Telemedicine Adoption for Healthcare Delivery: A Systematic Review

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***Abstract*—Telemedicine is the delivery of healthcare services using telecommunication and information technologies. The adoption of telemedicine has been promoted by advancements in technology, increased accessibility to the Internet, and the need for convenient and efficient healthcare delivery. Understanding the theoretical foundations of telemedicine adoption among healthcare providers and patients is crucial for successful acceptance and utilization. This systematic review aims to explore the theoretical frameworks and models that have been widely utilized to understand telemedicine adoption among healthcare providers and patients. A systematic search was conducted across two popular electronic databases, resulting in the inclusion of 21 relevant studies. The selected studies were analyzed to identify the theoretical perspectives employed in telemedicine adoption research. The key findings reveal that the Technology Acceptance Model (TAM), the Unified Theory of Acceptance, and the Use of Technology (UTAUT) model are the most widely models used to illustrate the factors affecting telemedicine adoption among healthcare providers and patients through different countries and telemedicine contexts. Understanding these theoretical models is crucial for policymakers and healthcare professionals as it can provide insight into the key factors influencing the widespread adoption of telemedicine. This knowledge can serve as a guidance for crafting initiatives, and tailoring policies to promote the successful acceptance and utilization of telemedicine among providers and patients in diverse healthcare environments.**

***Keywords*—Telemedicine; systematic review; technology acceptance model; adoption; telehealth; healthcare provider; patient**

I. Introduction

The integration of Information and communication technology (ICT) in healthcare systems has revolutionized the delivery of healthcare services. Telemedicine, a branch of ICT, has emerged as a promising approach for delivering care remotely, overcoming distance barriers, enhancing clinical outcomes, increasing patient engagement [1], and reducing costs [2], [3]. It can be used to provide a range of clinical services, including consultations, diagnosis, treatment, monitoring, therapy process, and exchange of medical information by using electronic communication tools such as video conferencing, phone calls, or secure messaging [4]. Broadly, telemedicine includes two different types of services which are: store and forward (asynchronous), and real-time interactive (synchronous) [5], [6]. Thus, telemedicine is an excellent opportunity for health professionals to reach a wider community through remote provision of healthcare services.

Telemedicine and telehealth are often used interchangeably, but they have slightly different meanings [7]. Telemedicine specifically refers to the remote delivery of clinical healthcare services, while telehealth includes a broader scope of remote healthcare services, including both clinical and non-clinical aspects [4], [8]. Due to the inconsistent usage of the term telemedicine in the studies, it becomes difficult to define it precisely in relation to other terms. Therefore, during the search process, related terms like eHealth, mHealth, and telehealth were also taken into consideration. The studies included in the analysis focused on telemedicine as a means of providing patient-centered healthcare services over long distances.

An increasing world population, especially the elderly, [9] will require access to remote healthcare services, such as that potentially offered by integrating telemedicine with traditional healthcare practice. The COVID-19 pandemic has significantly accelerated this trend of adopting telemedicine [10]. With the pandemic forcing many people to stay at home, the use of telemedicine has become even more necessary to ensure that patients can continue to receive uninterrupted care. Accordingly, telemedicine has become an essential component of healthcare service delivery. Despite the great promise of telemedicine, its actual use is insufficient and has not achieved a prominent utilization outcome [11], [12]. The reasons behind this are not only the technical aspect but also the human behavioral aspect [13]. Thus, the acceptance of technology plays a crucial role in successfully implementing and consistently using it and is considered a significant factor in ensuring the effective implementation of IT systems.

Investigating the literature reveals a number of models are useful in understanding individuals' intentions to adopt ICT [14]. Some of these models include the Technology Acceptance Model (TAM) [15], [16], Unified Theory of Acceptance and Use of Technology (UTAUT) [17], Diffusion of Innovations Theory (DOI) [18], Theory of Planned Behavior (TPB) [19], Theory of Reasoned Action (TRA) [20], and Health Belief Model (HBM) [21]. These models introduce different factors that influence end users' behavior to adopt telemedicine. However, limited evidence exists regarding the optimal theory or model for understanding the acceptance of telemedicine in the realms of technology adoption and acceptance.

While individual studies explore theoretical constructs as predictors for telemedicine acceptance, there is a notable absence of a comprehensive overview that systematically analyzes these constructs, models, and factors influencing the acceptance of various types of telemedicine. This evaluation is essential from the standpoint of providers and patients, who are pivotal users of the telemedicine system. Furthermore, the authors of [22] and [23] pointed out the gap in knowledge, emphasizing that existing models are limited in scope and constrained by regional or national borders. Therefore, before

suggesting a model to study telemedicine adoption, it is important to study systematically these models. Thus, this review is conducted to provide a comprehensive overview of the theories and models used to assess the behavioral intention in adopting telemedicine among healthcare providers and patients in different settings of telemedicine. The research will seek to answer:

RQ1. Which adoption theories and models are widely applied in the telemedicine context?

RQ2. What are the most prominent factors affecting telemedicine technology adoption from the end user's perspective in a different setting of telemedicine?

The rest of the paper is organized as follows: the study methods and materials are discussed in Section II, followed by Section III detailing our results. Finally, the discussion in Section IV is succeeded by an exploration of future research directions and limitations, followed by the conclusion in Section V.

II. Materials and Methods

A. Search Strategy

This systematic review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a systematic and transparent review process [24]. Two popular academic databases, including Scopus and PubMed, were selected to collect relevant studies published in the last decade (between 2012 and 2023) and available in English or Arabic languages. The Population, Intervention, Comparison, Outcome, and Study design (PICOS) framework was applied to establish the inclusion and exclusion criteria for the review [25] (see Table I). The inclusion criteria encompassed studies focusing on telemedicine adoption theories and models among healthcare providers and patients. The search terms used a combination of PICOS components and were refined using Boolean operators. The search was conducted in March 2023. A specific search string can be found in Appendix 1.

TABLE I. Inclusion and Exclusion Criteria

	Inclusion criteria	Exclusion criteria
Population	Patients, healthcare providers, nurses.	Not patient, not healthcare provider, not nurse.
Intervention	Telemedicine	Not telemedicine, no clinical services delivered to patients, no interaction with healthcare providers.
Outcome	Behavioral intention in adoption and acceptance of technologies	Not based on theory, no adoption or acceptance.
Study design	studies published in English or Arabic language,full text access.	Reviews, studies not published in English or Arabic language.

B. Search Result

The result of searching selected databases initially yielded 3,753 articles through electronic searches. In addition, manual searching yielded five articles from other sources. After removing duplicates and screening titles and abstracts, 230 articles were selected for full-text review. Finally, a total of 21 articles, meeting our inclusion criteria, were chosen for in-depth analysis. Fig. 1 displays the PRISMA flow diagram for the search and selection process.

C. Data Extraction and Organization

Data from the included studies were extracted using a standardized form (see Table II). The extracted data included study characteristics (e.g., authors, year of publication, journal, the country where the study was conducted), theoretical frameworks employed, study design, population target, sample size, key constructors affecting telemedicine adoption in different contexts, and type of statistical analysis used in the study. The findings were summarized to fulfill the review's objectives by focusing on identified theories and their constructs in understanding telemedicine adoption among healthcare providers and patients.

TABLE II. Data Extraction Form

Data Extraction	Description
Study ID	Identifier of the study.
Title	Title of the study.
Author/s	Author/s name.
Year	Year of the publication.
Journal	Published Journal.
Country	Country/place where the research conducted.
Telemedicine application	Type of Telemedicine application.
Theory/Model	Type of theory/model used in the study.
Data collection Design	Method used to collect data.
Population Focus	The target of research participants.
Population Sampling	Number of research participants.
Components of theory/model	Constructor used to build theory/model.
Moderator components	A variable that influences the presence of a relationship between variables.
Statistical Analysis type	Type of analysis used to obtain the result.

D. Quality of the Studies

A quality assessment checklist is essential for evaluating the methodological rigor and reliability of studies [26]. The quality assessment checklist of the included studies was adapted from [27] and includes five items, as presented in Table III. This checklist uses a 3-point scale where (1=Yes, 0.5=Partly, 0=No). The results of the quality assessment can be found in Appendix 2. Generally, all the included studies scored high in quality and passed the quality assessment, allowing us to proceed to the next step, which is analysis.

TABLE III. Quality Assessment Questions

No.	Question
1	Is the study related to telemedicine adoption and its application?
2	Does the study use adoption theories or models?
3	Does the study explicitly present the research methodology?
4	Does the data collection procedure outline in the study?
5	Are the study findings clearly presented and added to the literature?

III. Results

A. Characteristics of Included Studies

After reviewing studies from the last decade, the number of publications remained limited, with only a few studies until 2018. It was in that year when there was a noticeable surge in interest regarding telemedicine adoption, a trend that continued

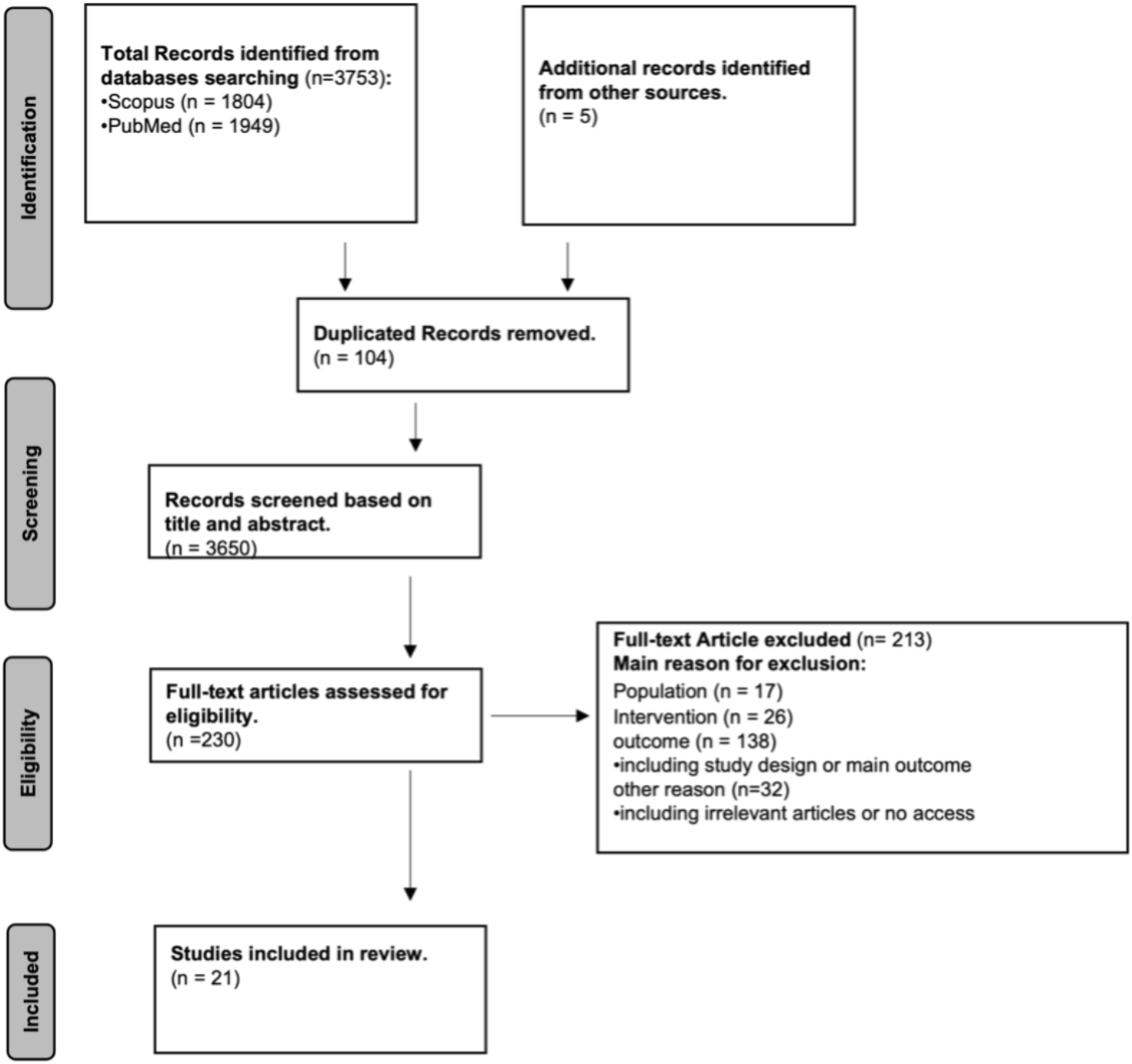

Fig. 1. The PRISMA flow diagram of studies search and selection.

during and beyond the COVID-19 pandemic. Fig. 2 illustrates the growth of publications over the last decade.

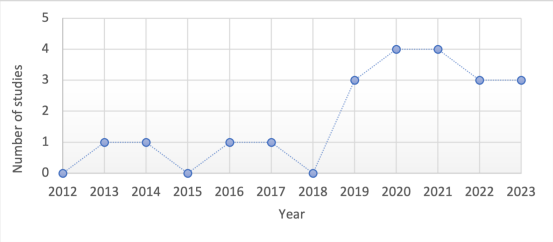

Fig. 2. Number of articles published by year.

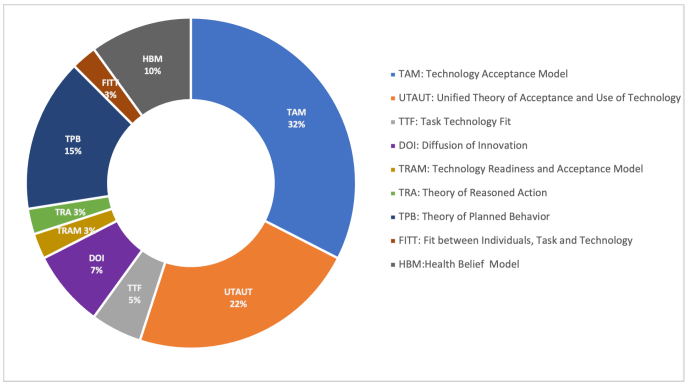

Fig. 3. Frequency of theories and models used to explain the adoption of telemedicine.

As previously mentioned, various frameworks, theoretical models, and their extensions have been developed to comprehend user intentions for adopting ICT, particularly in the context of telemedicine. Among the 21 studies included in the review, TAM and UTAUT with their extension were identified to be the highest models used compared to others. As shown in Fig. 3, the TAM model and its extension were used 13 times, UTAUT was used nine times, TPB six times, HBM four times, DOI three times, and the remaining models were used only once. This diversity of models reflects the complexity of telemedicine adoption process and underscores the importance of a different approach to understanding users' attitude toward this innovation.

The distribution of countries related to the included telemedicine studies varies. Developed countries contributed the most, with 14 studies, in contrast to developing countries, which had 6 studies. The USA had the highest number of studies, with 4, followed by Australia with 3 studies. Each of the following countries Netherlands, Canada, and Germany had 2 studies, while France had only one. In developing countries, China had 2 studies, whereas the remaining countries, including the Philippines, Malaysia, India, and Saudi Arabia, had one study each. This international diversity in research reflects the global significance and varied perspectives on telemedicine adoption especially in the developing countries.

In terms of research design, most of the studies relied on quantitative methodologies. One study employed a mixed-method approach, while 5 studies utilized qualitative research methods, including interviews (4 studies) and focus groups (1 study). There is a round balancing between publications focused on patients (12 studies) and those directed to providers (9 studies), covering a wide array of telemedicine applications. Details of the most important extracted data from these studies are presented in Table IV. For the complete set of extracted data, please refer to Appendix 3.

B. Telemedicine Applications

Telemedicine has a wide range of applications that are transforming the way healthcare services are accessed and delivered worldwide. Remote consultations, telerehabilitation, remote monitoring, mental health services, tele palliative care, teledermoscopy services, and teleneurology are examples of telemedicine applications that were covered and analyzed in the included studies. Among the included studies, a total of 5 studies focused on telemedicine services in general [13], [28]–[31], and the other 5 studies on telemonitoring [32]–[36]. A total of 3 studies were dedicated to remote mental health services - Telepsychotherapy [37]–[39], while 4 studies centered around telerehabilitation [40], [41], and tele palliative care [42], [43], each with 2 studies. The remaining studies were designed for teleneurology [44], teledermoscopy [45], teleconsultations [46], and group-based telemedicine [47], each with one study. Telemedicine is reshaping the landscape of healthcare, with a diverse array of applications that have been examined in recent studies.

Each application of telemedicine has its own factors that may influence its users' intentions, whether for the patient or provider. According to the analysis of the studies [13], [32]–[34], [39], [43], [45], [47], the most important factors shared by most studies of telemedicine applications are perceived usefulness and ease of use, which are key determinants of users' attitudes and behavioral intentions for the TAM model. This indicates that telemedicine applications that are easy to understand and bring desired benefits as needed have a higher chance of influencing user behavior to adopt the applications [13], [28], [35].

Other significant factors repeated in most studies are social influence and facilitating conditions from the UTAUT model. The literature highlighted that social influence is a significant predictor because the opinions of colleagues for providers and family or friends of patients strongly influence user behavior. Additionally, the availability of technological and organizational support shows a positive connection with usefulness and ease to use the technology [48], [49], thus, it has a better chance of influencing user behavior to adopt telemedicine. For an overview of the factors affecting each telemedicine application among healthcare providers and patients, see Appendix 4.

C. Overview of Telemedicine Adoption Factors

Telemedicine adoption is influenced by numerous factors, which are rooted in various theoretical frameworks to adopt the technology. Although some factors are synonyms to each other for example, insecure and perceived risk, it has been classified and counted its frequencies based on the identical general terminology (have the same meaning with different terms). These factors have been categorized into 5 groups, adapted

TABLE IV. MOST IMPORTANT EXTRACTED DATA FOR THE INCLUDED STUDIES

Study	Year	Country	Data collection method	Theory/Model	Constructs
Patient					
[28]	2020	KSA	survey	UTAUT, TTF	Awareness, Self-efficacy, Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition, TTF
[37]	2022	USA	survey	UTAUT, TAM3, TPB	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition, Anxiety, Attitude
[29]	2021	China	survey	-	Trust the sponsor of a healthcare website, Gender, Age, Educational level, City Income level, Consumer type
[45]	2016	Australia	survey	TAM, TRA, DOI, UTAUT	Perceived Usefulness, Ease of Use, Trust, Attitude/intention, Subjective Norm, Compatibility, Facilitator
[40]	2019	Netherlands	interview	UTAU	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition
[30]	2023	India	survey	Push-Pull Mooring(PPM), HBM,UTAUT2	Push Effects (Inconvenience and Perceived Healthcare Risk), Pull Effects (Opportunity for alternatives and Ubiquitous care) , Mooring effects (Trust in telemedicine) , Inertia (Habit, Switching Cost).
[46]	2023	Germany	survey	UTAU, External variables	Performance Expectancy, Effort Expectancy, Social Influence, Computer Proficiency, Knowledge about digital health care solutions (Awareness), Depressive symptoms.
[33]	2023	USA	survey	TAM	Perceived Usefulness, Ease of Use.
[47]	2019	USA	mixed method	TRAM, External variables	Perceived Usefulness, Ease of Use, Innovativeness, Optimism, Discomfort, Insecurity, Group readiness, HIV-related privacy concerns.
[34]	2019	USA	interview	FITT, UTAUT2,TAM, TAM3	Fit between individuals and task: (Motivation/ Engagement, Self-efficacy) Fit between individuals and technology: (Preference for device design, HIV status, Customized alert ,Ease of use) Fit between task and technology: (System functionality, Self-awareness).
[35]	2021	France	survey	UTAUT,HBM, UTAUT2	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition, Perceived risk, Financial cost
[36]	2021	Not mentioned	survey	TAM, TPB, TAM3,HBM	Interpersonal Influence, Personal Innovativeness, Trustworthiness,Attitude ,Self-efficacy, Health Interest ,Perceived Value.
Healthcare Provider					
[32]	2021	Australia	survey	TAM, TPB	Perceived Usefulness, Ease of Use, Attitude.
[39]	2013	Canada	survey	TAM, TPB	Perceived Usefulness, Ease of Use, Attitude.
[38]	2020	Germany	Interview/focus group	DOI, External variables	Perceived benefit, Avaliability of designed room.
[42]	2022	Netherlands	survey	UTAUT,TPB,TAM3,DOI	Outcome expectancy, Effort expectancy, Facilitating Condition,Social Influence, Attitude, Anxiety, Self-efficacy,Personal Innovativeness.
[41]	2020	Australia	interview	TAM,HBM,External variables	Context of use,Perceived Benefits,Technical and connectivity issues Client capability and compatibility,Lack of physical presence,Balancing the service and user needs.
[31]	2017	China	survey	-	Authenticity and reliability of data, Awareness, Previous experience.
[44]	2022	Philippine	survey	UTAUT, TPB	Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Attitude.
[13]	2014	Malaysia	survey	UTAUT, TAM, TPB,TAM3, External variables	Perceived Usefulness, Perceived Ease of Use, Attitude, Self-efficacy, Organizational Culture, Facilitating Conditions.
[43]	2020	Canada	interview	TAM	Perceived Usefulness, Perceived Ease of Use.

from [27], to study the adoption of telemedicine among healthcare providers and patients. These categories include individual factors, organizational factors, technological factors, security factors, and health factors. The following sections will discuss the factors of each category separately. Fig. 4 shows the factors influencing healthcare providers and patients based on the aforementioned classifications. The results show that, individual factors play a vital role in the successful adoption of telemedicine for both providers and patients as it occupied around half of the percentages among other factors. Additionally, technological, and organizational factors are considered more important for providers than patients.

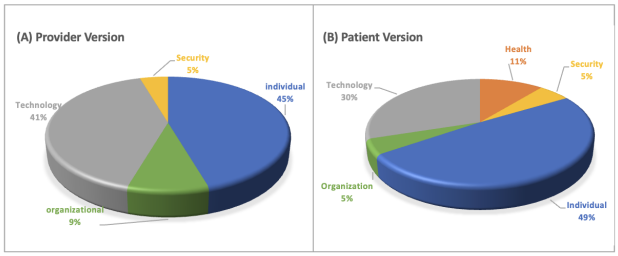

Fig. 4. Classify factors affecting the adoption of telemedicine from **(A)** provider's perspective. **(B)** patient's perspective.

1) Individual Factors: As a definition, individual factors refer to the personal attributes, beliefs, attitudes, and characteristics of an individual that influence their decision to accept, adopt, or resist the use of new technology [50]. Individual factors for telemedicine adoption represented 45% for providers and around half for patients. Fig. 5 summarizes the individual factors and analyzes their frequencies based on the number of using them in the included studies from both providers' and patients' perspectives. The findings of the analysis showed that social influence is the most important factor influencing patients which was repeated 6 times [28], [35], [37], [40], [45], [46]. The second most important factor is attitude, which was repeated 3 times [36], [37], [45], followed by personal innovativeness [36], [47], self-efficacy [34], [36], awareness [28], [46], and habit [30], [40], each of which was repeated 2 times. Furthermore, the remaining set of factors include group readiness [47], optimism [47], motivation, engagement [34], compatibility [45], and other demographic characteristics such as age, gender [29], [35], computer skills, education, and socioeconomic status [29], [34], [46], each of which was mentioned only once. Finally, the lack of control of technology was mentioned in one study as a barrier [47].

Contradictory to that, the most important factor influencing providers is the attitude which was mentioned 5 times [13], [32], [39], [42], [44]. Other important factors were repeated 2 times including social influence [42], [44], self-efficacy [13], [42], and experience [31], [44]. Additionally, personal innovativeness [42], awareness [31], voluntariness [44], and client capabilities [41] factors were mentioned one time for each as a success predictor. However, anxiety [42] and lack of physical presence [41] were reported once for each as barriers.In summary, the analysis of individual factors affecting telemedicine adoption reveals that social influence and attitude are key drivers for patients, while providers are primarily influenced by their attitude.

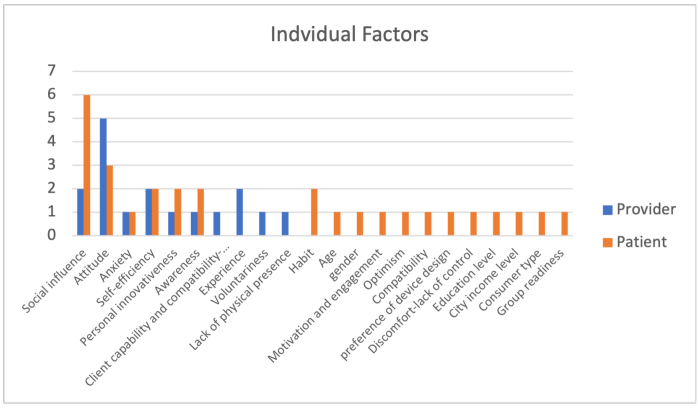

Fig. 5. Individual factors that influence the adoption of telemedicine for providers and patients.

2) Organizational Factors: Organizational factors refer to the various aspects and characteristics within healthcare institutions that influence the overall organization's operations, performance, efficiency, and quality of care provided. These characteristics including as examples infrastructure, resource allocation, and training programs [51].The review showed that the facilitating conditions factor is the significant facilitator for adopting telemedicine where it was repeated in the included studies 3 times for providers [13], [42], [44] and 5 times for patients [28], [35], [37], [40], [45]. Government policy, top management support, project team capacity, and external suppliers' capacity are examples of the facilitators mentioned in the included studies from the providers' perspective whereas technical and connectivity issues were mentioned as barriers for patients.

Another important factor for patients was the type of the hospital which was mentioned once [29]. On the other hand, the organizational culture factor influences providers' intention to adopt telemedicine and it was mentioned once in the included studies [13]. It is noteworthy that, the culture and values within an organization can either facilitate or hinder technology adoption and that rely on reinforcement of the top management of the organization and its policies to the adaptability, change, and support the innovation through the use of technology [13], [52]. Additionally, the findings of one study confirmed that patients tend to trust public hospitals more than private ones, thus affecting their intention to adopt telemedicine services provided by these hospitals [29]. In summary, organizational factors including facilitating conditions, government policy, and organizational culture shape the adoption of telemedicine in healthcare institutions.

3) Technological Factors: The technological factors for telemedicine adoption represented 41% for providers and 30% for patients. It refers to the technological components and considerations in the design, implementation, communication infrastructure, and related technologies that enable the delivery of remote healthcare. As shown in Fig. 6, the most common factors for patients were effort expectancy and performance expectancy [28], [35], [37], [40], [46], which were derived from the UTAUT model. They were mentioned in the included studies 5 times each. Other important factors that influenced the patients were perceived usefulness and ease to use [33],

[45], [47] which stem from the TAM model, and they were repeated 3 times for each. Task technology fit (TTF) and cost were also considered factors for patients which were repeated 2 times each. The remaining set of factors was repeated once in the included studies including perceived benefit [36], availability of the service [30], system functionality [34], customizing the functionality of the device [34], and computer proficiency [46].

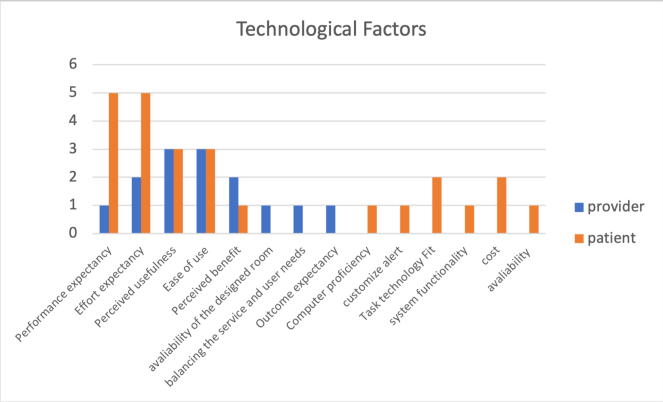

Fig. 6. Technological factors that influence the adoption of telemedicine for providers and patients.

In contrast, the most important factors for providers were perceived usefulness and ease to use which were mentioned 3 times [32], [39], [43]. Indeed, when the providers find telemedicine user-friendly and help them to improve their work with less effort then, they are more likely to integrate telemedicine into their practice and adopt it. Furthermore, other important factors from the providers' perspective were effort expectancy [42], [44] and perceived benefit [38], [41] were mentioned 2 times for each factor. Finally, performance expectancy [44], balancing the service and users' need [41], outcome expectancy [42], and availability of designed room [38] were facilitators that influenced the adoption and they were repeated once for each factor. In discussing the perceived benefits of telemedicine, the literature highlights that it offers a wide range of benefits that positively impact their practice, patient care, and overall healthcare delivery. These benefits contribute to improved efficiency of time and cost, help patients access support, and enhance the quality of care [38], [41], [53]. In summary, the adoption of telemedicine is significantly influenced by various technological factors that differ between providers and patients, with both groups placing a strong emphasis on the ease of use and perceived usefulness.

4) Security Factors: The security factors related to telemedicine adoption represented 5% for each provider and patient. It is defined as the level of protection and assurance that healthcare providers and patients have regarding the confidentiality, integrity, and availability of sensitive information and data transmitted, stored, or accessed during telemedicine interactions [54]. The most important security factor from the providers' perspective is the authenticity and reliability of data from remote patient monitoring, and it serves as a barrier that negatively influences telemedicine adoption [31]. Whereas the patients' behavioral intention was influenced by two factors: perceived trust and perceived risk which were repeated in the included studies four and two times respectively. The perceived trust ranges between privacy [47], trust in general [36], trust in the organization [29] and trust in telemedicine [45]. Moreover, the included studies identify the perceived risk in the context of losing to reach the desired outcome when using technology as it may not work properly [35], [47]. So, all security factors are considered barriers. This is due to the sensitive nature of healthcare data and the potential risks associated with remote communication and data exchange.

5) Health Factors: The factors related to health are likely to influence the behavioral intention of patients just, and it represented 11% among other factors. As it was defined, health factors refer to both the benefits and challenges that telemedicine brings to the healthcare landscape [55]. Health interests, perceived health risks, health conditions, and depressive symptoms are factors identified in the included studies once for each factor. The perceived health risk associated with telemedicine includes risk management, human resource, clinical risk, technology risk, and regulatory issues [30]. With regard to health interests, when individuals have a strong interest in maintaining their health and accessing healthcare services, they are more likely to adopt telemedicine as a convenient and accessible option [36]. Moreover, people with depressive symptoms are more likely to seek for professional treatment as telemedicine gives the option to receive treatment from home thus, adopting and accepting care through telemedicine [46].

IV. Discussion

Studying the behavioral intention of end users to adopt telemedicine has attracted research attention recently. The reasons behind that are the importance of understanding user perspectives, predicting adoption rates, and designing effective strategies to promote telemedicine adoption. By taking users' intentions and preferences into account, healthcare organizations can foster a positive telemedicine experience and maximize the potential benefits of this innovative healthcare delivery method.

The fundamental goal of this review is to summarize the different factors based on various acceptance theories that might influence healthcare providers and patients to adopt telemedicine through different applications. The findings of the review showed that the TAM and UTAUT models are the most important models in adopting and accepting telemedicine. This result is consistent with the study conducted to evaluate the different acceptance models and theories in the healthcare sector [56]. From a user-centered perspective, it has been noticed that the UTAUT model was used more frequently by patients than by providers to explain telemedicine acceptance. This is due to its inclusion of variables associated with social influence, which is likely to be more important for patients than for providers. In contrast, the TAM model was used for investigating the acceptance of providers more than for patients. As it was mentioned earlier, the functional characteristics of the technology to be free of effort and compatible with the desired need are good determinants for adopting telemedicine by users.

Furthermore, it has been found that some studies use a single theoretical model [33], [40], [43], while others use more than one model [13], [28], [32], [34]–[37], [42], [44],

[45]. Although the TAM and UTAUT are the based models in most literature as it was mentioned above, other factors from different models were integrated with them to represent the acceptance in different contexts. TRA, TPB, DOI, HBM, and TTF are the models that were integrated parts of their predictors with the based model. According to Barrettee, it is useful to combine more than one model as each model focuses on different aspects of technology adoption, such as individual perceptions, organizational factors, or external influences. By combining multiple models, researchers can obtain a holistic view of the adoption process, considering various factors that may influence technology acceptance [57].

Another important factor integrated with the base model in 4 studies is perceived trust [29], [30], [36], [45]. It was observed to be essential for patients to accept modern healthcare delivery. Accordingly, healthcare organizations and telemedicine providers must proactively address trust-related concerns and demonstrate a commitment to maintaining the highest standards of security, privacy, and quality care delivery. Building and maintaining trust in telemedicine services are key to establishing a sustainable and patient-centric approach to modern healthcare delivery. One of the most important factors added to the base model in 8 studies [13], [32], [36], [37], [39], [42], [44], [45] is attitude from TPB model. The TPB model suggests that an individual's attitude toward a specific behavior strongly influences their intention to perform that behavior [19]. This implies that a positive attitude toward using telemedicine services is likely to promote its adoption among healthcare providers and patients. So, if individuals believe that telemedicine is eased to use and offers tangible benefits, such as convenience, improved access to care, improve work efficiency, and time savings, they are more likely to have a positive attitude toward its adoption [13], [32].

Additionally, the findings revealed that self-efficacy significantly influences adoption. It refers to an individual's belief in their ability to use technology effectively [36]. As stated by Bandura in his social cognitive theory [58], individuals' behaviors are influenced by their own capabilities to perform a particular task. So, patients with high self-efficacy are more likely to actively engage and accept telemedicine to receive healthcare. Besides that, self-efficacy can influence the healthcare providers' willingness to adopt and integrate telemedicine into their practice, where high self- efficacy makes them feel more confident in their ability to use virtual communication tools, maintain patient engagement, and conduct remote consultations and treatment effectively [42], [59].

The review also explored different key factors that were extensively employed in the included literature with the base models to understand the acceptance including awareness, innovativeness, and habit. According to Chen et al. [31] , users with positive attitudes toward telemedicine reflect their great awareness of service benefits. Consequently, there is a direct relationship between users' awareness and their attitude, and thus their intention toward adopting telemedicine. Moreover, it is has found that innovativeness as a perceived advantage makes healthcare more accessible and efficient for a broader population [42], [47]. As a result, it improves the quality of healthcare delivery and maximizes patient engagement then its adoption. Regarding habit, authors in [30], and [40] indicate that building positive habits around telemedicine usage is crucial for its widespread adoption and long-term success. Consequently, telemedicine can become an established and habitual part of modern healthcare practices by addressing any barriers related to usability, trust, convenience, and positive outcomes.

A. Limitations and Future Research

The review has a few limitations, which gives an opportunity for further research. First, this review used only two databases for retrieving relevant studies. Including more databases could lead to richer results. Additionally, language bias could affect the results, papers not published in English or Arabic language were excluded. Third, the focus of the population in the included studies is for patients and healthcare providers including physicians and nurses. Future studies are encouraged to encompass different sets of the individual such as administrators, and health professionals as it may lead to in-depth knowledge and a full picture of the adoption process.

V. Conclusion

Telemedicine is an evolving field of healthcare that has revolutionized the way patients receive medical attention remotely. This systematic literature review identified the theoretical constructs associated with end-user adoption and acceptance of telemedicine. When reviewing included studies, it is obvious that TAM and UTAUT are the most widely technology acceptance models applied to the telemedicine context. Additionally, the constructs of TAM and UTAUT models were the most deployed factors to evaluate the acceptance and adoption of telemedicine. Adding to that other factors were integrated with the previous constructs including, attitude, self-efficacy, perceived trust, innovativeness, and habit.

Existing studies include various applications of telemedicine. Teleconsultations, telerehabilitation, telemonitoring, telepsychotherapy, tele palliative care, teledermoscopy services, and teleneurology are some examples of applications that are covered in this review. While some factors apply to all applications of telemedicine, others are validated to specific applications. Therefore, understanding the nuanced factors that impact the success of telemedicine in diverse healthcare contexts is crucial for optimizing patient care and healthcare delivery.

The review provided a classification analysis of the factors that influence telemedicine adoption among healthcare providers and patients. These categories include individual, organizational, technological, security, and health factors. In general, it has been noticed that individual factors occupied the largest percentage among other factors for both providers and patients. Social influence and attitude are the most significant factors at the individual level. At the organizational level, facilitating conditions is an essential factor for telemedicine adoption by both parties' providers and patients. Furthermore, perceived usefulness, ease of use, effort expectancy, and performance expectancy are important influencers at the technological level. Besides that, perceived trust was found to be a significant factor at the security level. Finally, at the health level, health interests, perceived health risks, health conditions, and depressive symptoms were identified to influence the patients' intention to adopt telemedicine.

The results of this review can provide insights to policymakers and healthcare organizations on the factors that influence end-user behavioral intention to adopt the modern healthcare delivery method. Understanding these factors is pivotal in crafting effective strategies for the widespread implementation of telemedicine. Moreover, recognizing the unique individual characteristics of end-users, such as their technological proficiency, awareness, and subjective norms, is essential. Tailoring telemedicine initiatives to meet the specific needs of diverse patient populations can significantly enhance the acceptance and utilization of this innovative approach to healthcare delivery. By acknowledging and accommodating these individual differences, healthcare systems can maximize the potential benefits of telemedicine, leading to improved patient outcomes and more efficient healthcare services.

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Appendices

Appendix 1: Database Search String

Search String (Scopus):

1.Population	patient* OR provider* OR doctor* OR physician OR nurse* OR HCP	11,296,563
	AND	
2.Intervention	Telemedicine OR "Remote Consultation" OR "virtual clinic" OR virtual-clinic OR "tele medicine" OR tele-medicine OR telehealth OR tele-health OR "mobile health" OR mHealth OR m-health OR eHealth OR e-health OR "remote consultation*" OR teleconsultation* OR tele-consultation* OR "tele consultation*" OR "video consultation*" OR "virtual consultation"* OR televisit* OR tele-visit* OR "tele visit*" OR eVisit* OR e-visit* OR "video visit*" OR "remote visit*" OR "virtual visit*" OR "video encounter*" OR "remote encounter*" OR "virtual encounter*" OR telediagnos* OR "tele-diagnos*" OR "tele diagnos*" OR "remote diagnos*" OR "virtual diagnos*" OR "video diagnos*" OR videoconferenc* OR "video conferenc*" OR "real-time video" OR "synchronous video"	7315
	AND	
3.Outcome	factor* OR influence OR determin* OR predict* OR "acceptance model" OR accept* OR satisfaction OR adopt* OR "adopt* model" OR "information system success model" OR theory OR theories OR framework* OR "behavioral intention" OR "intention to use"	31,302,427
Result	1 AND 2 AND 3	1804

Search String (PubMed):

1.Population	patient* OR provider* OR doctor* OR physician OR nurse* OR HCP	162,264
	AND	
2.Intervention	Telemedicine OR "Remote Consultation" OR "virtual clinic" OR virtual-clinic OR "tele medicine" OR tele-medicine OR telehealth OR tele-health OR "mobile health" OR mHealth OR m-health OR eHealth OR e-health OR "remote consultation*" OR teleconsultation* OR tele-consultation* OR "tele consultation*" OR "video consultation*" OR "virtual consultation"* OR televisit* OR tele-visit* OR "tele visit*" OR eVisit* OR e-visit* OR "video visit*" OR "remote visit*" OR "virtual visit*" OR "video encounter*" OR "remote encounter*" OR "virtual encounter*" OR telediagnos* OR "tele-diagnos*" OR "tele diagnos*" OR "remote diagnos*" OR "virtual diagnos*" OR "video diagnos*" OR videoconferenc* OR "video conferenc*" OR "real-time video" OR "synchronous video"	4,438
	AND	
3.Outcome	factor* OR influence OR determin* OR predict* OR "acceptance model" OR accept* OR satisfaction OR adopt* OR "adopt* model" OR "information system success model" OR theory OR theories OR framework* OR "behavioral intention" OR "intention to use"	139,233
Result	1 AND 2 AND 3	1949

Selected free full text, Books and Documents, Classical Article, Clinical Study, Controlled Clinical Trial, Corrected and Republished Article, Humans, Arabic, English.

Appendix 2: Quality Assessment Result

Quality assessment scores for included review studies.

Study ID	Q1	Q2	Q3	Q4	Q5	Score
1	1	1	1	1	1	5
2	1	1	1	1	1	5
3	1	0	1	1	1	4
4	1	1	1	1	1	5
5	1	1	1	1	1	5
6	0.5	1	1	1	1	4.5
7	1	0.5	1	1	1	4.5
8	1	1	1	1	1	5
9	1	1	1	1	1	5
10	1	1	1	1	1	5
11	1	1	1	1	1	5
12	1	1	1	1	1	5
13	0.5	1	1	1	1	4.5
14	1	0	1	1	1	4
15	1	1	1	1	1	5
16	1	1	1	1	1	5
17	0.5	1	1	1	1	4.5
18	1	1	1	1	1	5
19	1	1	1	1	1	5
20	0.5	1	1	1	1	4.5
21	0.5	1	1	1	1	4.5

Appendix 3: Complete form of the Extracted Data.

Study ID	Title	Author	year	Journal	country	Telemedicine application	Theory/model	Data Collection Design	Population		Telemedicine application	component of the theory/model	moderator components	statistical analysis
									NO. of sampling	Focus				
1	Adoption of telemedicine applications among Saudi citizens during COVID-19 pandemic: An alternative health delivery system	Yamin M, Alyoubi B	2020	Journal of Infection and Public Health	KSA	Telemedicine based wireless sensor network applications	UTAUT TTF	survey	348	patient	telemedicine covid-19	awareness self-efficacy UTAUT TTF awareness self-efficacy	non	structural equation modeling
2	Assessing patients' attitudes towards telepsychotherapy: The development of the unified theory of acceptance and use of technology-patient version	Békés V., Doorn K.A.-V., Bõthe B.	2022	Clinical Psychology and Psychotherapy	USA	telepsychotherapy	UTAUT	survey	107	patient	telepsychotherapy covid-19	Performance Expectancy Effort Expectancy Social Influence Facilitating Condition Anxiety Attitudes	non	Construct validity was assessed using exploratory factor analysis (EFA) in SPSS and confirmatory factor analysis (CFA) in Mplus 8.7. Reliability was assessed using two indicators (i.e., Cronbach's alpha and McDonald's) as using only Cronbach's alpha coefficients
3	Chinese patients' intention to use different types of internet hospitals: Cross-sectional study on virtual visits	Liu L., Shi L.	2021	Journal of Medical Internet Research	China	internet hospital	_	survey	1653	patient	telemedicine covid-19	_	non	logistic regression
4	Consumer acceptance of patient-performed mobile teledermoscopy for the early detection of melanoma	Horsham C., Loescher L.J., Whiteman D.C., Soyer H.P., Janda M.	2016	British Journal of Dermatology	Australia	teledermoscopy	TAM	survey	228	patient	teledermoscopy teledermoscopy for the early detection of melanoma	perceived usefulness ease of use trust attitude/intention subjective norms compatibility facilitators	non	not mentioned
5	Disparity in cancer survivorship care: A cross-sectional study of telehealth use among cancer nurses in Australia	Brunelli V.N., Fox J.A., Langbecker D.H.	2021	Collegian	Australia	telemedicine	TAM	survey	79	provider provider - nurse	telemonitoring cancer survivorship	perceived usefulness ease of use Attitude intention to use	non	logistic regression.
6	Electronic Health Program to Empower Patients in Returning to Normal Activities After Colorectal Surgical Procedures: Mixed-Methods Process Evaluation Alongside a Randomized Controlled Trial	den Bakker CM, Huirne JA, Schaafsma FG, de Geus C, Bonjer HJ, Anema JR.	2019	J Med Internet Res	Netherlands	using the "ikherstel" program	UTAUT	interview	14	patient	rehabilitation Empower Patients After Colorectal Surgery	Performance expectancy Effort expectancy Social influence Facilitating and inhibiting conditions	gender age experience voluntariness of use	_
7	Exploring the switching intention of patients to e-health consultations platforms: blending inertia with push–pull–mooring framework	Dogra N., Bakshi S., Gupta A.	2023	Journal of Asia Business Studies	India	telemedicine	push–pull–mooring (PPM) framework.	survey	413	patient	telemedicine	push effects (inconvenience and perceived risk) pull effects (opportunity for alternatives and ubiquitous care) mooring effects (trust) inertia (habit, switching cost)	non	structural equation modeling
8	Factors influencing mental health providers' intention to use telepsychotherapy in First Nations communities	Monthuy-Blanc J., Bouchard S., Maïano C., Séguin M.	2013	Transcultural Psychiatry	Canada	telepsychotherapy	TAM	survey	205	provider	telepsychotherapy mental health in First Nations communities	perceived usefulness ease of use	non	structural equation modeling
9	Intent to adopt video-based integrated mental health care and the characteristics of its supporters: Mixed methods study among general practitioners applying diffusion of innovations theory	Haun M.W., Stephan I., Wensing M., Hartmann M., Hoffmann M., Friederich H.-C.	2020	JMIR Mental Health	Germany	mental health specialist video consultations (MHSVC)	DOI Diffusion of Innovations Theory	focus group, interview	6	provider	telepsychotherapy mental health	perceived benefit availability	non	
10	Intention of healthcare providers to use video-communication in terminal care: a cross-sectional study	Evering RPostel Mvan Os-Medendorp H et al	2022	BMC Palliative Care	Netherlands	telemedicine	UTAUT DOI	survey	90	provider	app in palliative care terminal care	Outcome expectancy Effort expectancy Attitude Social influence Facilitating conditions Anxiety Self-efficacy Personal innovativeness	non	A multiple linear regression
11	Perceived Usability and Acceptability of Videoconferencing for Delivering Community-Based Rehabilitation to Individuals with Acquired Brain Injury: A Qualitative Investigation	Ownsworth T., Theodoros D., Cahill L., Vaezipour A., Quinn R., Kendall M., Moyle W., Lucas K.	2020	Journal of the International Neuropsychological Society	Australia	videoconferencing (VC)	TAM	interview	30	patient provider	rehabilitation for people with acquired brain injury (ABI)	the context or impetus for use perceived benefits potential problems and parameters around use balancing the service and user needs	non	Thematic analysis
12	Predictors of patients' acceptance of video consultation in general practice during the coronavirus disease 2019 pandemic applying the unified theory of acceptance and use of technology model	Esber A., Teufel M., Jahre L., in der Schmitten J., Skoda E.-M., Bäuerle A.	2023	Digital Health	Germany	telemedicine	UTAUT	survey	371	patient	teleconsultation covid-19	performance expectancy effort expectancy social influence computer proficiency	non	A hierarchical regression
13	Taking a Load Off: User Perceptions of Smart Offloading Walkers for Diabetic Foot Ulcers Using the Technology Acceptance Model	Finco MG, Cay G, Lee M, Garcia J, Salazar E, Tan TW, Armstrong DG, Najafi B.	2023	Sensors (Basel)	USA	Perceptions of Smart Offloading Walkers in adherence	TAM	survey	21	patient	telemonitoring Diabetic Foot Ulcers	perceived usefulness ease of use	non	Chi-squared tests
14	Telehealth attitudes and use among medical professionals, medical students, and patients in China: A cross-sectional survey	Chen P., Xiao L., Gou Z., Xiang L., Zhang X., Feng P.	2017	International Journal of Medical Informatics	China	telemedicine	not theory	survey	550	provider patient medical student	telemedicine general	advantage concern awareness usage	non	Structural equation modeling
15	The practice of teleneurology in the Philippines during the COVID-19 pandemic	Pagaling G.T., Espiritu A.I., Dellosa M.A.A., Leochico C.F.D., Pasco P.M.D.	2022	Neurological Sciences	Philippine	telemedicine	UTAUT	survey	147	provider	teleneurology	performance expectancy effort expectancy social influence facilitating conditions attitude behavioral intention	Experience Voluntariness	logistic regression analysis
16	Understanding Women's Willingness to Use e-Health for HIV-Related Services: A Novel Application of the Technology Readiness and Acceptance Model to a Highly Stigmatized Medical Condition	Marhefka S.L., Turner D., Lockhart E.	2019	Telemedicine and e-Health	USA	telemedicine	TRAM	mixed method	91	patient	Group-based telemedicine technology based group program of WLH	Innovativeness Optimism Discomfort Insecurity Perceived Usefulness Ease-of-Use group readiness HIV-related privacy concerns	_	logistic regression analysis
17	Use of the FITT framework to understand patients' experiences using a real-time medication monitoring pill bottle linked to a mobile-based HIV self-management app: A qualitative study	Cho H, Flynn G, Saylor M, Gradilla M, Schnall R.	2019	Int J Med Inform	USA	telemedicine- monitoring	FITT	interview	38	patient	telemonitoring improving medication adherence	fit between individuals and task: _motivation _self-efficacy _engagement fit between individuals and technology _preference for device design _HIV status _customized alert _ease of use fit between task and technology _system functionality _self-awareness	_	thematic analysis
18	Determinants of Telemedicine Acceptance in Selected Public Hospitals in Malaysia: Clinical Perspective	Zailani SGiiani MNikbin D et al.	2014	Journal of Medical Systems	Malaysia	telemedicine	extended TAM	survey	117	provider	telemedicine acceptance	government policy external suppliers' capacity project team's capacity top management support perceived usefulness perceived ease of use attitude self-efficiency	age job title job tenure	
19	Using the technology acceptance model to explore health provider and administrator perceptions of the usefulness and ease of using technology in palliative care	Nguyen MFujioka JWentlandt K et al	2020	Neurological Sciences	Canada	telemedicine	TAM	interview	18	provider	app in palliative care	perceived usefulness _ emote connection _ information-sharing platform ease of use _integration with existing IT systems _ user- friendly		
20	Understanding acceptance of eHealthcare by IoT natives and IoT immigrants: An integrated model of UTAUT, perceived risk, and financial cost	Ben Arfi WBen Nasr KKhatoova T et al	2021	Technological Forecasting and Social Change	France		UTAUT	survey	268	patient	telemonitoring IoT-based healthcare devices	performance expectancy effort expectancy social influence facilitating conditions perceived risk financial cost	age gender	Structural equation modeling
21	Factors influencing adoption model of continuous glucose monitoring devices for internet of things healthcare	Hossain MYusof AHussin A et al.	2021	Internet of Things (Netherlands)	not mentioned	telemedicine	TAM TRA TPB SE (Self-efficacy Theory)	survey	97	patient	telemonitoring Glucose Monitoring	Interpersonal Influence Personal Innovativeness Trustworthiness Attitude Toward a Wearable Device Self-Efficacy Health Interest Perceived Value	_	Partial least square and structural equation modelling

Appendix 4: List of the Factors Affecting Patients and Healthcare Providers in Different Telemedicine Applications.

Context of telemedicine	Focus		Factors					Frequency
			Individual	*Organizational and Environmental*	*Health*	*Technological*	*Security*	
Telerehabilitation	Provider (Ownsworth et al., 2020)	√	• Client capability and compatibility • Lack of physical presence	-	-	• Perceived benefit • Balancing the service and user needs. • The context for use • Technical and connectivity issues	-	
	Patient (den Bakker et al., 2019)	√	• Social Influence • Habit	• Facilitating Condition	-	• Performance Expectancy • Effort Expectancy	-	
Telemonitoring	Provider (Brunelli et al., 2021)	√	• Attitude	-	-	• Perceived usefulness • Ease to use	-	
	Patient (Hossain et al., 2021) (Finco et al., 2023) (Cho et al., 2019) (Ben Arfi et al., 2021)	√	• Motivation and engagement • Self-efficacy • Social Influence • Attitude • Personal innovativeness • Self-awareness • Age • Gender • Preference of device design	• Facilitating Condition • Financial cost	• Health condition statues (HIV) • Health interest • Perceived healthcare risk	• Perceived usefulness • Ease to use • Performance Expectancy • Effort Expectancy • System functionality • Perceived value • Customize alert	• Trust	ease to use (2) self-efficacy (2) Social Influence (2)
Telehealth applications in palliative care	Provider (Nguyen et al., 2020) (Evering et al., 2022)	√	• Social Influence • Attitude • Anxiety • Self-efficacy • Personal innovativeness	• Facilitating Condition	-	• Outcome expectancy • Effort Expectancy	-	
	patient	X	-	-	-	-	-	
Telepsychotherapy	Provider (Haun et al., 2020) (Monthuy-Blanc et al., 2013)	√	• Attitude	-	-	• Perceived usefulness • Ease to use • Availability of designed room. • Perceived benefit	-	
	Patient (Békés et al., 2022)	√	• Social Influence • Anxiety • Attitude	• Facilitating Condition	-	• Performance Expectancy • Effort Expectancy	-	
Teleneurology	Provider	√	• Social Influence	• Facilitating Condition	-	• Performance Expectancy	-	
	(Pagaling et al., 2022)		• Attitude • Experience • Voluntariness			• Effort Expectancy		
	patient	X	-	-	-	-	-	
Teledermoscopy	provider	X	-	-	-	-	-	
	Patient (Horsham et al., 2016)	√	• Subjective norms • Attitude • Compatibility	• Facilitating Condition		• Perceived usefulness • Ease to use	• Trust	
Teleconsultation	provider	X	-	-	-	-	-	
	Patient (Esber et al., 2023)	√	• Social Influence • Knowledge about digital health care solutions	-	• Depressive symptoms	• Performance Expectancy • Effort Expectancy • Computer proficiency	-	
Group-based telemedicine	provider	X	-	-	-	-	-	
	Patient (Marhefka et al., 2019)	√	• Optimism • Innovativeness • Discomfort • Group readiness	-	-	• Perceived usefulness • Ease to use	• Privacy • Insecurity	
Telemedicine	Provider (Chen et al., 2017) (Zailani et al., 2014)	√	• Attitude • Self-efficiency • Awareness • Previous experience	• Government policies • Top management support • Project team capacity • External suppliers' capacity • Health culture	-	• Perceived usefulness • Ease to use	• Authenticity and reliability of data from remote monitoring of patients	ease to use (2) perceived usefulness (2)
	Patient (Yamin & Alyoubi, 2020) (Liu & Shi, 2021) (Dogra et al., 2023)	√	• Social Influence • Awareness • Habit • Inconvenience • Age • Gender • Education level • City income level • Consumer type • Self-efficiency •	• Facilitating Condition • Cost	• Perceived healthcare risk • Hospital type	• Performance Expectancy • Effort Expectancy • Task technology fit • Ubiquitous care • Perceived benefit	• Trust in organization • Trust in telemedicine	