshmi (Manimaran & Lakshmi 2013)	2013	Journal Article	Health Management Information System (HMIS)	960	Healthcare Professionals: Doctors, Pharmacists, Nurses, etc.	India	Extended TAM
46	Tavakoli et al. (Tavakoli et al. 2013)	2013	Journal Article	Electronic Medical Record (EMR)	62	System Users	Iran	Extended TAM
47	Jackson, Yi & Park (Jackson, Yi & Park 2013)	2013	Journal Article	Personal Digital Assistant (PDA)	222	Physicians	USA	TAM, TPB, and IDT
48	Mohamed et al. (Mohamed et al. 2013)	2013	Conference	Electronic Health Technologies	129	Participants – Not Specified	UAE & UK	E-Health Technology Acceptance Model (E-HTAM2) – Extended TAM
49	Sarlan, Ahmad, Ahmad, et al. (Sarlan, Ahmad, Ahmad, et al. 2013)	2013	Journal Article	Clinic Information System (CIS)	252	Doctors & Staff	Malaysia	Extended Hybrid Model: TAM & TPB

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
50	Ford (Ford 2014)	2014	Master's Thesis	Over-the-counter Blood Pressure Monitor	26	Individuals in 2 age groups: (18-28) & (60-85)	USA	Extended UTAUT
51	Alaiad, Zhou & Koru (Alaiad, Zhou & Koru 2014)	2014	Journal Article	Home Healthcare Robots	64	Patients & Healthcare Professionals	USA	Extended UTAUT
52	Lin (Lin 2014)	2014	Journal Article	Knowledge Management Systems	361	Physicians	USA & Taiwan	Technology Acceptance View of Knowledge Management Systems in Healthcare Organizations (TAV-KMSHO)
53	Hsieh, Lai & Ye (Hsieh, Lai & Ye 2014)	2014	Conference	Health Cloud Services	443	Patients	Taiwan	Integrated Model: TAM & SQB
54	Gagnon et al. (Gagnon et al. 2014)	2014	Journal Article	Electronic Health Record (EHR)	150	Physicians	Canada	4 Models: TAM, Extended TAM, Psychosocial Model & Integrated Model
55	Fleming et al. (Fleming et al. 2014)	2014	Journal Article	Prescription Monitoring: Prescription Access	76	Emergency Physicians	USA	TAM
56	Corneille et al. (Corneille et al. 2014)	2014	Conference	Text-message Based Health Intervention	120	Undergraduate Psychology Students	USA	Diffusion of Innovation Theory
57	Steininger et al. (Steininger et al. 2014)	2014	Conference	Electronic Health Record (EHR)	204	Physicians	Austria	Modified TAM
58	Hwang, Kim & Lee (Hwang, Kim & Lee 2014)	2014	Journal Article	Ambulance Telemetry Technology	136	Emergency Medical Technicians	S. Korea	Extended TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
59	Hung, Tsai & Chuang (Hung, Tsai & Chuang 2014)	2014	Journal Article	Primary Health Information System (PHIS)	768	Nurses	Taiwan	Theory of Reasoned Action (TRA)
60	Rho, Choi & Lee (Rho, Choi & Lee 2014)	2014	Journal Article	Telemedicine Technology	183	Physicians	S. Korea	Extended TAM
61	Moon & Chang (Moon & Chang 2014)	2014	Journal Article	Innovative Smartphone	122	Hospital Professionals	S. Korea	Integrated Model: TRA, TAM & IS Success Model
62	Tsai (Tsai 2014)	2014	Journal Article	Telehealth System	365	Patients	Taiwan	Integrated Model: Extended TAM & HBM
63	Yallah (Yallah 2014)	2014	PhD Dissertation	Telemedicine	190	Physicians	Georgia	Extended TAM
64	Cleveland (Cleveland 2014)	2014	PhD Dissertation	Educational Technology	57	Nurse Educators	USA	Extended TAM
65	Devine (Devine 2015)	2015	PhD Dissertation	Social Media in Healthcare	137	Nurses	USA	UTAUT2
66	Ebie & Njoku (Ebie & Njoku 2015)	2015	Journal Article	Performance Appraisal System	80	Line Managers	United Kingdom	Extended TAM
67	Krishnan, Dhillon & Lutteroth (Krishnan, Dhillon & Lutteroth 2015)	2015	Conference	Consumer Health Informatics Applications	105	Health Consumers	Malaysia	Integrated Model: TAM, TRA & UTAUT2
68	Basak, Gumussoy & Calisir (Basak, Gumussoy & Calisir 2015)	2015	Journal Article	Personal Digital Assistant (PDA)	339	Physicians	Turkey	Extended TAM
69	Briz-Ponce & García-Peñalvo (Briz-Ponce & García-Peñalvo 2015)	2015	Journal Article	Mobile Technology and “apps” in Medical Education	124	Students and Medical Professionals	Spain	Extended TAM
70	Song, Park & Oh (Song, Park & Oh 2015)	2015	Journal Article	Bar Code Medication Administration	163	Nurses	USA	Extended TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
				Technology				
71	Holahan et al. (Holahan et al. 2015)	2015	Journal Article	Medication Reconciliation Technology	53	Primary Care Providers	USA	Effective Technology Use Model (ETUM)
72	Ahadzadeh et al. (Ahadzadeh et al. 2015)	2015	Journal Article	Health-Related Internet Use	293	Female Users	Malaysia	Integrated Model: HBM & TAM
73	Kowitlawakul et al. (Kowitlawakul et al. 2015)	2015	Journal Article	Electronic Health Records for Nursing Education (EHRNE)	212	Undergraduate Nurses	Singapore	Extended TAM
74	Elaklouk, Mat Zin & Shapii (Elaklouk, Mat Zin & Shapii 2015)	2015	Journal Article	Serious Games for Cognitive Rehabilitation	41	Therapists	Saudi Arabia	Extended TAM
75	Chang et al. (Chang et al. 2015)	2015	Journal Article	E-hospital Service: Web-based Appointment System	140	Patients	Taiwan	Extended TAM
76	Hsieh (Hsieh 2015)	2015	Journal Article	Health Cloud Services	209	Healthcare Professionals	Taiwan	Integrated Model: TPB & SQB
77	Steininger & Stiglbauer (Steininger & Stiglbauer 2015)	2015	Journal Article	Electronic Health Records (EHR)	204	Physicians	Austria	Modified TAM
78	De Veer et al. (De Veer et al. 2015)	2015	Journal Article	E-Health Applications	1014	Older People	Germany	UTAUT
79	Ku & Hsieh (Ku & Hsieh 2015)	2015	Conference	Health Cloud Services	105	Patients	Taiwan	Integrated Model: TPB & SQB
80	Liu & Cheng (Liu & Cheng 2015)	2015	Journal Article	Mobile Electronic Medical Records	158	Physicians	Taiwan	Integrated Model: TAM and Dual Factor Model
81	Miiro & Maiga (Miiro & Maiga 2015)	2015	Book Chapter	Social Networks For E-Health	278	Graduate Students	Uganda	E-Health Social Networked Model
82	Zaman (Zaman 2015)	2015	Master's Thesis	Electronic Documentation	248	Nurses	USA	Extended TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
				Systems (EHR, EMR, EPR)				
83	Sezgin & Özkan-Yıldırım (Sezgin & Özkan-Yıldırım 2016)	2016	Journal Article	Health Information Technology: Pharmaceutical Service Systems	1420	Pharmacists/ Pharmaceutical Assistants	Turkey	Integrated Model (P-TAM): TAM, UTAUT & TPB
84	Mansur, Fatma (Mansur, Fatma 2016)	2016	Journal Article	Information and Communication Technologies	303	Health Managers	Turkey	Extended TAM
85	Moon & Hwang (Moon & Hwang 2016)	2016	Book Chapter	Smart Health Care System	126	Students	S. Korea	Extended UTAUT
86	Ku & Hsieh (Ku & Hsieh 2016)	2016	Conference	Cloud-Based Healthcare Services	178	Elderly Citizens	Taiwan	Extended TPB
87	Made Dhanar et al. (Made Dhanar et al. 2016)	2016	Conference	Hospital Information Systems	100	Hospital Staff & Doctors	Indonesia	Integrated Model: TAM & DeLone and McLean IS Success
88	Kim, Seok, et al. (Kim et al. 2016)	2016	Journal Article	Mobile Electronic Medical Record (EMR)	449	Healthcare Professionals	S. Korea	Extended UTAUT
89	Cimperman, Makovec Brenčič & Trkman (Cimperman, Makovec Brenčič & Trkman 2016)	2016	Journal Article	Home Telehealth Services (HTS)	400	Old Users 50+	Slovenia	Extended UTAUT
90	Hadadgar et al. (Hadadgar et al. 2016)	2016	Journal Article	E-Learning Continuing Medical Education (CME)	146	General Practitioners	Iran	TPB
91	Hsiao & Chen (Hsiao & Chen 2016)	2016	Journal Article	Computerized Clinical Practice Guidelines	238	Physicians	Taiwan	Integrative Model of Activity Theory and TAM
92	Lazard et al. (Lazard et al. 2016)	2016	Journal Article	Patient Portal	333	Portal Users	USA	Extended TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
93	Lin et al. (Lin et al. 2016)	2016	Journal Article	Wearable Instrumented Vest	50	Elderly 60+	Taiwan	Extended TAM
94	Al-Nassar, Rababah & Al-Nsour (Al-Nassar, Rababah & Al-Nsour 2016)	2016	Journal Article	Computerized Physician Order Entry (CPOE)	118	Physicians	Jordan	Extended TAM
95	Lazuras & Dokou (Lazuras & Dokou 2016)	2016	Journal Article	Online Counseling Services	63	Mental health professionals	United Kingdom	Extended TAM
96	Ifinedo Princely, Odette Griscti, Judy Bailey (Ifinedo Princely, Odette Griscti, Judy Bailey 2016)	2016	Journal Article	Healthcare Information Systems (HIS)	197	Registered Nurses	Canada	Extended TAM
97	Holden et al. (Holden et al. 2016)	2016	Journal Article	In-room Pediatric ICU Technology	167	Nurses	USA	Expanded TAM
98	Ducey & Coovert (Ducey & Coovert 2016)	2016	Journal Article	Tablet Computer Use	261	Physicians	USA	Extended TAM
99	Chen, Chang & Lai (Chen, Chang & Lai 2016)	2016	Conference	Cloud Sphygmomanometer	521	System Users	Taiwan	Extended TAM
100	Guo, Zhang & Sun (Guo, Zhang & Sun 2016)	2016	Journal Article	Mobile Health Services	650	Service Users	China	Attribute-Perception-Intention Model
101	Becker (Becker 2016)	2016	Journal Article	Mobile Mental Health Applications	125	Young Adults	Germany	Extended TAM
102	Shujen Lee & Chen (Shujen Lee Chang & Chen 2016)	2016	Conference	3D Bio-printing	249	Adults	Taiwan	TAM
103	Hsieh (Hsieh 2016)	2016	Journal Article	Health Cloud Services	681	Patients	Taiwan	Dual Factor Model: UTAUT and SQB
104	Ahmadi et al. (Ahmadi et al. 2017)	2017	Journal Article	Picture Archiving and Communication System (PACS)	151	Healthcare Employees	Iran	UTAUT

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
105	Jayusman & Setyohadi (Jayusman & Setyohadi 2017)	2017	Conference	E-learning System	188	Students of School of Health Sciences	Indonesia	Extended TAM
106	Amin et al. (Amin et al. 2017)	2017	Journal Article	Cloud-based Healthcare Services	147	Healthcare Professionals	Malaysia, Pakistan & Saudi Arabia	UTAUT
107	(Ehteshami 2017)	2017	Journal Article	Barcode Technology	9	Users	Iran	Extended TAM
108	Ehteshami (Beglaryan, Petrosyan & Bunker 2017)	2017	Journal Article	Electronic Health Record (EHR)	233	Physicians	Armenia	Tripolar Model (TMTA) – Extended TAM
109	Rajanen & Weng (Rajanen & Weng 2017)	2017	Conference	Wearable Devices for Personal Healthcare – Smart Bands	158	Consumers	China	Extended TAM
110	Wahyuni & Nurbojatmiko (Wahyuni & Nurbojatmiko 2017)	2017	Conference	E-health Services Consumer Informatics	91	Citizens	Indonesia	Extended Model: TAM & HBM
111	Nematollahi et al. (Nematollahi et al. 2017)	2017	Journal Article	Electronic Medical Records (EMR)	235	Hospital Managers	Iran	UTAUT
112	Hsu & Wu (Hsu & Wu 2017)	2017	Journal Article	Nursing Information Systems	158	Nurses	Taiwan	TAM
113	Horne (Horne 2017)	2017	PhD Dissertation	Telemedicine	46	Healthcare Workers	USA	TAM
114	Hsieh et al. (Hsieh et al. 2017)	2017	Book Chapter	Personal Health Information System in Self-Health Management	240	Middle-Aged and Elderly Citizens	Taiwan	HBM
115	Lin (Lin 2017)	2017	Journal Article	Nursing Information System	531	Nurses	Taiwan	Integrated Model: TAM & ISSM
116	Dou et al. (Dou et al. 2017)	2017	Journal Article	Smartphone Health Technology for Chronic Disease Management	157	Patients	China	Extended TAM

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
117	Zhang et al. (Zhang et al. 2017)	2017	Journal Article	Mobile Health Services	650	Service Users	China	Extended TAM
118	Khan et al. (Khan et al. 2018)	2018	Journal Article	E-Prescribing	295	Physicians	Pakistan	Extended UTAUT
119	Kalavani, Kazerani & Shekofteh (Kalavani, Kazerani & Shekofteh 2018)	2018	Journal Article	Evidence-based Medicine (EBM) Databases	192	Medical Residents	Iran	UTAUT
120	Lin et al. (Lin et al. 2018)	2018	Journal Article	Wearable Cardiac Health Technologies	48	Patients	Taiwan	Extended TAM
121	Martins et al. (Martins et al. 2018)	2018	Journal Article	E-health Technology	210	Hospital Employees	Nigeria	Extended UTAUT
122	Beldad & Hegner (Beldad & Hegner 2018)	2018	Journal Article	Fitness Apps	476	Users of Fitness Apps	Germany	Extended TAM
123	Perlich, Meinel & Zeis (Perlich, Meinel & Zeis 2018)	2018	Journal Article	Interactive Documentation System	46	Therapists & Patients	Germany	Extended UTAUT
124	Nadri et al. (Nadri et al. 2018)	2018	Journal Article	Hospital Information Systems	202	Systems Users	Iran	Extended TAM
125	Tubaishat (Tubaishat 2018)	2018	Journal Article	Electronic Health Records (EHR)	1539	Nurse	Jordan	TAM
126	Özdemir-Güngör & Camgöz-Akdağ (Özdemir-Güngör & Camgöz-Akdağ 2018)	2018	Journal Article	Electronic Health Records (EHR)	99	Healthcare Professionals & Administrative Staff	Turkey	Modified TAM
127	Aldosari et al. (Aldosari et al. 2018)	2018	Journal Article	Electronic Medical Records (EMR)	153	Nurses	Saudi Arabia	Modified TAM
128	Ku & Hsieh (Ku & Hsieh 2018)	2018	Conference	Health Management Mobile Services	105	Citizens	Taiwan	Integrated Model: TPB & HBM
129	Hennemann et al. (Hennemann et al. 2018)	2018	Journal Article	Occupational E-Mental-Health	1829	Employees with long sick leaves	Germany	Extended UTAUT

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
130	Vitari & Ologeanu-Taddei (Vitari & Ologeanu-Taddei 2018)	2018	Journal Article	Electronic Health Records (EHR)	1741 + 1119	Physicians, Paraprofessionals & Administrative Personnel	France	New Developed Model
131	Venugopal et al. (Venugopal et al. 2019)	2018	Conference	Telemedicine & Electronic Health Records (EHR)	568	Clinical Staff	India	UTAUT
132	Liu & Lee (Liu & Lee 2018)	2018	Journal Article	Pharma-Cloud	179	Pharmacists	Taiwan	Extended TAM
133	Zhou et al. (Zhou et al. 2019)	2019	Journal Article	Telehealth	436	60+ Years Old Patients	China	Extended TAM
134	Francis (Francis 2019)	2019	Journal Article	Self-monitoring Devices	258	Healthcare Providers	USA	Expanded UTAUT2
135	Li et al. (Li et al. 2019)	2019	Journal Article	Smart Wearables	146	60+ Years Old Adults	China	Extended Hybrid Model: TAM & UTAUT
136	Tao et al. (Tao et al. 2019)	2019	Journal Article	Health Information Portal	201	Adults	China	Extended TAM Model
137	Masyarakat et al. (Masyarakat et al. 2019)	2019	Journal Article	Nutrition Information System	50	Nutrition Officers	Indonesia	UTAUT
138	Tsai et al. (Tsai et al. 2019)	2019	Journal Article	Telehealth	281	Adults 40+	Taiwan	Integrated Model: TAM & SQB
139	Turja et al. (Turja et al. 2019)	2019	Journal Article	Care Robots	544	Healthcare Professionals	Finland	Robot Acceptance Model for Care (RAM-care)
140	Idoga et al. (Idoga et al. 2019)	2019	Journal Article	Cloud-based Health Center (CBHC)	300	Healthcare Professionals	Nigeria	UTAUT2
141	Boon-itt (Boon-itt 2019)	2019	Journal Article	Health Websites	222	Internet Consumers	Thailand	Extended TAM
142	Schomakers, Lidynia & Ziefle (Schomakers, Lidynia & Ziefle 2019)	2019	Conference	e-Health technologies: Fitness Trackers and Remote Monitoring of Implanted Cardiac Devices	253	Patients with Chronic Health Conditions	Germany	Acceptance Model of E-Health Technologies

Appendix C: Full Set of Factors and Confirmed Hypotheses - TAM

Table 36. Full Set of Factors and Confirmed Hypotheses - TAM

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations	
		PEOU	PU	AT	BI	AU						
1	Extended TAM	✓	✓		✓		SOCIAL INFLUENCE (SI)	SELF-EFFICACY (SE)	TASK-TECHNOLOGY FIT (TTF)	TRUST (TRU)	PEOU → PU SI → PU SE → BI	TRU → BI TTF → PEOU TTF → PU
2	Extended TAM Model	✓	✓		✓		SUBJECTIVE NORM (SN) PERCEIVED PSYCHOLOGICAL RISK (PSR)	SYSTEM SELF-EFFICACY (SSE) PERCEIVED FINANCIAL RISK (PFR)	IMAGE (IM) PERCEIVED RISK OF PERFORMANCE (PROP)		SN → BI SN → PU SN → IM IM → PU PU → BI	PEOU → PU SSE → BI PSP → BI PSR → BI PFR → BI
3	TAM	✓	✓		✓						PEOU → PU PEOU → BI PU → BI	
4	TAM		✓		✓		PERCEIVED CONFIDENCE (PCON)				PU → BI PCON → BI	
5	Extended TAM	✓			✓		INFORMATION QUALITY (IQ)	MEDICAL SERVICE QUALITY PERCEPTION (MSVQ)	MEDICAL BEHAVIORAL INTENTION (PBI)	TELEHEALTH ACCEPTANCE (ACC)	EOU → ACC MSVQ → ACC IQ → ACC ACC→ TBI	
6	Extended TAM Model	✓	✓	✓	✓		PERCEIVED UBIQUITY (PUB)	TECHNOLOGY ANXIETY (TA)	RESISTANCE TO CHANGE (RC)	BENEFIT (BF)	PUB → PU PUB→ PEOU PUB → RC PUB → AT	RC → BI BF → BI PU → AT
7	Extended TAM	✓	✓		✓		INJUNCTIVE SOCIAL NORM (INJ)	DESCRIPTIVE SOCIAL NORM (DES)	TRUST IN FITNESS APP DEVELOPER (TRU)	HEALTH VALUATION (HVA)	PEOU → BI PU → BI INJ → BI PEOU → PU INJ → PU	DES → PU TRU → PU PEOU → TRU INJ → TRU DES → TRU
8	Extended TAM	✓	✓		✓	✓	SUBJECTIVE NORM (SN)	IMAGE (IM) RESULT DEMONSTRABILITY (RD)	JOB RELEVANCE (JR)	OUTPUT QUALITY (OQ)	SN → IM PEOU → BI PU → BI	OQ → PU PEOU → PU JR → PU
9	TAM	✓	✓		✓						PEOU → BI PU → BI PEOU → PU	

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations	
		PEOU	PU	AT	BI	AU						
10	Modified TAM	✓	✓	✓	✓		TECHNOLOGY ANXIETY (TA)	RESISTANCE TO CHANGE (RC)			AT → BI PU → BI PU → AT PEOU → AT	RC → PEOU TA → AT TA → PU
11	Modified TAM	✓	✓		✓		SYSTEM QUALITY (SQ)	TOP MANAGEMENT & IT SUPPORT (MIT)	USER CHARACTERISTICS (UCR)		PU → SQ PEOU → SQ PU → MIT PEOU → MIT PEOU → PU	PEOU → BI PU → BI SQ → BI MIT → BI UCR → BI
12	Extended TAM	✓	✓		✓		ACCESSIBILITY QUALITY (AQ)	COMPUTER SELF-EFFICACY (CSE)	VOLUNTARINESS (VOL)	SUBJECTIVE NORM (SN)	SN → PU AQ → PEOU PEOU → PU PEOU → BI	
13	Extended TAM	✓	✓	✓	✓	✓	EASE OF LEARNING (EA)	CAPABILITIES (CAP)			PU → AT PEOU → AT PU → BI EA → PEOU EA → PU	CAP → PEOU CAP → PU AT → BI BI → AU EA → CAP
14	Tripolar Model of Technology Acceptance (TMTA) – Extended TAM	✓	✓		✓		COMPUTER ANXIETY (CA) ORGANISATIONAL SUPPORT (OS) ADMINISTRATIVE MONITORING (AM)	PERSONAL INNOVATIVE-NESS (PINV) PATIENT INFLUENCE (PI) PROJECTED COLLECTIVE USEFULNESS (PCU)	ORGANIZATIONAL CHANGE (OC) PROFESSIONAL RELATIONSHIPS (PREL) RESISTANCE TO CHANGE (RC)		PEOU → PU PINV → PEOU PINV → BI CA → PEOU PI → PEOU PI → PCU PI → BI PU → PCU	RC → PU RC → BI OS → PEOU AM → PU PREL → PU PREL → PCU OC → PCU PCU → BI
15	Extended TAM	✓	✓		✓		TRUST (TRU) MOBILE SKILLS (MS)	SOCIAL INFLUENCE (SI) AFFINITY (AF)	COMPATIBILITY (COM) INNOVATIVENESS (INV)	AGE (A) GENDER (G) BEHAVIORAL MOTIVATION (BM)	PU → BI PEOU → PU TRU → PU PEOU → TRU BM *PEOU → BI BM *PU → BI	SI → BI AF → BI COM → BI
16	Extended Model: TAM & HBM	✓	✓		✓		HEALTH CONSCIOUSNESS (HC)	PERCEIVED HEALTH RISK (PHR)			HC → BI HC → PU PU → BI	PHR → BI PHR → PU PEOU → PU
17	TAM	✓	✓		✓		INFORMATION QUALITY (IQ)	SERVICE QUALITY (SVQ)	SYSTEM QUALITY (SQ)	USER SATISFACTION (US)	IQ → PU IQ → PEOU SQ → PU SQ → PEOU	PEOU → PU PEOU → BI US → BI
18	Extended TAM	✓	✓		✓		SOCIAL FACTOR (SF) ANXIETY (ANX)	VOLUNTARINESS (VOL) SELF EFFICACY (SE)	EXPERIENCE (EXP) AGE (A)	EDUCATION (EDU) FOREIGN LANGUAGE (FL)	PU → BI PEOU → BI SI → BI VOL → BI ANX → BI	EDU → BI FL → BI EXP → BI A → BI
19	Extended TAM	✓	✓		✓		WEB AESTHETICS SIMPLICITY (SIMP)	WEB AESTHETICS DIVERSITY (DIV)	WEB AESTHETICS COLORFULNESS (CO)	WEB AESTHETICS CRAFTSMANSH-IP (CRA)	SIMP → PEOU DIV → PEOU PEOU → PU PU → BI	

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations	
		PEOU	PU	AT	BI	AU						
20	Extended TAM	✓	✓	✓	✓		TECHNOLOGY ANXIETY (TA)				TA → PEOU PEOU → PU PEOU → AT PU → ATT AT → BI	
21	Extended TAM	✓	✓		✓	✓	INSTABILITY OF NEW SOFTWARE PROVIDERS (INSP)	SOFTWARE QUALITY (SWQ)			INSP → PEOU SWQ → PEOU PEOU → PU	PEOU →BI PU → BI BI → AU
22	Extended TAM	✓	✓	✓			JOB RELEVANCE (JR)	SUBJECTIVE NORMS (SN)	DESCRIPTIVE NORMS (DS)	COMPUTER ANXIETY (CA) USAGE INTENTIONS (UI)	PU → UI PU: JR → IU	
23	Extended TAM	✓	✓		✓		SELF-REPORTED USAGE (SRU)	COMPUTER SELF-EFFICACY (CSE)	COMPUTER HABIT (CH)	ACCESSIBILITY TO COMPUTER (ACS)	PU → BI CH → BI BI →ACS	
24	Expanded TAM	✓	✓		✓		SOCIAL INFLUENCE, INSTITUTIONAL (SII) COMPLETE USE OF SYSTEM (CUS)	SOCIAL INFLUENCE, PATIENT/FAMILY (SIPF) SATISFACTION WITH SYSTEM (SAT)	PERCEIVED TRAINING ON SYSTEM (PTS)	PERCEIVED USEFULNESS, TRADITIONAL (PUT) PERCEIVED USEFULNESS FOR PATIENT/FAMILY INVOLVEMENT, (PUPFI) PERCEIVED USEFULNESS FOR CARE DELIVERY (PUCD)	PEOU → SAT PUPFI → SAT PUCD → SAT PUCD → IU	SAT → CUS SIPF → IU IU → CUS
25	Extended TAM	✓	✓	✓	✓		COMPATIBILITY (COM)	RELIABILITY (REL)	SUBJECTIVE NORM (SN)		PU → BI PU → AT PEOU → AT SN→ PU SN → COM COM → PU	COM →PEOU AT → BI REL→ PU REL→ PEOU REL →COM
26	Extended TAM	✓	✓		✓		SUBJECTIVE NORMS (SN) IMAGE (IM) RESULT DEMONSTRABILITY (RD)	JOB RELEVANCE (JR) OBJECTIVE USABILITY (OU) COMPUTER SELF-EFFICACY (CSE)	OUTPUT QUALITY (OQ) PERCEPTIONS OF EXTERNAL CONTROL (PEC) COMPUTER ANXIETY (CA)	COMPUTER PLAYFULNESS (CP) PERCEIVED ENJOYMENT (ENJ)	PU → BI PEOU → BI PEOU → PU SN→ PU IMG → PU	OQ → PU JR → PU SN → IMG CSE → PEOU OU → PEOU
27		✓	✓			✓	TRAINING (TR) ACCEPTANCE (ACC)	UNDERSTAND SYSTEM (UNS)	FACILITATING CONDITIONS (FC)	ORGANISATIONAL SUPPORT (OS)	PEOU → PU PU → ACC PEOU → ACC ACP→ AU PU → AU PEOU → AU	TR → PEOU UNS → PU UNS → PEOU FC → PU FC → PEOU
28	Extended TAM	✓	✓		✓		PERCEIVED ENJOYMENT (ENJ)	SUBJECTIVE NORMS (SN)	COMPUTER SELF-EFFICACY (CSE)	PERSONAL INNOVATIVENESS (PINV)	PEOU → PU PU → ENJ PEOU → BI PU→ BI	SN → PU PINV → PEOU CSE → PEOU
29	Extended TAM	✓	✓	✓	✓		SOCIAL INFLUENCE	FACILITATING CONDITIONS	SELF-EFFICACY (SE)	ANXIETY (A)	PEOU → PU	A → PU

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations	
		PEOU	PU	AT	BI	AU	(SI)	(FC)	RECOMMENDATION (REC)	RELIABILITY (REL)	PU → AT SI → AT SI → SE SI → PU SI → BI FC → SI FC → SE FC → REC	A → REL AT → BI AT → REC AT → REL SE → BI REC → BI REC → SE REL → SE
30	Extended TAM	✓	✓		✓	✓	HOSPITAL MANAGEMENT SUPPORT FOR PATIENT SAFETY (HMSPS) EXPERIENCE (EXP)	TEAMWORK WITHIN HOSPITAL UNITS (TWHU) COMMUNICATION OPENNESS (COP) FEEDBACK AND COMMUNICAION ABOUT ERRORS (FCE)	NURSING SHIFT (NS) LENGTH OF USE (LoU) ETHNICITY (ET)	AGE (A) EDUCATION (EDU) COMPUTER SKILLS (CS)	A → BI PU → BI EDU → PEOU ET → PU ET → PEOU NS → PU	LoU → PEOU LoU → PU EXP → BI TWHU→ BI FCE → PEOU FCE → PU
31	Extended TAM	✓	✓	✓	✓		EHRNE SELF-EFFICACY (ESE)				PEOU → PU PEOU → AT PU → AT PU → BI	ESE → PU ESE → PEOU AT → BI
32	Extended TAM	✓	✓		✓		PERCEIVED ENJOYMENT (ENJ)				PEOU →BI PU → BI ENJ → BI	
33	Extended TAM	✓	✓		✓		USER EXPERIENCE (EXP)	WEB SITE QUALITY (WQ)	SERVICE QUALITY (SVQ)		PEOU → PU EXP → PU EXP → PEOU WQ → PEOU PU → BI	
34	Modified TAM		✓	✓	✓		PRIVACY CONCERNS (PRV)	SOCIAL INFLUENCE (SI)	HIT EXPERIENCE (EXP)		AT → BI PU → BI PU → AT SI → BI SI → PU EXP → BI	EXP → AT EXP → PU EXP → BI PRV → AT PRV → BI
35	TAM & Extended TAM	✓	✓		✓		COMPUTER SELF-EFFICACY (CSE)	RESULT DEMONSTRABILITY (RD)			PEOU → PU PEOU → BI PU → BI CSE → PEOU RD → PU	
36	TAM	✓	✓	✓	✓						Non-users : ATT → BI Users : PU → BI	
37	Modified TAM		✓	✓	✓		PRIVACY CONCERNS (PRV)	SOCIAL INFLUENCE (SI)	HIT EXPERIENCE (EXP)		AT → BI PU → BI PU → AT SI → BI SI → PU EXP → BI	EXP → AT EXP → PU EXP → BI PRV → AT PRV → BI
38	Extended TAM	✓	✓	✓	✓		CLINICAL FACTORS (CLF)	SUBJECTIVE NORM (SN)	LOYALITY INCENTIVES (INC)	ORGANIZATIONAL FACILITATION (ORGF)	PEOU → PU PEOU → AT	SN → PU SN → AT

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations	
		PEOU	PU	AT	BI	AU						
							NON CLINICAL FACTORS (NCLF)	EXPECTATION CONFIRMATION (EXC)	JOB FIT (JF)		PU → AT PU → BI AT → BI CLF → PU CLF → AT	JF → PU JF → AT INC → AT ORGF → AT
39	Extended TAM	✓	✓		✓		ACCESSIBILITY OF PATIENTS (AoP)	ACCESSIBILITY OF MEDICAL RECORDS (AoMD)	SELF-EFFICACY (SE)	PERCEIVED INCENTIVES (PIN)	PEOU → PU PEOU → BI PU → PI PU → BI PI → BI	SE → PEOU SE → PU AoP → PU AoMD → PU
40	TAM	✓	✓	✓	✓						PEOU → BI PU → BI AT → BI	
41	TAM	✓	✓	✓	✓	✓					PEOU → PU PU → PEOU PU → AT PEOU → AT	PU → BI AT → BI BI → AU
42	Extended TAM	✓	✓	✓	✓		COMPUTER SELF-EFFICACY (CSE)				PEOU → PU PU → AT PEOU → AT PU → BI	AT → BI CSE → PU CSE → PEOU
43	Extended TAM	✓	✓	✓	✓		INNOVATIVENESS (INV)	SUBJECTIVE NORM (SN)			PEOU → PU PU → AT PEOU → AT AT → BI	INV → PEOU SN → PU SN → BI
44	Extended TAM	✓	✓	✓			TRAINING (TR)	PERCEIVED RISK (PR)	EXPERIENCE LEVEL (EXP)		PEOU → PU TR → PU PEOU → AT PU → AT	EXP → PEOU PR → PEOU TR → PEOU
45	TAM		✓	✓	✓						PU → BI PU med AT→ BI AT → BI	
46	Extended TAM	✓	✓				CONTINUANCE INTENTION (CI)	RELATIONSHIP QUALITY (RQ)			PEOU → PU PU → RQ PEOU → RQ PU → CI RQ → CI	
47	Extended TAM2		✓		✓		VOLUNTARINESS (VOL) EXPERIENCE (EXP)	SUBJECTIVE NORM (SN) IMAGE (IM)	DEMONSTRABILITY (DEM) PERSO NAL INNOVATIVENESS (PINV)	QUANTATIVE OVERLOAD (QUAN) QUALITAVE OVERLOAD (QUAL)	SN → IM IM → PU DEM → PU QUAL → PU QUAN → PU PINV → PU	QUAL → PINV QUAN → PINV SN → BI PU → BI EXP mod SN → BI
48	Extended TAM	✓	✓		✓		INNOVATIVENESS (INV)	OPTIMISIM (OPT)	INSECURITY (INSEC)	DISCOMFORT (DCOM)	OPT → PEOU OPT → PU INV → PEOU INSEC → PEOU	DCOM → PEOU PEOU → PU PEOU → BI PU → BI
49	Extended TAM	✓	✓	✓	✓	✓	VOLUNTARINESS (VOL) INNOVATIVENESS (INV) INFORMATION (INF)	TECHNOLOGY (TECH) PROCESSING (PROS) OBJECTIVES & VALUES (OBV)	STAFFING & SKILLS (STS) MANAGEMENT & STRUCTURING (MGST) OTHERS: MONEY AND TIME	AGE (A) GENDER (G) EXPERIENCE (EXP)	VOL mod PU → BI VOL mod PEOU → BI VOL mod PEOU → AT VOL mod PEOU → PU INV → BI	TECH → PEOU PROS → PEOU STS → PEOU MGST → PEOU MTM → PEOU OBV → PEOU TECH → PU

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations	
		PEOU	PU	AT	BI	AU						
									(MTM)		INV → PEOU INV → EXP INV → AT PEOU → AT EXP → PEOU	PROS → PU STS → PU MGST → PU MTM → PU OBV → PU
50	Extended TAM	✓	✓	✓	✓		DATA Quality (DQ)	USER INTERFACE (UI)			DQ → PEOU DQ → PU UI → PEOU UI → PU UI → AT UI → BI	PEOU → PU PEOU → AT PEOU → BI PU → AT AT → BI
51	Modified TAM2	✓	✓		✓		SUBJECTIVE NORMS (SN)	DESCRIPTIVE NORMS (DS)	COMPUTER ANXIETY (CA)	RELEVANCE (RELV)	PEOU → BI RELV → BI SN → BI	
52	Extended TAM	✓	✓				INTENTION TO ADOPT RFID (IN)	IMAGE (IM)	RESULT DEMONSTRABILITY (RD)	COMPUTER ANXIETY (CA)	SN → PU OQ → PU IM → PU JR → PU	PEOU → PU FC → PEOU PEOU → IN PU → IN
							SECURITY AND PRIVACY (SECPRV)	JOB RELEVANCE (JR)	SELF-EFFICACY (SE)	FACILITATING CONDITION (FC)		
							SUBJECTIVE NORM (SN)	OUTPUT QUALITY (OQ)				
53	Extended TAM	✓	✓		✓		ACCESS TO SHARED INFORMATION (SHINFO)	TRUST (TRU)			PU → BI PEOU → BI PEOU → PU SHINFO → BI TRU → BI	
54	Extended TAM	✓	✓		✓		COMPUTER SELF-EFFICACY (CSE)				PU → BI PEOU → BI PEOU → PU CSE → PEOU CSE → PU	
55	Extended TAM	✓	✓		✓		COMPATIBILITY (COM)	SUBJECTIVE NORM (SN)	HABIT (HB)	FACILITATORS (FAC)	PU → BI FAC → BI COM → BI	
56	Extended TAM	✓	✓		✓		SUBJECTIVE NORM (SN)	PERCEIVED BEHAVIORAL CHANGE (PBCH)	VOLUNTARY (VOL)		PU → PBCH PU → SN PEOU → BI	PBCH → SN SN → VOL
57	Extended TAM	✓	✓		✓		PERCEIVED USEFULNESS FOR OWN PERFORMANCE (PU-SELF)	PERCEIVED USEFULNESS FOR PATIENT CARE CHANGE (PU-PT)	SOCIAL INFLUENCE (SI)	SATISFACTION (SATISF)	PEOU → PU-SELF PU-SELF → PU-PT PU-SELF → SATISF PU-PT → SATISF PEOU → SATISF	SATISF → BI PU-PT → BI SI → BI PU → PU-PT
58	Extended TAM - Integrated Model of IT Acceptance in Healthcare	✓	✓	✓			ENABLING FACTORS (ENBF)	COMPUTING SUPPORT (CSP)	SELF -EFFICACY (SE)	USE (U)	CSP X EXP → ENBF EFF X EXP → ENBF ENBF X EXP → PU PEOU X EXP → PU	ENBF → PU ENBF → PEOU IQ → PU IQ → PEOU PEOU → PU PEOU → COM
							INFORMATION QUALITY (IQ)	CONTENT (CNT)	TIMELINESS (TIM)	COMPATIBILIT (COM)		
								ACCURACY (ACRC)	FORMAT (FMT)	EXPERIENCE (EXP)		

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations	
		PEOU	PU	AT	BI	AU					PU → AT PU → COM CNT → IQ ACRC → IQ FMT → IQ TIM → IQ	PEOU → AT CSP → ENBF EFF → ENBF
59	Extended TAM	✓	✓				ADOPTION INTENTION (AI)	OUTCOME QUALITY (OQ)	SOCIAL NORM (SOC)		PEOU → PU SOC → PU SOC → AI OQ → PU	
60	Extended TAM	✓	✓	✓	✓		COMPATIBILITY (COM)	SUBJECTIVE NORM (SN)	HABIT (HB)	FACILITATORS (FAC)	PU → BI FAC → BI	
61	TAM	✓	✓	✓	✓						PU → AT PU → BI PEOU → AT PEOU → PU AT → BI	
62	Modified TAM	✓	✓		✓		COMPATIBILITY (COM)	SUBJECTIVE NORM (SN)	HABIT (HB)	FACILITATORS (FAC)	FAC → BI PU → BI PEOU → BI	
63	Extended TAM	✓	✓		✓		EMERGENCY (ER)				PEOU → PU PU → BI	
64	Extended TAM	✓	✓		✓		PERCEIVED BARRIERS TO USE (PBU)	AGENCY TYPE (AGN)			PBU → BI PU → BI PEOU → BI PEOU → PU PBU → AGN	
65	Telemedicine TAM (TTAM) - Extended TAM	✓	✓	✓	✓		YEARS WORKING IN THE HOSPITAL (WRK)	SUPPORT FROM PHYSICIANS (SUPPH)	SUPPORT FROM ADMINISTRATORS (SUPADM)		PU → BI PU → AT AT → BI SUPADM → PEOU	PEOU → AT PEOU → PU SUPPH → PU WRK → PU
66	TAM	✓	✓	✓	✓						PU → AT PU → BI PEOU → AT PEOU → PU AT → BI	
67	Extended TAM	✓	✓		✓	✓	SELF-EFFICACY (SE)	COMPUTER ANXIETY (CA)			PU → BI SE → BI	
68	e-Health Technology Acceptance Model – Extended TAM	✓	✓		✓		E-HEALTH TECHNOLOGY DESIGN (EH) TRUST (TRU)	PC SKILLS (PSK) POWER DISTANCE (PD)	SUBJECTIVE NORM (SN) MASCULINITY (MSC)	UNCERTAINTY AVOIDANCE (UNA) TANGBILITY (TG)	PU → BI PEOU → BI EH → BI SN → BI PEOU → PU TRU → PU SN → PU UNA → PU PD → PU TG → PEOU PSK → PEOU SN → PEOU MSC → PEOU	UNA → BI PSK → BI TG → BI TRU → BI PSK → TG EH → TG EH → TRU UNA → TRU MSC → TRU TG → TRU MSC → SN MSC → UNA

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations	
		PEOU	PU	AT	BI	AU						EH → MSC PD → MSC
69	Extended TAM	✓	✓	✓	✓		PERCEIVED RISK (PR)	INFORMATION INTEGRITY (INFIN)	TRUST (TRU)		PEOU → PU TRU → PU TRU → PEOU TRU → AT PU → AT	AT → BI PR → TRU INFIN → TRU INFIN→ PR
70	Mobile Technology Acceptance Model (Mo-HTAM) – Extended TAM	✓	✓		✓		E-HEALTH TECHNOLOGY DESIGN (EH)	FEMINISM (FEM)	SUBJECTIVE NORM (SN)	INTENTION TO USE M-HEALTH (INMH) – same IU	PU → INMH PEOU → INMH EH → INMH SN → INMH UNA → INMH	FEM → INMH MSC → INMH TRU → INMH INEH → INMH
							TRUST (TRU)	POWER DISTANCE (PD)	MASCULINITY (MSC)			
								TANGBILITY (TG)	UNCERTAINTY AVOIDANCE (UNA)	INTENTION TO USE E-HEALTH (INEH) – same IU		
71	Extended TAM Model	✓	✓	✓	✓		APPLICATION-SPECIFIC SELF-EFFICACY (SE)	OBJECTIVE USABILITY (OU)	SUBJECTIVE USABILITY (SU)		PEOU → AT PU → AT SE → PEOU SE → PU	OU → SU SU → SE SU → PEOU AT → BI
72	Extended TAM	✓	✓		✓	✓	PERCEIVED HEALTH THREAT (PHT)	RESISTANCE TO CHANGE (RC)	RELATIONSHIP WITH DOCTOR (RWD)	USAGE EXPERIENCE (EXP)	PHT → BI PHT → PU RC → BI BI → AU SE → PEOU RC → PU	RWD → RC RWD → PU RWD → PEOU BI → AU PU → BI
										SELF-EFFICACY (SE)		
73	Extended TAM	✓	✓				SELF-EFFICACY (SE)	RESPONSE-EFFICACY (RE)	ADOPTION INTENTION (AI)		SE → PEOU RE → PEOU PEOU → PU PEOU → AI	PU → AI SE *PU → AI RE*PU → AI
74	Extended TAM		✓		✓		QUALITY OF HEALTH WEBSITE (QHW)	TRUST (TRU)	PERCEIVED INFORMATION QUALITY (PIQ)		QHW → PIQ PIQ → TRU TRU → PU PU → IT	
75	E-Health Technology Acceptance Model (E-HTAM2) – Extended TAM	✓	✓				TECHNOLOGY DESIGN (TD)	UNCERTAINTY AVOIDANCE (UNA)	INDIVIDUALISM / COLLECTIVISM (IND)	POWER DISTANCE (PD)	PU → INEH PEOU → INEH TD → INEH PD → INEH	SN → INEH IND → INEH UNA → INEH TRU → INEH
							MASCULINITY (MSC)	TRUST (TRU)	SUBJECTIVE NORM (SN)	INTENTION TO USE E-HEALTH (INEH)		
76	Extended TAM : Telemedicine Adoption Model	✓					PERCEIVED TELEMEDICINE TECHNOLOGY SAFETY (PTTS)	PERCEIVED TELEMEDICINE TECHNOLOGY SERVICE RISKS (PTTSR)	ANTICIPATED TELEMEDICINE TECHNOLOGY USE RESULTS (ATTUR)	COLLECTIVE ATTITUDE OF HEALTHCARE STAFF (CAHS)	PTTS → TA PTTSB → TA PTTSR → TA TTAT → TA ATTUR → TA	CAHS → TA TTC → TA CAHS → TA PSNTT → TA
							PERCEIVED TELEMEDICINE TECHNOLOGY SERVICE BENEFITS (PTTSB)	TELEMEDICINE TECHNOLOGY ATTRIBUTES (TTAT)	TELEMEDICINE TECHNOLOGICAL CONTEXT (TTC)	PERCEIVED SERVICE NEEDS OF TELEMEDICINE TECHNOLOGY (PSNTT)		
										TECHNOLOGY ADOPTION (TA)		
77	Extended TAM	✓	✓		✓		YEARS OF EDUCATION (EDU)	TEACHING EXPERIENCE (TEXP)	YEARS PRACTICING (PRC)	CAMPUS LOCATION (LOC)	The null hypothesis – there are no factors that predict the nursing educators' perceived ease of use to accept and use educational technology in the	
									PROFESSIONAL CERTIFICATION (PROF)	COMPUTER EXPERIENCE (EXP)		

Sr. No.	Acceptance Model	TAM Constructs					External Factors				Verified Relations
		PEOU	PU	AT	BI	AU					classroom – cannot be rejected. - The null hypothesis – there are no factors that predict the nursing educators' perceived usefulness to accept and use educational technology in the classroom – cannot be rejected.

Appendix D: Full Set of Factors and Confirmed Hypotheses - Other Models.

Table 37. Full Set of Factors and Confirmed Hypotheses - Other Models.

Sr. No.	Acceptance Model	Factors & Variables						Verified Relations	
1	Extended Hybrid Model: TAM TPB	PERCEIVED EASE OF USE (PEOU)	ATTITUDE TOWARDS (AT)	PERCEIVED BEHAVIORAL CONTROL (PBC)	COMPUTER SELF-EFFICACY (CSE)	FACILITATING CONDITION (FC)		CSE → PEOU CA → PEOU CA → BI ATT → BI PBC → BI PEOU → ATT PEOU → PU	PU → ATT FC → PBC FC → PEOU SN → PEOU SN → PU FC → ATT CSE → ATT
		PERCEIVED USEFULNESS (PU)	BEHAVIORAL INTENTION (BI)	SUBJECTIVE NORM (SN)	COMPUTER ANXIETY (CA)				
2	Dual Factor Model: UTAUT and SQB	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	INTENTION TO USE (IU)	FACILITATING CONDITION (FC)	SUNK COSTS (SC)	PE → IU EE → IU SI → IU FC → IU RU → IU IU → RU	SC → RU IN → RU PV → RU TC → RU UN → RU
		REGRET AVOIDANCE (RA)	RESISTANCE USE (RU)	INTERIA (IN)	PERCEIVED VALUE (PV)	TRANSITION COSTS (TC)	UNCERTAINTY (UN)		
3	TAM, TPB, and IDT	PERCEIVED EASE OF USE (PEOU)	BEHAVIORAL INTENTION (BI)	SUBJECTIVE NORM (SN)	IMAGE (IM)			SN → BI SN → PU SN → IM IM → PU PBC → BI PBC → PEOU RD → PU	RD → PEOU PIIT → SN PIIT → PBC PIIT → PEOU PIIT → RD PEOU → PU PU → BI
		PERCEIVED USEFULNESS (PU)	PERCEIVED BEHAVIORAL CONTROL (PBC)	RESULT DEMONSTR-ABILITY (RD)	PERSONAL INNOVATIVE-NESS IN IT (PIIT)				
4	Expanded UTAUT2	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	HEDONIC MOTIVATION (HM)	PRICE VALUE (PRVL)	PE → BI SI → U HM → BI PRVL → BI	
							BEHAVIORAL INTENTION (BI)		
5	Extended Hybrid Model: TAM UTAUT	FACILITATING CONDITIONS (FC)	COMPATIBILITY (COM)	SOCIAL INFLUENCE (SI)	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	INTENTION TO USE (IU)	FC → PEOU FC → IU COM → PEOU COM → PU COM → IU SI → PU	Health → PU Health → IU PRFR → PU PEOU → PU PU → IU
		SELF-REPORTED HEALTH CONDITIONS (HEALTH)	PERCEIVED SOCIAL RISK (PSR)	PERFORMANCE RISK (PRFR)					
6	Extended UTAUT2	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	PERCEIVED CREDIBILITY (PCRD)	PERCEIVED ORGANIZATI-ONAL SUPPORT (POS)	PE → BI EE → BI SI → BI FC → BI	PC → BI FC → U BI → U POS → U
						BEHAVIORAL INTENTION (BI)	USE (U)		
7	UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI)	BEHAVIOR USE (BU)	PE → BU EE → BU SI → BU FC → BU	BI → BU A → BU VOL → BU
				GENDER (G)	EXPERIENCE (EXP)	AGE (A)	VOLUNTARINESS (VOL)		
8	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	E-HEALTH AWARNESS (HA)	ICT INFRASTRUC-TURE (IT)	PE → BI EE → BI SI → BI	AGE *FC → U HA → BI IT → U BI → U
					E-HEALTH POLICY (HP)	BEHAVIORAL INTENTION (BI)	USE (U)		
9	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	ATTITUDE TO TECHNOLOGY (AT)	INTENTION TO USE (IU) ACTUAL USE (AU)	PE → IU EE → IU SI → IU FC → IU AT → IU	
10	Integrated Model: TPB & HBM	ATTITUDE (AT)	SUBJECTIVE NORM (SN)	PERCEIVED BEHAVIORAL CONTROL (PBC)	PERCEIVED SUSCEPTIBILITY (PS)	PERCEIVED SEVERITY (PSV)	INTENTION TO USE (IU)	SN → IU PS → IU AT → IU	

Sr. No.	Acceptance Model	Factors & Variables						Verified Relations	
11	Extended UTAUT	PERFORMANCE EXPECTANCY (PE) EXPERIENCE WITH EHEALTH INTERVENTION (EXP)	EFFORT EXPECTANCY (EE) ONLINE HEALTH INFORMATION SEARCH (ONS)	SOCIAL INFLUENCE (SI) MIGRATION BACKGROUND (MGB)	EHEALTH LITERACY (E-HEALS) EDUCATIONAL LEVEL (EL)	MENTAL HEALTH (MH) SEX (SX)	WORK ABILITY (WAI) ACCEPTANCE (ACC) ONLINE TIME (OT)	PE → ACC EE → ACC SI → ACC WAI → PE WAI → EE WAI → SI SX → PE SX → EE SX → SI OT → EE	OT → PE ONS → PE ONS → EE ONS → SI MH → PE MH → SI EL → PE EL → EE MGB → PE MGB → SI
12	New Developed Model	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	INTENTION TO USE (IU)	MISFIT (MF)	DATA SECURITY (DS) ANXIETY (A)	SELF-EFFICACY (SE) TRUST (TRU)	PEOU → PU PEOU → IU PU → IU PU → IU SE → PEOU	A → PEOU TRU → PEOU SE → PU MF → PU DS→ PU
13	UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI)	USE BEHAVIOR (UB)	PE → BI EE → BI SI → BI FC→ UB BI→ UB	
14	UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI)		PE → BI EE → BI SI → BI FC→ BI	
15	UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI) EXPERIENCE (EXP)	GENDER (G) AGE	PE → BI EE → BI SI → BI FC→ BI	EXP *PE → BI EXP *EE → BI SI → BI EXP *FC → BI
16	UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI)	USE BEHAVIOR (UB)	EE → BI FC→ BI FC→ UB BI→ UB	
17	Integrated Model (P-TAM): TAM, UTAUT & TPB	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	BEHAVIORAL INTENTION (BI)	PERCEIVED BEHAVIORAL CONTROL (PBC)	SYSTEM FACTORS (SYS)		PEOU → BI PU → BI PEOU → PU SYS → BI	SYS → PEOU SYS → PU PBC → PU PBC → PU
18	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	PERSONAL INNOVATIVEN-ESS (PINV)	PERCEIVED ENJOYMENT (ENJ) INTENTION TO USE (IU)	SI → IU PE → IU ENJ → IU	
19	Extended TPB	ATTITUDE (AT)	SUBJECTIVE NORM (SN)	PERCEIVED BEHAVIOR CONTROL (PBC)	PERCEIVED RISK (PR)	TRUST (TRU)	INTENTION TO USE (IU)	AT → IU SN → IU PBC → IU	PR → IU TRU → IU
20	Integrated Model: TAM & DeLone and McLean IS Success Model	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	SELF EFFICACY (SE)	INFORMATION QUALITY (IQ)	SYSTEM QUALITY (SQ) SYSTEM QUALITY (SQ)	INFORMATION SECURITY (ISEC) ACCEPTANCE OF HIS (AoH)	JR → PEOU JR → PU IQ → PEOU IQ → PU SE → IQ SE → ISEC	SQ → PEOU PEOU → AoH PU → AoH SE → SQ SE → JR
21	Extended UTAUT	ATTITUDE (AT)	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI)	PE → AT EE → AT AT → BI SI → BI FC → BI	
22	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI) COMPUTER ANXIETY (CA)	DOCTOR'S OPINION (DOC) PERCEIVED SECURITY (PSEC)	PE → BI EE → BI PE → EE FC → BI PSEC → BI	CA → EE PSEC → EE PSEC → RE DOC → PE
23	TPB	ATTITUDE TOWARDS (AT)	PERCEIVED BEHAVIORAL CONTROL (PBC)	SUBJECTIVE NORM (SN)	INTENTION (IN)			AT → IN PBC → IN	
24	Integrative Model Of Activity Theory and The Technology Acceptance Model	COMPLEXITY (COX)	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	COMPATIBILITY (COM) SOCIAL INFLUENCE (SI)	ATTITUDE (AT) ORGANISATIO-NAL SUPPORT (OS)	TASK UNCERTAINTY (TU) INTENTION TO USE (IU)	PU → IU AT → IU SI → IU OS → IU	

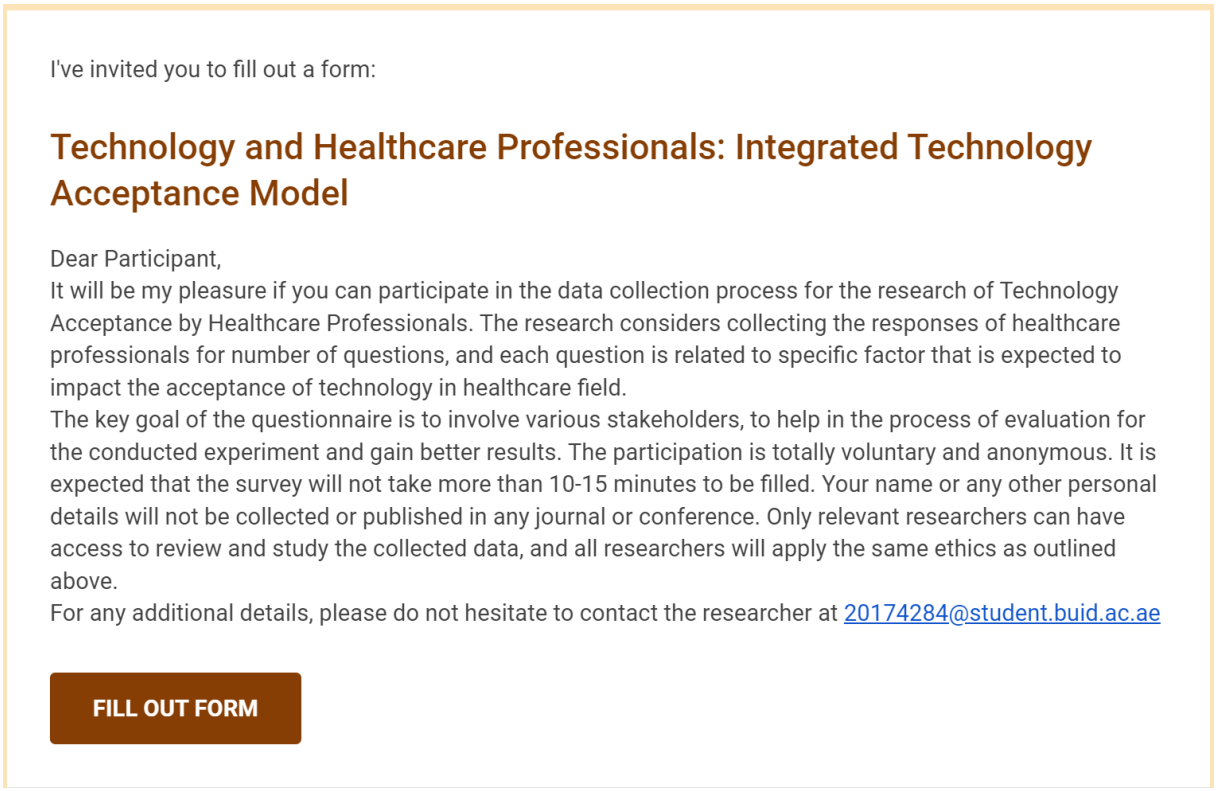
Sr. No.	Acceptance Model	Factors & Variables						Verified Relations	
25	Attribute-Perception-Intention Model	ADOPTION INTENTION (AI)	PRIVACY CONCERN (PRV)	PERCEIVED PERSONALIZATION (PSN)	TRUST (TRU)	AGE (A)		A → AI TRU → AI PRV → TRU PSN → TRU	
26	UTAUT2	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	HEDONIC MOTIVATION (HM)	PROFESSIONAL USE (PROFU)	PRS → PROF PE → BI EE → BI SI → BI FC → BI HM → BI PRVL → BI HB → BI	PE → AU EE → AU SI → AU FC → AU HM → AU PRVL → AU HB → AU
		PRICE VALUE (PRVL)	HABIT (HB)	BEHAVIORAL INTENTION (BI)	PERSONAL USE (PRS)	ACTUAL USE (AU)			
27	Integrated Model: TAM, TRA & UTAUT2	PERCEIVED FINANCIAL RISK (PFR)	HEDONIC MOTIVATION (HM)	PERCEIVED EASE OF USE (PEOU)	PERFORMANCE EXPECTANCY (PE)	TECHNOLOGY ANXIETY (TA)		HM → BI PEOU → BI PE → BI TA → BI	
				PERCEIVED PRIVACY RISK AND SECURITY RISK (PRV)	BEHAVIORAL INTENTION (BI)	RESISTANCE TO CHANGE (RC)			
28	Effective Technology Use Model (ETUM)	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	EFFECTIVE TECHNOLOGY USE (ETU) - CONSISTENCY OF USE (CU) QULAITY OF USE (QU)	COMPATIBILITY WITH WORKPLACE VALUES (VAL)	IMPLEMENTATION CLIMATE (IMC) – SOCIAL INFLUENCE (SI) / FACILITATING CONDITIONS(FC)	COMPATIBILITY WITH WORKPLACE PROCESSES (PROC)	PU med VAL → ETU PU med IMC → ETU PEOU med IMC → ETU PEOU med PROC → ETU IMC strong & VAL low THEN CU high & QU low IMC strong & VAL high THEN CU & QU high	
29	Integrate Model: HBM & TAM	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	ATTITTUDE TOWARDS (AT)	PERCEIVED HEALTH RISK (PHR)	HEALTH CONSCIOUSNESS (HC)	HEALTH-RELATED INTERNET USE (HIU)	PHR → PU HC → PU HC → AT HC → HIU PEOU → AT PU → AT PU → HIU AT → HIU PU & AT med PHR → HIU PU & AT med HC → HIU	
30	Integrated Model: TPB & SQB	REGRET AVOIDANCE (RA)	RESISTANCE USE (RU)	SOCIAL NORMS (SOC)	PERCEIVED VALUE (PV)	PERCEIVED BEHAVIOR CONTROL (PBC)	INTENTION TO USE (IU)	AT → IU SOC → IU PBC → IU SWC → RU RA → RU	IN → RU PV → RU PT → RU IU → RU
		INTERIA (IN)	SUNK COSTS (SC)	SWITCHING COSTS (SWC)	ATTITUDE (AT)	PERCEIVED THREAT (PT)			
31	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	SELF EFFICACY (SE)	INTENTION TO USE (IU)	AGE (A)	A → IU SX → IU EDU → IU USE → IU	PE → IU EE → IU SE → IU
					SEX (SX)	EDUCATIONAL LEVEL (EDU)	INTERNET USER (USE)		
32	Integrated Model: TPB & SQB	ATTITUDE (AT)	SUBJECTIVE NORMS (SN)	PERCEIVED BEHAVIOR CONTROL (PBC)	TRANSFER COSTS (TRC)	INTERIA (IN)	SUNK COSTS (SC)	AT → IU SN → IU PBC → IU RU → IU	TRC → RU IN → RU SC → RU IU → RU
						RESISTANCE USE (RU)	INTENTION TO USE (IU)		
33	Integrated Model: TAM and Dual Factor Model	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	ATTITTUDE TOWARDS (AT)	PERCEIVED THREAT (PT)	PERCEIVED MOBILITY (PM)	BEHAVIORAL INTENTION (BI)	PU → BI PEOU → BI PT → BI PEOU → PU	PT → PU PM → PU PM → PT PM → PEOU
34	E-Health Social Networked Model	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	ATTITTUDE TOWARDS (AT)	BEHAVIORAL INTENTION (BI)	TOP LEADERSHIP INVOLVMENT (TLI)	SOCIAL ATTRACTIVENESS (SATT)	PSC → AT TLI → AT SATT → BI SS → PEOU SI → PU SAWR → PU	
		SOCIAL COMMUNICATION (SCOM)	SOCIAL AWARENESS (SAWR)	E-HEALTH ACCEPTANCE (HACC)	PERCEIVED STRENGTH OF CONTROL (PSC)	GOVERNMENT POLICY & REGULATION	SOCIAL SUPPORT (SS)		
							SOCIAL INFLUENCE (SI)		
35	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	AGE (A)	TASK TIME (TT)	BEHAVIORAL INTENTION (BI)	Age*EE → BI PE → BI SI → BI	Age → TT Age → PE Age → EE
				Amount of Error (AER)	WECHSLER DIGIT SYMBOL SUBSTITUTION TEST (DSST)	Training Time (TRT)	Attitude Towards		
36	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	PERCEIVED SECURITY (PSEC)	USAGE INTENTION (UI)	EE → PE PE → UI SI → UI PSEC → UI	

Sr. No.	Acceptance Model	Factors & Variables						Verified Relations	
37	Technology Acceptance View of Knowledge Management Systems in Healthcare Organizations (TAV-KMSHO)	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	BEHAVIORAL INTENTION (BI)	PERCEIVED INFORMATION SECURITY (PISEC)	SUBJECTIVE NORMS (SN) HIGH CONTEXT/ LOW CONTEXT (CON)	MASCULINITY/ FEMININITY (MSC) UNCERTAINTY AVOIDANCE (UNA)	PEOU med IND → BI SN med IND → BI SN med PD → BI PU med UNA → BI PU med CON → BI	
38	Integrated Model: TAM & SQB	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	INTENTION TO USE (IU)	PERCEIVED VALUE (PV)	REGRET AVOIDANCE (RA) UNCERTAINTY (UN)	TRANSITION COSTS (TRC) RESISTANCE USE (RU)	PU → IU PEOU → IU PEOU → PU RU → IU	IU → RU TRC → IU PV → IU IN → IU
39	Psychosocial Model	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	BEHAVIORAL INTENTION (BI)	SUBJECTIVE NORMS (SN)	PROFESSIONAL NORMS (PN)	COMPUTER SELF EFFICACY (CSE)	PEOU → BI SN → BI PN → BI	
40	Integrated Model: Psychosocial Model & TAM	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	BEHAVIORAL INTENTION (BI)	SUBJECTIVE NORMS (SN)	PROFESSIONAL NORMS (PN) RESISTANCE TO CHANGE (RC)	COMPUTER SELF EFFICACY (CSE) RESULTS DEMONSTRABILITY (RD)	PEOU → BI SN → BI PN → BI RD → BI	
41	Extended Diffusion of Innovation Theory	RELATIVE ADVANTAGE (RADV)	COMPATIBILITY (COM)	COMPLEXITY (COX)	PRIVACY CONCERNS (PRV)	RISK BELIEFS (RB)	INTENTION TO USE (IU)	RADV → IU COM → IU COX → IU	
42	Theory of Reasoned Action (TRA)	PERCEIVED USEFULNESS (PU)	ATTITUDE (AT)	PERCEIVED TRUST (PTRU)	CO-WORKERS' VIEWPOINTS (CWV)	COMPATIBILITY (COM)	INTENTION TO USE (IU)	PU → AT PTRU → PU COM → PU COM → PTRU	PTRU → AT AT →IU CWV → IU CWV → AT
43	Integrated Model: TRA, TAM & IS Success Model	ATTITUDE (AT)	SOCIAL INFLUENCE (SI)	INTENTION TO USE (IU)	DEVICE (DV) CONTENTS QUALITY (CQ)	PORTABILITY (POR) EASE OF USE (EOU)	SECURITY (SEC) USER INNOVATION (UINV)	SI → IU AT →IU POR → SI SEC →SI CQ → SI UINV → SI	UNIV → AT CST → AT CQ →AT EOU → AT SPT → AT
44	Integrated Model: Tam & TPB	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	BEHAVIORAL INTENTION (BI)	SUBJECTIVE NORMS (SN)	COMPLEXITY OF TASK (COXT)	IMAGE (IM) FACILITATING CONDITIONS (FC)	PEOU → PU PU → BI PEOU → BI COXT → BI CT → PT SN → BI	REM → PU REM → COXT SN → PU SN → COXT SSE → PEOU
45	TPB	SUBJECTIVE NORMS (SN)	PERCEIVED BEHAVIORAL CONTROL (PBC)	ATTITUDE (AT)	INTENTION (IN)	ACTUAL USE (AU)		PBC → AT AT → PBC AT → SN SN → AT PBC → SN SN → PBC	AT → IN SN → IN PBC → IN PBC → AU IN → AU
46	Integrated Model: TAM & Flow Theory	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	INTENTION TO USE (IU)	FLOW (FLW)	LEARNER-SYSTEM INTERACTION (LSI)	INSTRUCTOR-LEARNER INTERACTION (ILI)	FLW → PU FLW → PEOU FLW → IU PEOU → PU PU → IU PEOU → IU LSI → PU LSI → PEOU	LSI → FLW ILI → PU ILI → PEOU ILI → FLW LLI → PU LLI → PEOU LLI → FLW
47	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	TRUST (TRU)	BEHAVIORAL INTENTION (BI)	PE → BI FC → BI TRU → BI	
48	Diffusion of Innovation Theory	KNOWLEDGE ABOUT WIRELESS TECHNOLOGIES (KWT)	PERCEIVED CONTROL (PC)	RISK PERCEPTION (RP)	THREAT – DEVICE (TDV)	THREAT – INFRASTRUCTURE (TINF)	ACCEPTANCE – DEVICE (ACDV) USAGE BARRIERS (BAR)	**(Non-users)** KWT → RP PC → BEN PC → BAR RP → TDV RP → TINF UB → ACDV UB → ACINF TINF → ACINF BAR → TDV BAR → TINF	**(Users)** RP → TINF UB → ACDV TINF → ACINF

Sr. No.	Acceptance Model	Factors & Variables						Verified Relations	
49	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	SELF-EFFICACY (SE)	ATTITUDE TOWARDS USING TECHNOLOGY (ATT)	FC → BI SE → BI	
50	Integrated Model: TAM & TPB	COMPUTER ANXIETY (CA)	PERCEIVED BEHAVIORAL CONTROL (PBC)	COMPUTER SELF-EFFICACY (CSE)	FACILITATING CONDITIONS (FC) PERCEIVED USEFULNESS (PU)	TRAINING (TR) BEHAVIORAL INTENTION (BI)	SUBJECTIVE NORM (SN) PERCEIVED EASE OF USE (PEOU)	CA → PEOU FC → PEOU CSE → PEOU MS → PEOU TR → PEOU PEOU → PU TR → PU	FC → AT MS → AT PEOU → AT PU → AT PBC → BI AT → BI SN → BI
51	Attitude - Perceived Risk- Motivation Model	FINANCIAL RISK (FR)	PRIVACY RISK (PRV)	PSYCHOLOGICAL RISK (PSR)	TIME RISK (TMR)	SOCIAL RISK (SCR) BEHAVIORAL INTENTION (BI)	PERCEIVED RISK (PR) EXTRINSIC MOTIVATION (EXM)	FR → PR PRV → PR PSR → PR TMR → PR SCR → PR	AT → PR INM → EXM PR → BI INM → BI EXM → BI
52	Extended UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC) AGE (A)	IT KNOWLEDGE (ITK) EXPERIENCE (EXP)	BEHAVIORAL INTENTION (BI) GENDER (G)	PE → BI EE → BI SI → BI FC → BI ITK → BI	EXP → EE → BI EXP → FC → BI EXP → SI → BI VOL → SI → BI
53	Integrated Model - Health Information Technology Acceptance Model (HITAM): HBM, TPB & TAM	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	BEHAVIORAL INTENTION (BI)	ATTITUDE (AT)	HEALTH BELIEF AND CONCERNS (HBC) HEALTH STATUS (HS)	SUBJECTIVE NORM (SN) SELF-EFFICACY (SE)	PU → BI PEOU → BI PT → BI PEOU, PU med HBC→ AT PEOU, PU med HBC→ BI PEOU, PU med SN→ AT PEOU, PU med SN→ BI PEOU, PU med REL→ AT PEOU, PU med REL→ BI PEOU, PU med SE→ AT PEOU, PU med SE→ BI PEOU, PU med HS→ AT PEOU, PU med HS→ BI	PU → AT PEOU → AT PT → AT
54	Modified UTAUT	PERFORMANCE EXPECTANCY (PE)	PERCEIVED POSITIVE CONSEQUENCE (PPC)	PERCEIVED NEGATIVE CONSEQUENCE (PNC)	SUPPORT (SPT)	OCCUPATION (OCC)	EXPERIENCE (EXP) AGE (A)	SPT → IU A → IU SPT X A → IU SPT X OCC→ IU (NURSE) PE X OCC→ IU (NURSE) PPC X OCC→ IU (NURSE) PE X OCC→ IU (PHYSICIAN)	PNC X G→ IU SPT X G → IU
55	Modified UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	COMPATIBILITY (COM)	BEHAVIORAL INTENTION (BI)	EE → PE EE → BI SI → BI	FC → UB COM → UB BI → UB
56	Integrated Model: TAM & TPB	COMPUTER ANXIETY (CA)	COMPUTER SELF-EFFICACY (CSE)	PERCEIVE EASE OF USE (PEOU)	PERCEIVE USEFULNESS (PU)	PERCEIVED BENEFIT (PB)	SUBJECTIVE NORM (SN) ATTITUDE (AT)	CA → PEOU CSE → PEOU PBC → PEOU PBC → BI SN → BI	PEOU → PU PU → AT PEOU → AT PB →AT AT → BI
57	Integrated Model: TAM & IS success model	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	INTENTION TO USE (IU)	INFORMATION QUALITY (IQ)	SYSTEM QUALITY (SQ)	SERVICE QUALITY (SVQ)	PU → IU PEOU → IU PEOU → PU IQ → PU	SVQ → PU SVQ → PEOU SQ → PEOU
58	Integrated Model: TAM & ISSM	PERCEIVED USEFULNESS (PU)	PERCEIVED EASE OF USE (PEOU)	SYSTEM QUALITY (SQ)	INFORMATION QUALITY (IQ)	SERVICE QUALITY (SVQ)	NURSES' SATISFACTION WITH NIS USE (NSNU)	TAM + ISSM → NSNU PU + SQ → NSNU PU + IQ → NSNU PEOU + SQ → NSNU PEOU + IQ → NSNU PEOU + SVQ → NSNU	
59	UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI)	USE BEHAVIOR (UB)	BI → UB PE → EE PE → BI	EE → BI SI → BI
60	Integrated Model: TAM & SQB	PERCEIVED USEFULNESS (PU)	PERCEIVED EASE OF USE (PEOU)	ATTITUDE (AT)	ADOPTION BEHAVIORAL INTENTION (ABI)	AVAILABILTIY (AVL) ANXIETY (A)	COMPATIBILITY (COM) TRANSITION COSTS (TC)	AVL → PEOU A → PEOU AVL → PU A → PU COM → PU PU → ABI	PU → AT AT → ABI COM → AT TC → AT A → COM
61	Robot Acceptance Model for Care (RAM-care)	PERCEIVED USEFULNESS (PU)	PERCEIVED EASE OF USE (PEOU)	ATTITUDE (AT)	SOCIAL INFLUENCE (SI)	PERCEIVED ENJOYMENT (ENJ)	TRUST (TRU) PERSONAL VALUES (PRVAL)	SI → IU AT → IU PU → IU ENJ → IU	PRVAL → PU PRVAL → SI PTU → PRVAL

Sr. No.	Acceptance Model	Factors & Variables						Verified Relations	
62	UTAUT2	PERFORMANCE EXPECTANCY (PE)	CLOUD BASED HEALTH KNOWLEDGE (CBHK)	SELF-EFFICACY (SE)	IT INFRASTRUCTU-RE (IT)	DATA SECURITY (DS)	SOCIAL INFLUENCE (SI)	PE → IS PE → BI CBHK → BI SI → BI IT → BI	
63	Acceptance Model of E-Health Technologies	PRIVACY DISPOSITION (PDIS)	PRIVACY CONCERNS (PC)	PERCEIVED DATA SENSITIVITY (PDS)	PERCEIVED BENEFITS (PB)	TRUST IN DATA PROTECTION (TRUDP)	USE INTENTION (UI)	PDIS → PC PDS → PC TRUDP → PC PB → UI PC → UI	
64	HBM	PERCEIVED SUSCEPTIBILITY (PS)	PERCEIVED SEVERITY (PSV)	PERCEIVED BENEFITS (PB)	PERCEIVED BARRIERS (PBR)	SELF-EFFICACY (SE)	CUES TO ACTION (CUE)	PS → UI PB → UI	SE → UI CUE → UI
65	Integrated Model: Extended TAM & HBM	PERCEIVED EASE OF USE (PEOU)	PERCEIVED USEFULNESS (PU)	USAGE INTENTION (UI)	SOCIAL TRUST (STR) CUES TO ACTION (CUE)	INSTITUTIONAL TRUST (INTR) PERCEIVED BARRIERS (PBR)	PERCEIVED SUSCEPTIBILITY (PS) PERCEIVED BENEFITS (PB)	PEOU → PU STR → PU INTR → PU INTR → PEOU STR → PEOU	PU → UI PEOU → UI CUE → UI PB → UI PBR → UI
66	UTAUT	PERFORMANCE EXPECTANCY (PE)	EFFORT EXPECTANCY (EE)	SOCIAL INFLUENCE (SI)	FACILITATING CONDITIONS (FC)	BEHAVIORAL INTENTION (BI)	ACTUAL USE (AU)	PE → BI EE → BI SI → BI BI → AU	

Appendix E: Ethical Form



I've invited you to fill out a form:

Technology and Healthcare Professionals: Integrated Technology Acceptance Model

Dear Participant,
It will be my pleasure if you can participate in the data collection process for the research of Technology Acceptance by Healthcare Professionals. The research considers collecting the responses of healthcare professionals for number of questions, and each question is related to specific factor that is expected to impact the acceptance of technology in healthcare field.
The key goal of the questionnaire is to involve various stakeholders, to help in the process of evaluation for the conducted experiment and gain better results. The participation is totally voluntary and anonymous. It is expected that the survey will not take more than 10-15 minutes to be filled. Your name or any other personal details will not be collected or published in any journal or conference. Only relevant researchers can have access to review and study the collected data, and all researchers will apply the same ethics as outlined above.
For any additional details, please do not hesitate to contact the researcher at 20174284@student.buid.ac.ae

FILL OUT FORM

Figure 21. Ethical Form.

Appendix F: Consent Form

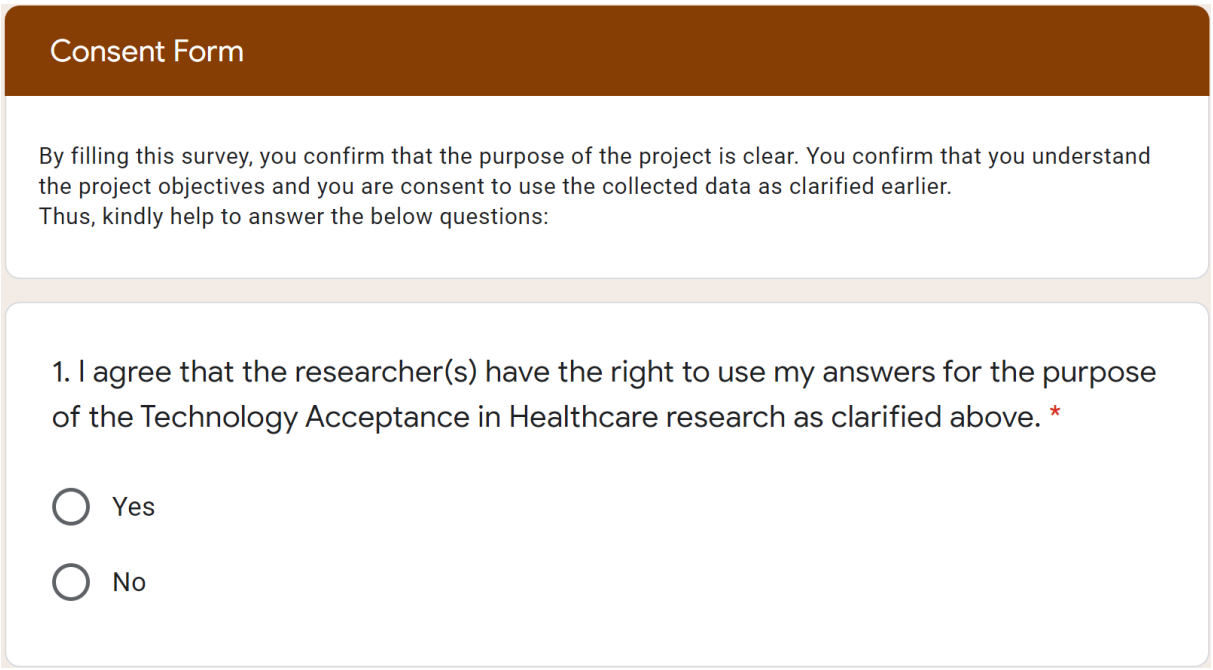


Figure 22. Consent Form.