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Review

Technology Acceptance in Healthcare: A Systematic Review

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Abstract: Understanding the factors affecting the use of healthcare technologies is a crucial topic that has been extensively studied, specifically during the last decade. These factors were studied using different technology acceptance models and theories. However, a systematic review that offers extensive understanding into what affects healthcare technologies and services and covers distinctive trends in large-scale research remains lacking. Therefore, this review aims to systematically review the articles published on technology acceptance in healthcare. From a yield of 1768 studies collected, 142 empirical studies have met the eligibility criteria and were extensively analyzed. The key findings confirmed that TAM and UTAUT are the most prevailing models in explaining what affects the acceptance of various healthcare technologies through different user groups, settings, and countries. Apart from the core constructs of TAM and UTAUT, the results showed that anxiety, computer self-efficacy, innovativeness, and trust are the most influential factors affecting various healthcare technologies. The results also revealed that Taiwan and the USA are leading the research of technology acceptance in healthcare, with a remarkable increase in studies focusing on telemedicine and electronic medical records solutions. This review is believed to enhance our understanding through a number of theoretical contributions and practical implications by unveiling the full potential of technology acceptance in healthcare and opening the door for further research opportunities.

Keywords: technology acceptance; technology adoption; healthcare; systematic review

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1. Introduction

Technology acceptance is defined as opposite to the term rejection, where it signifies the positive decision toward using an innovative solution [1,2]. Technology acceptance is concerned with the psychological status of a person regarding the intention to use a specific technology [3]. A 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 and other social or cultural issues [4].

There is no doubt on how information technologies have proliferated in the healthcare sector [5]. Information technologies are important to enhance the quality of healthcare services and improve patients' satisfaction. Moreover, the staff using the technology in the healthcare domain is an essential issue, since information technologies play a vital role in increasing their work efficiency and effectiveness [6]. That is why it is crucial to determine and understand how people react to the emergence of new technologies. The low levels of acceptance for particular information technology can lead to failure or delay in implementing that technology. Additionally, the lack of acceptance of technology in healthcare can negatively impact its key objectives [7].

Over the years, the acceptance of different information technologies and applications has been explored in the healthcare field. These technologies include internet-based health websites [8], picture archiving and communication systems (PACs) [9], mobile applications [7], telemedicine technologies, and electronic health records [10]. As is the case with other technologies, healthcare technologies were examined using different technology acceptance models and theories. This is because those theories and models offer a better understanding of the users' behaviors toward a specific technology or service through the factors underpinning them [11]. It is believed that the identification of these factors would enhance the effectiveness of healthcare technologies by allowing scholars to investigate the technical, social, and cultural aspects and understand the correlation between those factors and users' readiness to use healthcare systems. Therefore, this study aims to systematically review the studies that empirically evaluated the different technologies in healthcare in relation to technology acceptance models and theories. Stemming from this aim, the authors intend to answer the following research questions:

RQ1. What are the prevailing technology acceptance models and theories explored in the healthcare domain?

RQ2. What are the key factors affecting technology acceptance in the healthcare domain?

RQ3. What are the primary confirmed relationships among the influential factors in the past studies?

RQ4. What are the leading information technologies studied and their relationships with countries and participants?

RQ5. How are the reviewed studies distributed across the regions and countries of technology implementation?

RQ6. What is the progress of technology acceptance studies in healthcare?

2. Literature Review

During the last three decades, various theoretical models and their extensions have been designed to understand the acceptance levels and individuals' behaviors toward different technologies in various disciplines [6]. These models introduced different factors to understand their effect on the user's acceptance of technology. Those theories include but are not limited to the theory of reasoned action (TRA) [12], the technology acceptance model (TAM) [13–15], extensions of TAM [16,17], the unified theory of acceptance and use of technology (UTAUT) [18], social cognitive theory (SCT) [19,20], the theory of interpersonal behavior (TIB) [21], the perceived characteristics of innovating theory [22], the theory of planned behavior (TPB) [23], the model of PC utilization [24], the motivational model [25], innovation diffusion theory (IDT) [26], and Igbaria's model [27].

Among the aforementioned theories and models, the UTAUT is known as the most relevant [28] and the most actively used model in technology acceptance studies in the healthcare domain [28,29]. Apart from the healthcare domain, TAM is also recognized as the gold standard model across several technologies [30–32]. On the other hand, UTAUT has shown 20–30% better explanatory power than TAM, which means 40–50% of the explanatory power regarding the behavioral intention of end-users [18,31].

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, the review studies have mainly discussed one specific technology acceptance model except for two review studies [33,34]. Besides, only one study focused on the classification of studies based on the examined technologies, participants, and country of implementation [6]. For instance, telehealth solutions were mainly studied from the perspective of older populations [35], with little attention paid to the developing countries. There is an increasing number of healthcare services, which has resulted from the increment of population ages [36,37]. To make it distinct, this review provides a broader view for understanding healthcare technologies and identifies the potential gaps in technology acceptance in healthcare.

It is beneficial to have a general review exploring multiple technology acceptance models instead of focusing on one acceptance model (e.g., TAM). Additionally, reviewing different information technologies instead of only one technology (e.g., electronic medical records) is essential to recognize 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, this study aims to identify the prevailing acceptance models, the most utilized factors, and the most confirmed relationships to address the literature gaps and assist further research in building integrated models for technology acceptance in the healthcare domain.

As an example for the included studies, Tubaishat [38] has studied the acceptance of electronic health records (EHRs) through a self-administered questionnaire filled by 1539 nurses from 15 hospitals in Jordan. The utilized research model was the original TAM. A multiple linear regression analysis was used to explore nurses' perceptions regarding the ease of use and usefulness of the solution. It was found that the intention to use is influenced by the perceived ease of use and perceived usefulness. The study was limited to nurses without including other medical staff, such as physicians, pharmacists, or laboratory staff.

Hadadgar et al. [39] have explored 146 general practitioners' (GPs) intention to use the e-learning continuing medical education (e-CME). Based on the theory of planned behavior (TPB), the results revealed that attitudes and perceived behavioral control factors significantly influence the intention to use the e-CME solution. The study included only one user group (i.e., GPs), with a limited sample compared to the optimum sample for factor analysis. Further, Perlich et al. [29] have discussed the acceptance of interactive documentation systems by therapists and patients in an addiction therapy center in Germany. The study relied on extending the UTAUT model with the attitude construct. The key results indicated that attitude is the strongest predictor of intention to use.

Table 1. Previous review studies on technology acceptance in healthcare.

Source	Multiple Acceptance Models	Multiple Technologies	Databases	Coverage	Aim
[30]	-	✓	16 datasets (names not reported)	Before July 2008 (not clearly reported)	Literature review of 20 articles to study the application of TAM in the healthcare domain.
[40]	-	-	PubMed, EMBASE, CINAHL, Business Source Premier, Science Citation Index, Social Sciences Citation Index, Cochrane Library, ABI/Inform, and PsychINFO	1999–2009	Systematic review for 60 studies to explore the barriers and facilitators to implementation.
[41]	-	✓	MEDLINE, EMBASE, CINAHL, Cochrane, Ovid, DARE, Biosis Previews, PsycINFO, HSTAT, ERIC, ProQuest, ISI Web of Knowledge, LILACS, and Ingenta	19–0–2007	Systematic review for 101 studies to explore the factors that facilitate or limit the implementation of ICTs in clinical settings.
[42]	-	✓	MEDLINE, EMBASE, CINAHL, PSYCINFO, and the Cochrane Library	19–5–2009	Systematic review for 37 review studies to identify the barriers and facilitators to e-health implementation and outstanding gaps in the literature.
[43]	-	✓	Science Direct, Springer, TÜBĐTAK EKUAL, Taylor and	19–9–2010	Qualitative review to analyze 50 articles to study the possible predictors of TAM.

			Francis, EBSCO Host, and Blackwell		
[33]	✓	✓	ACM Digital Library, CINAHL, IEEE Xplore, MEDLINE, PsycINFO, Scopus, and Web of Science	Not specified	Systematic review for 16 studies provides an overview of factors that influence the acceptance of electronic technologies that support older adults.
[44]	-	-	PubMed, EMBASE, CINAHL, and PsychINFO	20–0–2014	Systematic review for 33 studies to explore the factors influencing healthcare professionals' adoption of mobile health applications.
[45]	-	-	Google Scholar Med-line, Embase, CINAHL, PsycINFO, and Scopus	20–0–2015 19–6–2015	Systematic review for 44 studies to review the main barriers to adopt assistive technologies by older adults.
[6]	-	✓	Web of Science, PubMed, and Scopus	19–9–2017	Systematic review to analyze 134 TAM-based studies in health information systems. The study aims to understand the existing research and debates as is relevant to TAM in the healthcare domain.
[34]	✓	✓	Medline, Embase, CINAHL, Cochrane, Scopus, and Web of Science	19–8–2018	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 study	✓	✓	PubMed, IEEE Xplore, Springer, ACM, Science Direct, and Google Scholar	20–0–2019	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.

3. Materials and Methods

This review is based on the findings from studies published in digital journals and databases to discuss and empirically explore technology acceptance in healthcare. A review of the previous relevant literature is a vital phase of any scientific study [46]. Generally, reviews can simplify and extend the theory development, filling gaps in research, or close areas where a profusion of research exists [47]. A systematic review is helpful to make researchers more familiar with the research topic [48]. 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 [49].

As presented in Figure 1, the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) have been applied to conduct this review [50,51]. Using the PRISMA helps in demonstrating the flow of information through the different phases of the review [52]. It also depicts the number of articles identified, included, and excluded and the rationale behind the excluded articles. 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 analyze the retrieved studies.

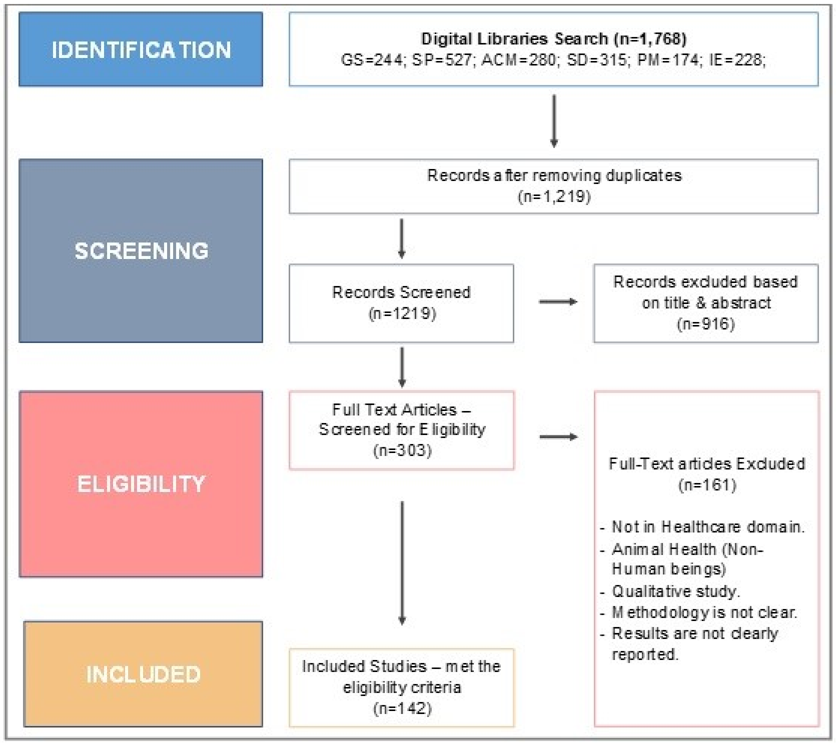

Figure 1. PRISMA flow diagram.

3.1. 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 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 applying 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 must be a journal article, conference paper, book chapter, Ph.D. dissertation, or master's thesis.	The study is a review, position paper, editorial, etc.
4	The study must be published in the English language.	The study is published in languages other than English.

3.2. Data Sources and Search Strategy

The studies have been identified by exploring 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 initial search results showed a total number of 1768 studies, as seen in Figure 1. In that, the inclusion and exclusion criteria were applied, and the refinement stages as per the PRISMA were followed. The analysis of the collected studies was carried out by the first and third authors of this study by analyzing each article independently. The differences in analyzing the studies between the two authors were resolved through discussion and further review of the disputed studies. Accordingly, a total number of 142 studies were recognized as valid to be included in the analysis.

Table 3. Summary of search keywords.

ID	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")

3.3. Data Abstraction and Analysis

All citations have been downloaded into Mendeley reference manager [53]. 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 quickly screening the title and abstract. If the study passes this round, the full paper 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 determines the theory used to explore the factors impacting specific technology acceptance in healthcare. The second phase categorizes the studies based on the publication year, publication type, and country of implementation. The third stage extracts the studied constructs, understands the developed hypotheses, and analyzes the findings.

A total of 1768 studies were retrieved from the digital libraries, as seen in Figure 1. 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. 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 (Table A2 in Appendix B).

3.4. Quality Assessment

It is crucial to assess the quality of the collected studies [54]. 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 4, the checklist had no intention to criticize the work of any researcher [49]. The designed checklist was conformed to what was suggested in prior research [49,55,56]. The checklist is based on a 3-point scale from 0 to 1, where 0 means "no", 0.5 "partially", and 1 "yes". The results of the quality assessment can be seen in Table A1 in Appendix A. In general, all the included studies have passed the quality assessment and are considered valid to be further analyzed.

Table 4. Quality assessment checklist.

Sr.	Question
1	Does the research have clear aims and objectives?
2	Are the technology acceptance model and its hypotheses 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?

4. Results

The results of the review provided a detailed analysis of the recent literature on technology acceptance in healthcare. The comprehensive summary for all the included studies can be found in Table A2 in Appendix B. According to the analyzed 142 studies, the findings of the study can be summarized based on the six research questions.

4.1. 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 [57]. In Table A2, the authors have classified the studies 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 ($N = 76$) [58–61]. It was also found that several studies ($N = 21$) have discussed the integration between TAM and other technology acceptance models (e.g., UTAUT, TPB) [62–64]. The analysis also shows that the UTAUT and its extensions were widely employed to explore the user's acceptance of technology in healthcare ($N = 26$) [65,66]. Further, the results showed that the number of studies related to the employment of the TPB model is reasonable ($N = 12$).

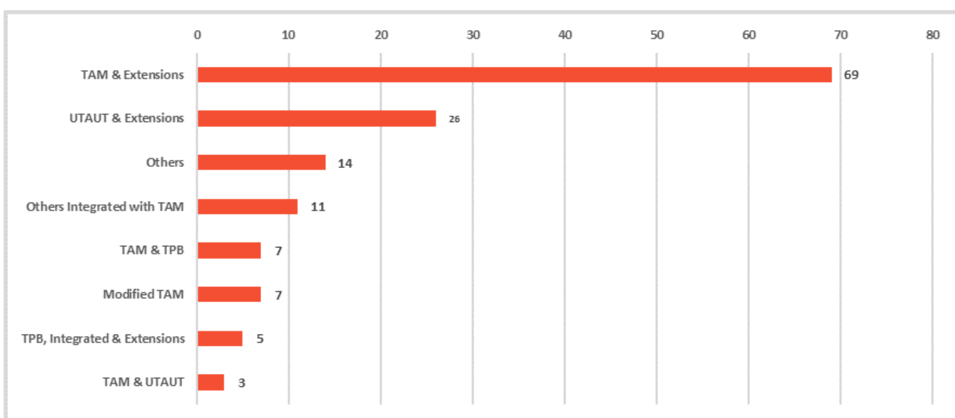

Figure 2. Most studied technology acceptance models.

4.2. Key Factors Affecting Technology Acceptance in the Healthcare Domain

For being the key constructs of the 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 [60,67–69]. 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 different technologies in healthcare (see Figure

3). Although such a result is expected, it is significant to confirm the need for behavioral intention within the theory and practice of technology acceptance.

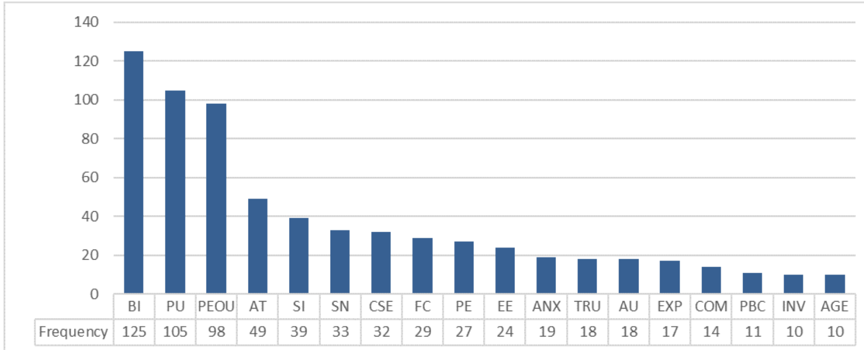

Figure 3. Key factors affecting technology acceptance in healthcare.

Another aspect that needs to be considered is the user's performance and the related expected positive gain that has been investigated extensively, as per the findings in Figure 3. A similar case with the perceived ease of use factor and its equivalent effort expectancy appeared in the analysis for 98 and 24 times, respectively.

Apart from the factors of TAM and UTAUT acceptance models, 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 [1,19,20], innovativeness (N = 10) [70], and trust (N = 18) [71] as external factors.

4.3. Main Confirmed Relationships among the Influential Factors

The classification analysis in this study 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 technology acceptance in the healthcare domain. It is crucial to understand those common hypotheses to let researchers understand the potential correlation 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 findings of previous studies [72].

As seen in Figure 4, the most confirmed hypotheses 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 on technology acceptance in healthcare. In other words, the frequency in Figure 4 presents the number of studies that have confirmed the significance of each hypothesis.

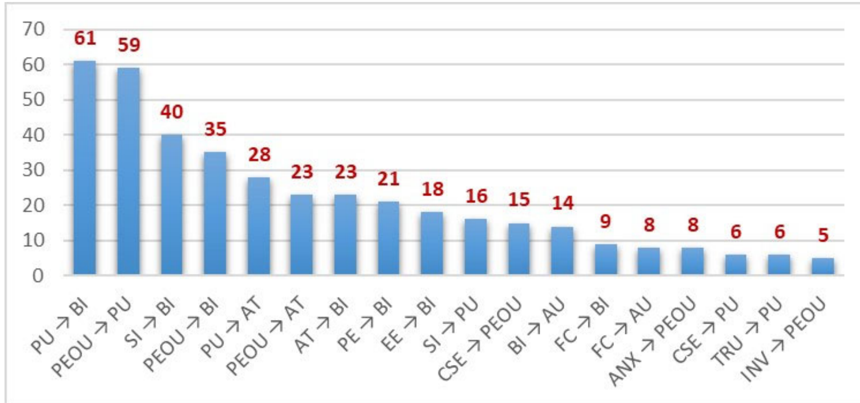

Figure 4. The most confirmed hypotheses in the reviewed literature.

4.4. Main Information Technologies and Their Relationships with Countries and Participants

Figure 5 presents the distribution of the studied information technologies in the reviewed studies. As suggested by Rahimi et al. [6], the categorization of information technologies was performed based on the Medical Subject Headings (MeSH) thesaurus [73]. 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). By having a quick look at the analysis in Table 5, it seems that the classification of technologies across the countries is equally distributed, with a slight notable difference in telemedicine and cloud computing. Telemedicine was mainly studied in Taiwan and the USA, while cloud computing was primarily studied in Taiwan.

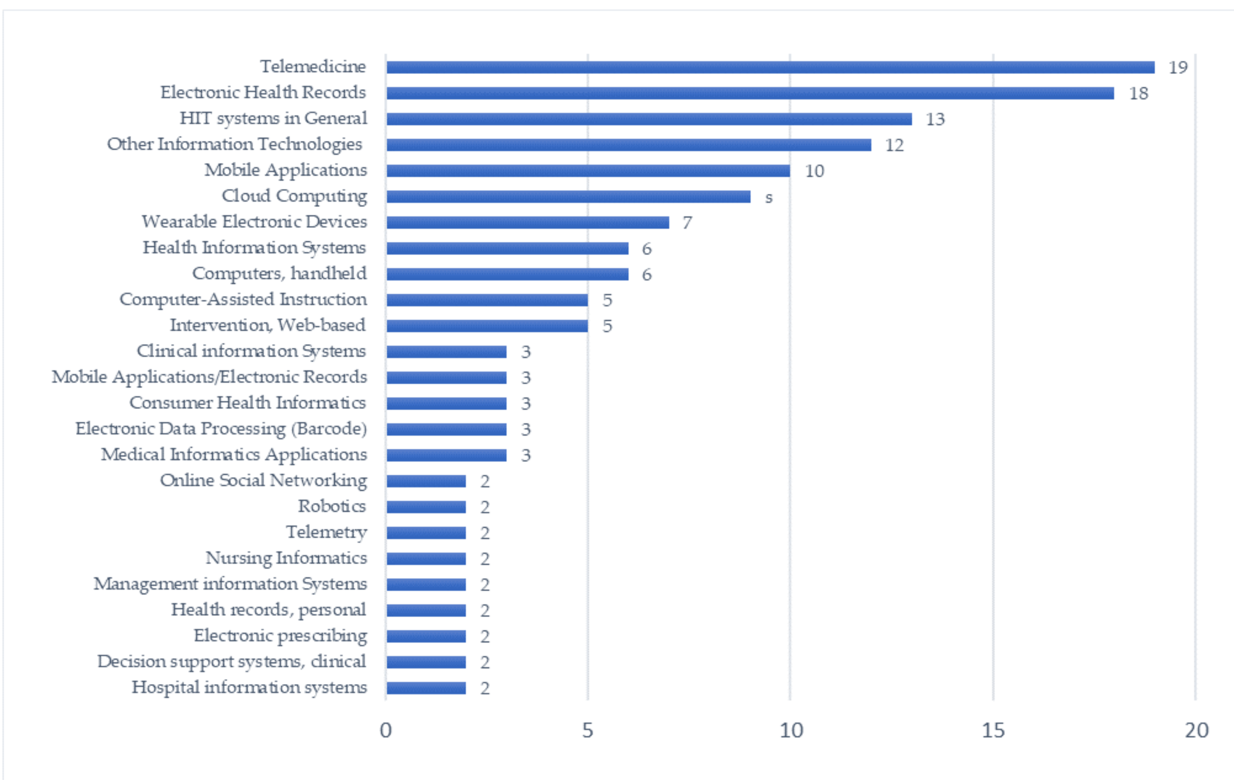

Figure 5. Distribution of studies in terms of technology type.

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) attracted the attention of scholars to understand their technology acceptance. In terms of technology type and participants, we 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 6). Additionally, 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.

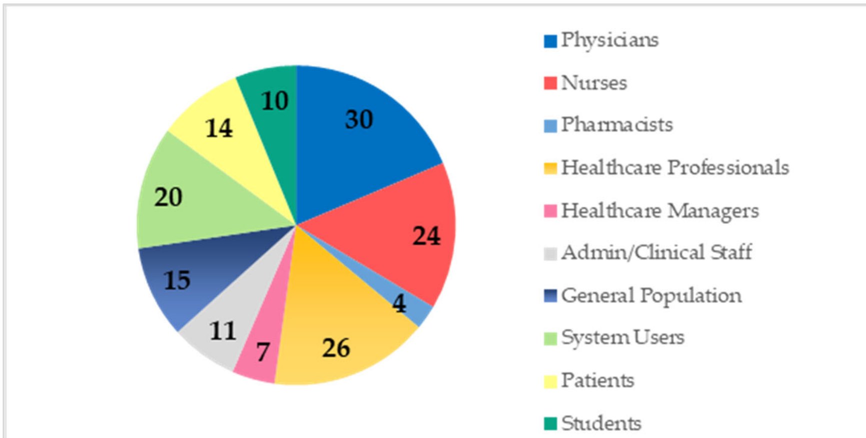

Figure 6. Distribution of studies in terms of participants.

4.5. Distribution of Studies across Regions and Countries

This review also 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. Taiwan recorded 20.27% (*N* = 30) of the entire analyzed studies, as seen in Table 7. Further, the USA as a first runner-up is doing well, with 22 empirical studies (14.86%) to assess technology acceptance in healthcare. As shown in Figure 8, the geographic heat map 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 7 and Figures 7 and 8.

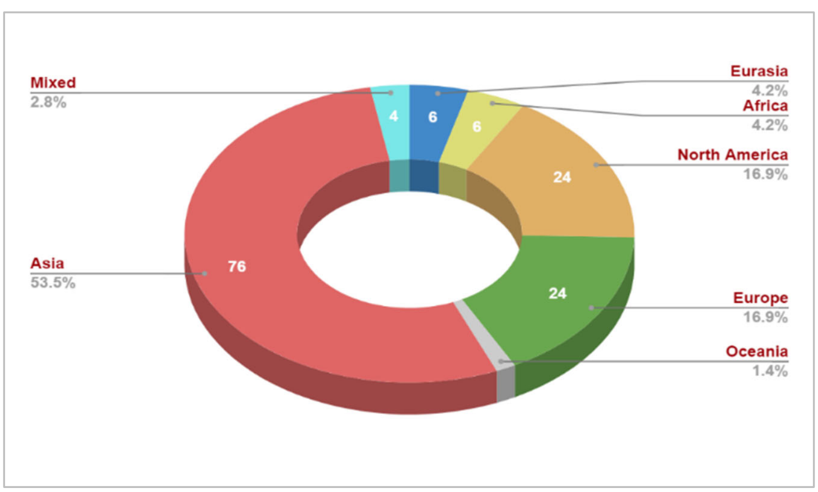

Figure 7. Publications statistics per region. Mixed: conducted in two different regions.

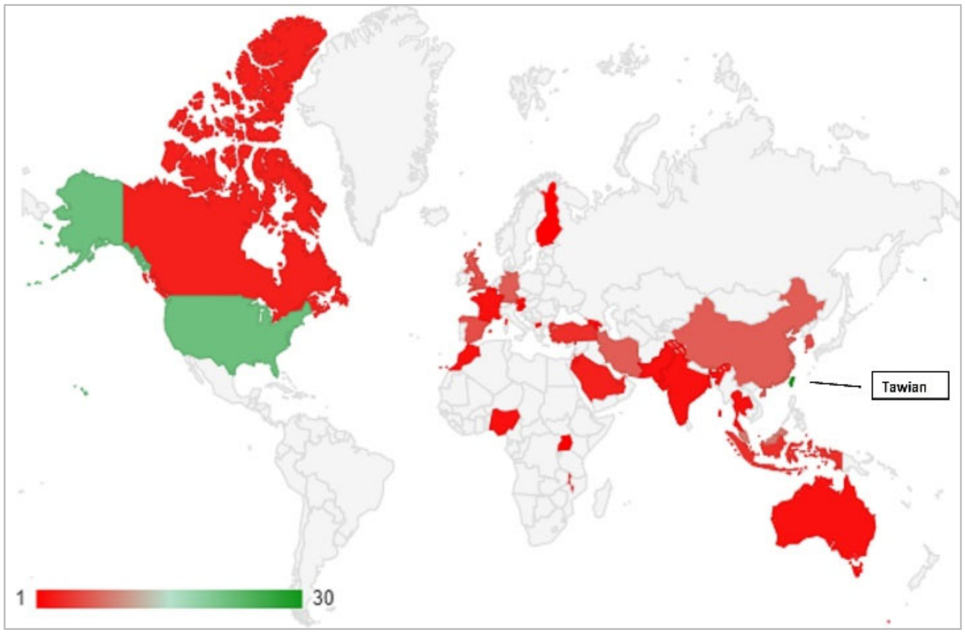

Figure 8. Geographic chart for the studies included in this review.

Table 5. Technology types and directions of countries.

Technology	Frequency	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 and 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, and 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 and 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

Table 6. Technology types and participants' groups.

	Participant Groups									
Technology	**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	
Handheld Computers	3			2		1			1	1
Health Information Systems		3		1	1	2		1		
Web-Based Systems (Intervention)				2			1	1	1	
Computer-Assisted Instruction	1	1								3
Medical Informatics Applications		1		1	1					
Electronic Data Processing (Barcode)		1	1					1		
Consumer Health Informatics								3		
Mobile Applications/Electronic Records	1	1		1						
Clinical Information Systems	2							3		
Hospital Information systems	1					1		1		
Decision Support Systems	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 Technologies	1	1	1	3	2			1	1	2
Total	**30**	**24**	**4**	**26**	**7**	**11**	**15**	**20**	**14**	**10**

Table 7. 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

4.6. 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 peaks 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 technologies.

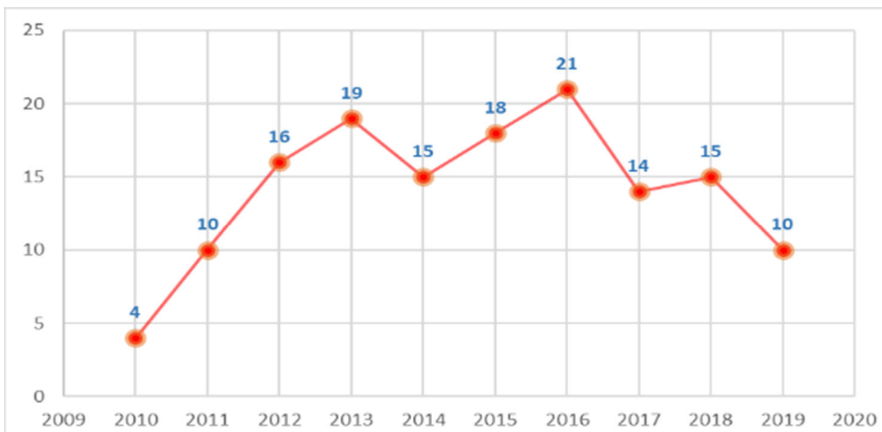

Figure 9. Frequency of studies per year.

5. Discussion

The results of this review are believed to add a thorough understanding of the literature on technology acceptance in healthcare. The fundamental goal of this study was to review the empirical studies and analyze the results to understand the research situation of technology acceptance in the healthcare sector. This review covered the studies conducted in the recent decade to explore the acceptance of different technologies using different acceptance theories, various factors, and different 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. It was also found that several studies have discussed integrated models. In general, the main aim of the integration in those studies was to improve the explanatory power of the TAM model. These results align with what was proposed by [47] 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 several healthcare technologies. This observation is compatible with the conclusions of prior research [28,29]. Additionally, 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 [18,31], to better understand technology acceptance and facilitate building more unified models [74].

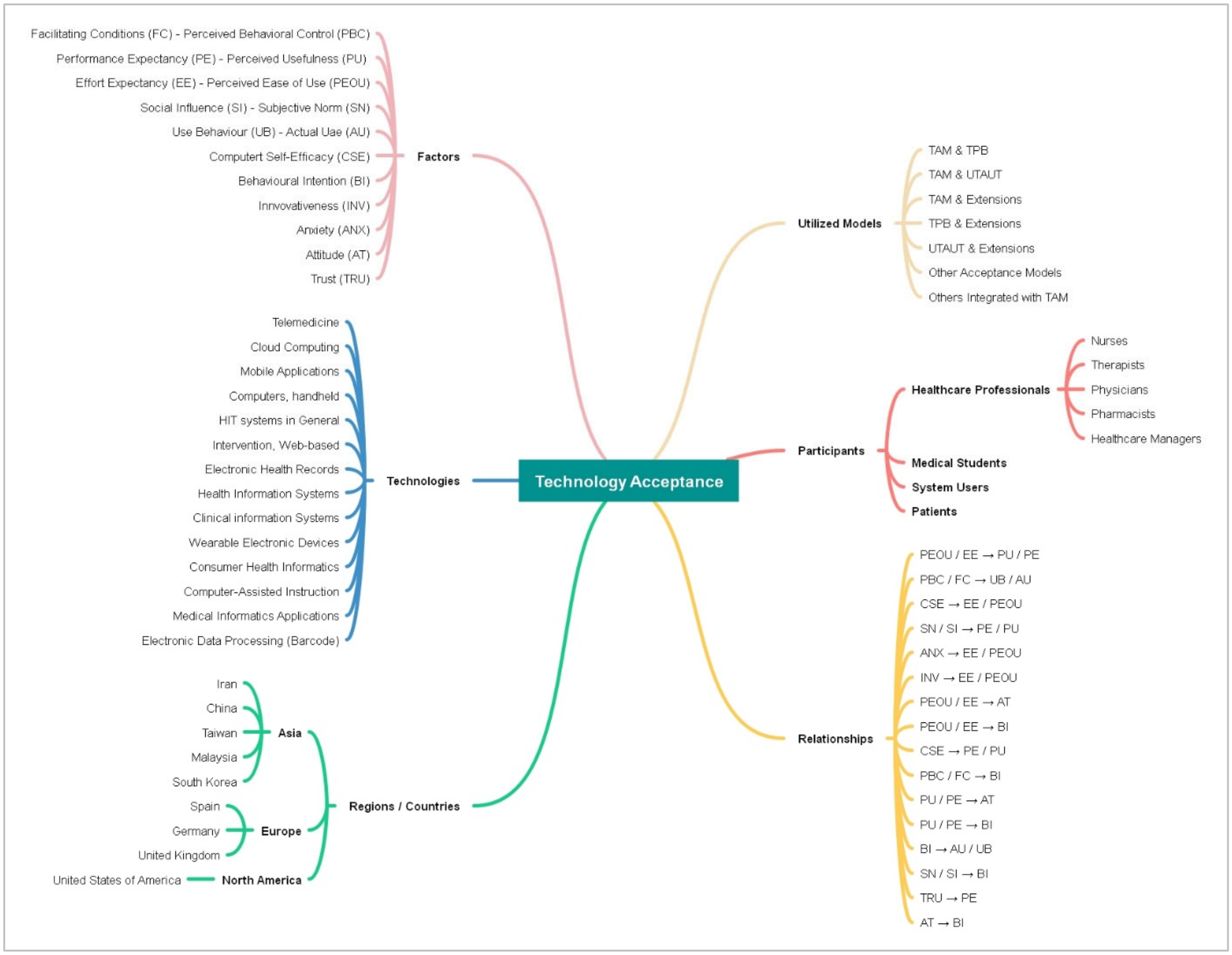

Figure 10. Mind map for the results summary.

This study also explored the key factors that were extensively employed in the recent literature to understand the acceptance of various healthcare technologies. The results showed that behavioral intention was utilized 125 times in the reviewed studies. This finding is significant to confirm the 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 various technologies in healthcare [60,67–69]. These two factors are the core of the TAM. Other studies have confirmed that these constructs could explain about 40% of users' acceptance and intention to use specific technologies [33] in various domains, including healthcare [30,75,76]. Instead, the UTAUT was found to extend the explanatory power by 20% to 30% more than TAM regarding user's behavior intention [31]. 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 [33]. The TAM, UTAUT, and their constructs are robust theories to understand the acceptance of various technologies through different users.

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 [9,18,31]. This is also applied to the perceived ease of use and its identical factor, 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" confirm the users' need for support and motivation to accept and use information technologies in healthcare. Additionally, 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 users' innovativeness and confidence to use information technology without fear of making 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 correlations between the factors within a specific model. The determination of confirmed hypotheses is essential to understand the possible significant correlations between constructs and assist researchers in developing or enhancing acceptance theories based on the findings of other scholars. The recognition of the factors and their confirmed correlations can provide a better view for decision makers and help them determine the technology's strengths and weaknesses, enhancing its level of acceptance [77].

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 [9,78]. Additionally, the results exposed that attitude toward 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 [31,79]. It is essential to implement user-friendly solutions in healthcare to expand the positive attitude toward technology adoption [31,61]. The relationship between social influence and both behavioral intention and perceived usefulness was extensively confirmed. This correlation suggests that users' behavioral intention to use technology is significantly influenced by their social groups and beliefs 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. This can signify a lack or plethora in the literature regarding a particular technology or country. The classification of technologies can enable scholars to have a look for other technology solutions in healthcare. The results showed that telemedicine and electronic health records were the most studied technologies in general. This observation indicates that there is still room to explore the acceptance of these technologies in different countries and settings, especially that there is no specific country to lead the 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. It is, therefore, recommended to conduct more research on the technologies that are not covered or neglected, such as picture archiving and communication systems (PACs) [9] and robotics [80].

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 different technologies. This result can be misleading when the technology type is added. 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 other technologies by various 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 user needs to be innovative to try a new smartwatch or mobile application without fear of making mistakes and trust that the technology will not make his/her data public or breach the confidentiality terms.

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. 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 across many Arab countries, the lack of technology acceptance research exists, specifically in the healthcare domain.

Taiwan recorded 20.27% of the analyzed studies, which makes up almost 40% of the total number of studies in Asia. This might be an outcome for the well-established healthcare systems in Taiwan [81]. In contrast, China and South Korea's results 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 conducted to understand the enablers and barriers to adopting various healthcare technologies in China and South Korea.

Regarding the years of publication, the results indicated a fluctuation in the number of studies per year. 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 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 does not support technology acceptance literature. The current need to adopt new technologies and improve healthcare services opens the door for more studies to explain technology acceptance. It is expected that the number of studies will increase due to the outbreak of COVID-19 that was identified in December 2019 in China and has resulted in the deaths of thousands of human beings worldwide [82,83].

6. Conclusions

This study aimed to systematically provide an overview of the studies published on technology acceptance in healthcare. The study provided a classification analysis that includes the studied technology acceptance models, the influential factors, the confirmed relationships among those factors, the types of the studied information technologies, participants, year of publication, and countries (direction of research). Following the PRISMA guidelines, 1768 published studies were reviewed, and 142 studies were found to be valid and included in the statistical analysis. According to the findings, it is clear that TAM and UTAUT are the prevailing technology acceptance models. Additionally, the analysis found that the constructs of TAM and UTAUT were the most utilized factors to understand the acceptance of technology in healthcare. Moreover, other factors were extensively studied including, computer anxiety, computer self-efficacy, innovativeness, and trust. Overall, room is still available to integrate various technology acceptance models or add other factors to the current models to produce more robust and valid acceptance models.

On the other hand, some technology solutions were found to be dominant, including electronic health records, telemedicine, and mobile applications. In general, the results were scattered in terms of the research directions (technology country). Healthcare workers (i.e., physicians, nurses, and healthcare professionals) were the main focus of the reviewed studies. Patients' technology acceptance was only discussed in around 10% of the reviewed studies. In addition, the reviewed studies were mainly conducted in Taiwan and the USA, with minimum research articles in Arab and African countries.

6.1. Theoretical Contributions

As per the conducted classification analysis, the study provided multiple contributions to technology acceptance models and theories, especially in healthcare. This 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, this study included only the empirically evaluated acceptance models, their extensions, and integrations. Third, the study 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 such as 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.

6.2. Practical Implications

The study provides various practical implications for the healthcare domain. First, this 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 should 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, we believe that 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. End-users need 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 need to concentrate on Arab and African countries, as there is potential to implement those new information technologies within the healthcare sector in these countries.

6.3. Limitations and Future Work

This systematic review 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). Therefore, 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, this review has covered only empirical quantitative studies. Further reviews might consider qualitative studies.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Quality assessment 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

Table A2. Full list of the included publications.

Sr.	Source	Year	Article Type	Studied Technology	Sample Size	Sample Type	Country	Acceptance Model
1	Bennani and Oumlil [84]	2010	Conference	ICT Appropriation	111	Physicians and Nurses	Morocco	TAM
2	Lai and Li [85]	2010	Conference	Computer Assistance Orthopedic Surgery System	115	Healthcare Professionals	Taiwan	Integrated Model: TAM and TPB
3	Kim et al. [86]	2010	Journal Article	Tele-Homecare Technology (Telemedicine)	40	Physicians	USA	Compare Two Models: TAM and TPB
4	Holtz [87]	2010	PHD Dissertation	Electronic Medical Records	113	Nurses	USA	UTAUT
5	Pai and Huang [88]	2011	Journal Article	Healthcare Information Systems	366	Nurses, Head Directors, and Other Related Personnel	Taiwan	Integrated Model: TAM and IS Success Model
6	Orruño et al. [89]	2011	Journal Article	Tele-Dermatology System	171	Physicians	Spain	Modified TAM
7	Maarop et al. [90]	2011	Conference	Teleconsultation Technology	72	Healthcare Providers	Malaysia	Extended TAM
8	Schnall and Bakken [91]	2011	Journal Article	Continuity of Care Record (CCR) with Context-Specific Links	94	HIV Case Managers	USA	Extended TAM

9	Kowitlawakul [92]	2011	Journal Article	eICU Telemedicine Technology	117	Registered Nurses	USA	Telemedicine TAM (TTAM)—Extended TAM
10	Damanhoori et al. [93]	2011	Conference	Breast Self-Examination Teleconsultation	279	Female Citizens	Malaysia	TAM
11	Lim et al. [94]	2011	Journal Article	Mobile Phones to Seek Health Information	175	Female Citizens 21+	Singapore	Extended TAM
12	Mohamed, Tawfik, and Norton [95]	2011	Conference	Electronic Health Technologies	50	Participants—Not Specified	UAE and UK	E-Health Technology Acceptance Model (E-HTAM)—Extended TAM
13	Ortega Egea and Román González [96]	2011	Journal Article	Electronic Health Care Records (EHCR)	254	Physicians	Spain	Extended TAM
14	Mohamed, Tawfik, and Al-Jumeily [97]	2011	Conference	Smart Mobile Phone in the Medical Domain	229	Students Medical Practitioners, Ministry of Health Staff and Universities Staff	UAE and UK	Mobile Technology Acceptance Model (Mo-HTAM)—Extended TAM
15	Ketikidis et al. [7]	2012	Journal Article	Health Information Technology (HIT)	133	Healthcare Professionals: Doctors and Nurses	North Macedonia	Modified TAM2
16	Chong and Chan [98]	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 and Park [99]	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, and TAM
18	Terrizzi et al. [100]	2012	Conference	Integrated Electronic Health Records (IEHR)	31	Physicians and Office Staff	USA	Extended TAM

19	Chow et al. [101]	2012	Journal Article	Online Virtual Health Learning: Rapid Sequence Intubation (RSI)	206	Nursing Students	Hong Kong	Extended TAM
20	Asua et al. [102]	2012	Journal Article	Telemonitoring System	268	Nurses, General Practitioners, and Pediatricians	Spain	Extended TAM
21	Khalika Banda and Gombachika [103]	2012	Conference	Mobile Health Services	38	Health Surveillance Assistants	Malawi	Extended TAM
22	Holden et al. [104]	2012	Journal Article	Bar-coded medication - dispensing and administration technology	39	Pharmacists and Pharmacy Technicians	USA	Extended TAM
23	Chang and Hsu [105]	2012	Journal Article	Online Patient-Safety Reporting System	183	Healthcare Professionals	Taiwan	Modified UTAUT
24	Ifinedo [106]	2012	Conference	Information Systems	227	Health Professionals	Canada	Modified UTAUT
25	Moores [107]	2012	Journal Article	Clinical Management System	346	Clinical Staff	France	Extended TAM—Integrated Model
26	Guo et al. [108]	2012	Conference	Mobile Health Services	492	Service Participants	Taiwan	Extended TAM
27	Sarlan et al. [109]	2012	Conference	Clinic Information System	252	Doctors and Staff	Malaysia	Integrated Model: TAM and TPB
28	Gagnon et al. [110]	2012	Journal Article	Home Telemonitoring System	93	Doctors and Nurses	Spain	Modified TAM
29	Chua et al. [111]	2012	Conference	Home-based Pill Dispensers	21	Patients	Singapore	TAM
30	Su, Tsai, and Chen [112]	2012	Conference	Telecare System	365	Older Resident	Taiwan	TAM
31	Chow et al. [113]	2013	Journal Article	Clinical Imaging Portal	128	Nursing Students	Hong Kong	Extended TAM
32	Cheng [114]	2013	Journal Article	E-Learning System	218	Nurses	Taiwan	Integrated Model: TAM and Flow Theory
33	Bennani and Oumlil [28]	2013	Conference	IT in Healthcare	250	Nurses	Morocco	Extended UTAUT
34	Vanneste, Vermeulen, and Declercq [115]	2013	Journal Article	BelRAI Web Application: Web-Based System Enabling Person-Centered Recording and Data Sharing	282	Healthcare Professionals	Belgium	Extended UTAUT
35	Huang [116]	2013	Journal Article	Telecare	369	Residents 15+	Taiwan	Extended TAM

36	Escobar-Rodríguez and Romero-Alonso [117]	2013	Journal Article	Automated Unit-Based Medication Storage and Distribution Systems	118	Nurse	Spain	Extended TAM
37	Arning, Kowalewski, and Ziefle [118]	2013	Conference	Wireless Medical Technologies (WMT)	305	Users/Non-Users	Germany	Innovation Diffusion Theory
38	Sarlan, Ahmad, and Fatimah [119]	2013	Conference	Health Information System (HIS)	252	Staff in Private Healthcare Organizations	Malaysia	Integrated Model: TAM and TPB
39	Cocosila [120]	2013	Journal Article	Mobile Health Applications	170	Smokers (18+)	United Kingdom	Attitude-Perceived Risk-Motivation Model
40	Gajanayake, Sahama, and Iannella [58]	2013	Journal Article	Electronic Health Record (EHR)	334	Medical, Nursing, and Health Students	Australia	TAM
41	Chen et al. [121]	2013	Journal Article	E-Appointment System	334	Citizens	Taiwan	Extended TAM
42	Kummer, Schäfer, and Todorova [122]	2013	Journal Article	Sensor-Based Medication Systems	579	Nurses	Australia	Extended TAM2
43	Kuo, Liu, and Ma [123]	2013	Journal Article	Mobile Electronic Medical Record (MEMR)	665	Nurses	Taiwan	Extended TAM
44	Krueklai, Kiattisin, and Leelasantitham [124]	2013	Journal Article	E-Health Solutions	200	Participants from Government Hospitals	Thailand	UTAUT
45	Manimaran and Lakshmi [125]	2013	Journal Article	Health Management Information System (HMIS)	960	Healthcare Professionals: Doctors, Pharmacists, Nurses, etc.	India	Extended TAM
46	Tavakoli et al. [126]	2013	Journal Article	Electronic Medical Record (EMR)	62	System Users	Iran	Extended TAM
47	Jackson, Yi, and Park [127]	2013	Journal Article	Personal Digital Assistant (PDA)	222	Physicians	USA	TAM, TPB, and IDT
48	Mohamed et al. [128]	2013	Conference	Electronic Health Technologies	129	Participants—Not Specified	UAE and UK	E-Health Technology Acceptance Model (E-HTAM2)—Extended TAM

49	Sarlan, Ahmad, and Ahmad [62]	2013	Journal Article	Clinic Information System (CIS)	252	Doctors and Staff	Malaysia	Extended Hybrid Model: TAM and TPB
50	Ford [129]	2014	Master's Thesis	Over-the-Counter Blood Pressure Monitor	26	Individuals in 2 age groups: (18–28) and (60–85)	USA	Extended UTAUT
51	Alaiad, Zhou, and Koru [130]	2014	Journal Article	Home Healthcare Robots	64	Patients and Healthcare Professionals	USA	Extended UTAUT
52	Lin [131]	2014	Journal Article	Knowledge Management Systems	361	Physicians	USA and Taiwan	Technology Acceptance View of Knowledge Management Systems in Healthcare Organizations (TAV-KMSHO)
53	Hsieh, Lai, and Ye [132]	2014	Conference	Health Cloud Services	443	Patients	Taiwan	Integrated Model: TAM and SQB
54	Gagnon et al. [133]	2014	Journal Article	Electronic Health Record (EHR)	150	Physicians	Canada	4 Models: TAM, Extended TAM, Psychosocial Model, and Integrated Model
55	Fleming et al. [134]	2014	Journal Article	Prescription Monitoring: Prescription Access	76	Emergency Physicians	USA	TAM
56	Corneille et al. [135]	2014	Conference	Text-Message-Based Health Intervention	120	Undergraduate Psychology Students	USA	Innovation Diffusion Theory
57	Steininger et al. [136]	2014	Conference	Electronic Health Record (EHR)	204	Physicians	Austria	Modified TAM
58	Hwang, Kim, and Lee [137]	2014	Journal Article	Ambulance Telemetry Technology	136	Emergency Medical Technicians	S. Korea	Extended TAM
59	Hung, Tsai, and Chuang [138]	2014	Journal Article	Primary Health Information System (PHIS)	768	Nurses	Taiwan	Theory of Reasoned Action (TRA)
60	Rho, Choi, and Lee [139]	2014	Journal Article	Telemedicine Technology	183	Physicians	S. Korea	Extended TAM
61	Moon and Chang [140]	2014	Journal Article	Innovative Smartphone	122	Hospital Professionals	S. Korea	Integrated Model: TRA, TAM, and IS Success Model

62	Tsai [141]	2014	Journal Article	Telehealth System	365	Patients	Taiwan	Integrated Model: Extended TAM and HBM
63	Yallah [142]	2014	PhD Dissertation	Telemedicine	190	Physicians	Georgia	Extended TAM
64	Cleveland [143]	2014	PhD Dissertation	Educational Technology	57	Nurse Educators	USA	Extended TAM
65	Devine [144]	2015	PhD Dissertation	Social Media in Healthcare	137	Nurses	USA	UTAUT2
66	Ebie and Njoku [145]	2015	Journal Article	Performance Appraisal System	80	Line Managers	United Kingdom	Extended TAM
67	Krishnan, Dhillon, and Lutteroth [146]	2015	Conference	Consumer Health Informatics Applications	105	Health Consumers	Malaysia	Integrated Model: TAM, TRA, and UTAUT2
68	Basak, Gumussoy, and Calisir [147]	2015	Journal Article	Personal Digital Assistant (PDA)	339	Physicians	Turkey	Extended TAM
69	Briz-Ponce and García-Peñalvo [148]	2015	Journal Article	Mobile Technology and "Apps" in Medical Education	124	Students and Medical Professionals	Spain	Extended TAM
70	Song, Park, and Oh [149]	2015	Journal Article	Bar Code Medication Administration Technology	163	Nurses	USA	Extended TAM
71	Holahan et al. [150]	2015	Journal Article	Medication Reconciliation Technology	53	Primary Care Providers	USA	Effective Technology Use Model (ETUM)
72	Ahadzadeh et al. [151]	2015	Journal Article	Health-Related Internet Use	293	Female Users	Malaysia	Integrated Model: HBM and TAM
73	Kowitlawakul et al. [152]	2015	Journal Article	Electronic Health Records for Nursing Education (EHRNE)	212	Undergraduate Nurses	Singapore	Extended TAM
74	Elaklouk, Mat Zin, and Shapii [153]	2015	Journal Article	Serious Games for Cognitive Rehabilitation	41	Therapists	Saudi Arabia	Extended TAM
75	Chang et al. [154]	2015	Journal Article	E-Hospital Service: Web-Based Appointment System	140	Patients	Taiwan	Extended TAM
76	Hsieh [155]	2015	Journal Article	Health Cloud Services	209	Healthcare Professionals	Taiwan	Integrated Model: TPB and SQB
77	Steininger and Stiglbauer [156]	2015	Journal Article	Electronic Health Records (EHR)	204	Physicians	Austria	Modified TAM
78	De Veer et al. [157]	2015	Journal Article	E-Health Applications	1014	Older People	Germany	UTAUT

79	Ku and Hsieh [158]	2015	Conference	Health Cloud Services	105	Patients	Taiwan	Integrated Model: TPB and SQB
80	Liu and Cheng [159]	2015	Journal Article	Mobile Electronic Medical Records	158	Physicians	Taiwan	Integrated Model: TAM and Dual-Factor Model
81	Miiro and Maiga [160]	2015	Book Chapter	Social Networks For E-Health	278	Graduate Students	Uganda	E-Health Social Networked Model
82	Zaman [161]	2015	Master's Thesis	Electronic Documentation Systems (her, EMR, EPR)	248	Nurses	USA	Extended TAM
83	Sezgin and Özkan-Yıldırım [162]	2016	Journal Article	Health Information Technology: Pharmaceutical Service Systems	1420	Pharmacists/ Pharmaceutical Assistants	Turkey	Integrated Model (P-TAM): TAM, UTAUT, and TPB
84	Mansur, Fatma [163]	2016	Journal Article	Information and Communication Technologies	303	Health Managers	Turkey	Extended TAM
85	Moon and Hwang [164]	2016	Book Chapter	Smart Health Care System	126	Students	S. Korea	Extended UTAUT
86	Ku and Hsieh [165]	2016	Conference	Cloud-Based Healthcare Services	178	Elderly Citizens	Taiwan	Extended TPB
87	Made Dhanar et al. [166]	2016	Conference	Hospital Information Systems	100	Hospital Staff and Doctors	Indonesia	Integrated Model: TAM and DeLone and McLean IS Success
88	Kim, Seok, et al. [31]	2016	Journal Article	Mobile Electronic Medical Record (EMR)	449	Healthcare Professionals	S. Korea	Extended UTAUT
89	Cimperman, Makovec Brenčič, and Trkman [35]	2016	Journal Article	Home Telehealth Services (HTS)	400	Old Users 50+	Slovenia	Extended UTAUT
90	Hadadgar et al. [39]	2016	Journal Article	E-Learning Continuing Medical Education (CME)	146	General Practitioners	Iran	TPB
91	Hsiao and Chen [167]	2016	Journal Article	Computerized Clinical Practice Guidelines	238	Physicians	Taiwan	Integrative Model of Activity Theory and TAM
92	Lazard et al. [168]	2016	Journal Article	Patient Portal	333	Portal Users	USA	Extended TAM
93	Lin et al. [169]	2016	Journal Article	Wearable Instrumented Vest	50	Elderly 60+	Taiwan	Extended TAM
94	Al-Nassar, Rababah, and Al-Nsour [170]	2016	Journal Article	Computerized Physician Order Entry (CPOE)	118	Physicians	Jordan	Extended TAM

95	Lazuras and Dokou [171]	2016	Journal Article	Online Counseling Services	63	Mental Health Professionals	United Kingdom	Extended TAM
96	Ifinedo Princely, Odette Griscti, and Judy Bailey [172]	2016	Journal Article	Healthcare Information Systems (HIS)	197	Registered Nurses	Canada	Extended TAM
97	Holden et al. [173]	2016	Journal Article	In-Room Pediatric ICU Technology	167	Nurses	USA	Expanded TAM
98	Ducey and Coovert [174]	2016	Journal Article	Tablet Computer Use	261	Physicians	USA	Extended TAM
99	Chen, Chang, and Lai [175]	2016	Conference	Cloud Sphygmomanometer	521	System Users	Taiwan	Extended TAM
100	Guo, Zhang, and Sun [176]	2016	Journal Article	Mobile Health Services	650	Service Users	China	Attribute-Perception-Intention Model
101	Becker [177]	2016	Journal Article	Mobile Mental Health Applications	125	Young Adults	Germany	Extended TAM
102	Shujen Lee and Chen [178]	2016	Conference	3D Bio-Printing	249	Adults	Taiwan	TAM
103	Hsieh [179]	2016	Journal Article	Health Cloud Services	681	Patients	Taiwan	Dual-Factor Model: UTAUT and SQB
104	Ahmadi et al. [9]	2017	Journal Article	Picture Archiving and Communication System (PACS)	151	Healthcare Employees	Iran	UTAUT
105	Jayusman and Setyohadi [180]	2017	Conference	E-Learning System	188	Students at School of Health Sciences	Indonesia	Extended TAM
106	Amin et al. [181]	2017	Journal Article	Cloud-Based Healthcare Services	147	Healthcare Professionals	Malaysia, Pakistan, and Saudi Arabia	UTAUT
107	[182]	2017	Journal Article	Barcode Technology	9	Users	Iran	Extended TAM
108	Ehteshami [183]	2017	Journal Article	Electronic Health Record (EHR)	233	Physicians	Armenia	Tripolar Model (TMTA)—Extended TAM
109	Rajanen and Weng [184]	2017	Conference	Wearable Devices for Personal Healthcare—Smart Bands	158	Consumers	China	Extended TAM
110	Wahyuni and Nurbojatmiko [185]	2017	Conference	E-Health Services Consumer Informatics	91	Citizens	Indonesia	Extended Model: TAM and HBM

111	Nematollahi et al. [186]	2017	Journal Article	Electronic Medical Records (EMR)	235	Hospital Managers	Iran	UTAUT
112	Hsu and Wu [59]	2017	Journal Article	Nursing Information Systems	158	Nurses	Taiwan	TAM
113	Horne [187]	2017	PhD Dissertation	Telemedicine	46	Healthcare Workers	USA	TAM
114	Hsieh et al. [188]	2017	Book Chapter	Personal Health Information System in Self-Health Management	240	Middle-Aged and Elderly Citizens	Taiwan	HBM
115	Lin [189]	2017	Journal Article	Nursing Information System	531	Nurses	Taiwan	Integrated Model: TAM and ISSM
116	Dou et al. [190]	2017	Journal Article	Smartphone Health Technology for Chronic Disease Management	157	Patients	China	Extended TAM
117	Zhang et al. [191]	2017	Journal Article	Mobile Health Services	650	Service Users	China	Extended TAM
118	Khan et al. [78]	2018	Journal Article	E-Prescribing	295	Physicians	Pakistan	Extended UTAUT
119	Kalavani, Kazerani, and Shekofteh [65]	2018	Journal Article	Evidence-Based Medicine (EBM) Databases	192	Medical Residents	Iran	UTAUT
120	Lin et al. [60]	2018	Journal Article	Wearable Cardiac Health Technologies	48	Patients	Taiwan	Extended TAM
121	Martins et al. [192]	2018	Journal Article	E-Health Technology	210	Hospital Employees	Nigeria	Extended UTAUT
122	Beldad and Hegner [67]	2018	Journal Article	Fitness Apps	476	Users of Fitness Apps	Germany	Extended TAM
123	Perlich, Meinel, and Zeis [29]	2018	Journal Article	Interactive Documentation System	46	Therapists and Patients	Germany	Extended UTAUT
124	Nadri et al. [69]	2018	Journal Article	Hospital Information Systems	202	Systems Users	Iran	Extended TAM
125	Tubaishat [38]	2018	Journal Article	Electronic Health Records (EHR)	1539	Nurse	Jordan	TAM
126	Özdemir-Güngör and Camgöz-Akdağ [61]	2018	Journal Article	Electronic Health Records (EHR)	99	Healthcare Professionals and Administrative Staff	Turkey	Modified TAM
127	Aldosari et al. [193]	2018	Journal Article	Electronic Medical Records (EMR)	153	Nurses	Saudi Arabia	Modified TAM
128	Ku and Hsieh [194]	2018	Conference	Health Management Mobile Services	105	Citizens	Taiwan	Integrated Model: TPB and HBM

129	Hennemann et al. [195]	2018	Journal Article	Occupational E-Mental-Health	1829	Employees with Long Sick Leaves	Germany	Extended UTAUT
130	Vitari and Ologeanu-Taddei [196]	2018	Journal Article	Electronic Health Records (EHR)	1741 + 1119	Physicians, Paraprofessionals, and Administrative Personnel	France	New Developed Model
131	Venugopal et al. [10]	2018	Conference	Telemedicine and Electronic Health Records (EHR)	568	Clinical Staff	India	UTAUT
132	Liu and Lee [68]	2018	Journal Article	Pharma-Cloud	179	Pharmacists	Taiwan	Extended TAM
133	Zhou et al. [197]	2019	Journal Article	Telehealth	436	60+ Years Old Patients	China	Extended TAM
134	Francis [198]	2019	Journal Article	Self-Monitoring Devices	258	Healthcare Providers	USA	Expanded UTAUT2
135	Li et al. [63]	2019	Journal Article	Smart Wearables	146	60+ Years Old Adults	China	Extended Hybrid Model: TAM and UTAUT
136	Tao et al. [199]	2019	Journal Article	Health Information Portal	201	Adults	China	Extended TAM Model
137	Masyarakat et al. [200]	2019	Journal Article	Nutrition Information System	50	Nutrition Officers	Indonesia	UTAUT
138	Tsai et al. [64]	2019	Journal Article	Telehealth	281	Adults 40+	Taiwan	Integrated Model: TAM and SQB
139	Turja et al. [80]	2019	Journal Article	Care Robots	544	Healthcare Professionals	Finland	Robot Acceptance Model for Care (RAM-care)
140	Idoga et al. [66]	2019	Journal Article	Cloud-Based Health Center (CBHC)	300	Healthcare Professionals	Nigeria	UTAUT2
141	Boon-itt [8]	2019	Journal Article	Health Websites	222	Internet Consumers	Thailand	Extended TAM
142	Schomakers, Lidynia, and Ziefle [201]	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

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