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ORIGINAL RESEARCH

Trust: How It Affects the Use of Telemedicine in Improving Access to Assistive Technology to Enhance Healthcare Services

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Background: Modern telemedicine (TM) technologies play a crucial role in enhancing access to Assistive Technology in healthcare services. However, the full benefits of this technology will not be realized unless it is widely accepted among service users (patients). This study aimed to investigate the impact of patient trust and perceived risk on the acceptance of TM for Assistive Technology in healthcare.

Materials and Methods: A comprehensive survey instrument was developed and refined through expert feedback and a pilot study, leading to data collection from 917 participants. The theoretical framework guiding this research was based on the Trust factors in TM, which helped in conceptualizing the factors influencing patient acceptance of TM.

Results: The study revealed a significant gap in patient trust in TM and highlighted the multifaceted nature of perceived risk, emphasizing the need to consider individual risk factors separately. Results also indicated that trust in technological reliability and the perceived effectiveness of TM were critical factors influencing its adoption. The findings underscore the importance of building trust among service users and promoting the reliability of TM for achieving desirable medical outcomes.

Conclusion: In conclusion, to facilitate widespread acceptance of TM for Assistive Technology, a multi-faceted approach involving healthcare providers, organizations, and governments is essential to address patient concerns, enhance trust, and promote the benefits of this technology.

Keywords: trust, risk, telemedicine, TM, technology adoption, patient, behaviour

Introduction

In recent decades, a number of factors, such as ageing national populations and rising costs, have combined with increasingly limited resources to make adequate healthcare provision difficult to achieve without the introduction of new, more efficient, healthcare solutions.[1,2] However, advances in digital technology can play a key role in addressing this challenge. One example of how digital technology can enhance healthcare provision is in the area of telemedicine (TM),[3,4] a growing technology which has the potential to enable high-quality, high-efficiency and convenient healthcare provision over wide areas.[2] While TM has applications in several health-related fields, it has particularly high potential for improving access to assistive technology. Defined as the implementation of information and communication technologies (ICTs) to deliver healthcare services, TM is already proving to be a valuable tool for improving access to assistive technology, especially in countries which have a high proportion of citizens.[5]

However, despite its recognized potential, and increasing use in improving access to assistive technology, TM has not yet achieved mass adoption.[4,6] A full understanding of the reasons for this will play a key role in driving acceptance forward. However, this requires further research. While previous studies in technology acceptance has provided some significant insights, such as the relationship between perceived benefits and technology adoption,[6] the healthcare context has some key differences from the general technology environment. In particular, Intention to Use (ITU) in a healthcare

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context depends not only on utilitarian factors such as perceived usefulness and perceived benefits, but also on a range of psychological factors, such trust and risk.[7,8]

In the general world of health provision, the role of trust and perceived risk has been shown, by various studies, to be important in the acceptance of technological processes and interventions e.g.[9,10] Other research has also shown that these factors (trust and risk) are multidimensional. The effect of trust, for example, on ITU, can be broken down to a number of sub-factors, such as trust in medical practitioners or trust in online information e.g.[11,12] In a similar way, risk can also be considered to be multidimensional.[13,14] The risk of compromised private information has been found to be of particular significance as a barrier to technology acceptance.[7,8]

Despite these valuable advances in understanding technology acceptance in the general healthcare context, however, the acceptance of TM remains a unique situation. The reason for this is that, with TM, the patient is not only required to accept technology, but to accept a shift in the patient-practitioner relationship.[15,16] With TM, the patient-practitioner relationship is re-framed in a digital context, which separates the issue of acceptance from the overarching healthcare context.

It should be noted that there have been a number of studies on the role of trust and risk in TM acceptance. However, these studies have generally treated both factors (risk and trust) as single, holistic constructs, as opposed to multi-part, constructs e.g.[17,18] Further, these studies have rarely factored-in the issue of trust and its effects. While some research has found that the perceived risk to personal privacy can (negatively) affect trust,[19] the extent to which the replacement of personal interaction (patient-practitioner) with a technological process can create further negative consequences remains unclear.[20] To drive acceptance of TM, particularly as assistive technology, it is important to understand the effects of multiple patient concerns, including the fear that TM will not deliver a satisfactory medical outcome, concerns about (mis)use of personal data, anxieties about wasting time and psychological stress.[13,14] Considered collectively, these issues mean that there is a significant gap in two main aspects of TM research with respect to assistive technology: (1) patient trust in TM, and (2) how various risk factors interact to affect TM adoption.

Another factor which can affect the relationship between perceived trust and perceived risk, and therefore the readiness to adopt TM, is the service user's background and personal context.[20,21] Although some previous studies have specified a service user's illness/symptom, none have attempted to account for the effect of aspects of their background or social/educational context, such as (ie gender, nationalities and language). Any dependency of the relationship between the various trust and risk factors on the service user's native language is currently unexplored. It is important to understand any such dependency more fully, if TM is to be more effectively used to facilitate access to assistive technology. These considerations lead to the research question (RQ):

RQ1: How do perceived trust and risk factors affect the intention to use TM for accessing assistive technology among service users?

The paper is organized in a structured manner. Section 2 offers a thorough review related to the development of the theoretical framework and hypotheses. Subsequently, an outline of the research methodology is presented in Section 3, followed by the presentation of results in Section 4, and an in-depth discussion in Section 5. Finally, the study's conclusions are summarized in Section 6, highlighting the significant findings and limitations and future research.

Theoretical Framework and Hypothesis Development

Trust Factors in TM

Although trust is a widely-applied concept across many disciplines, it lacks a universally agreed definition for academic and research purposes.[22,23] In the overall technology field, the concept is generally accepted as referring to a subject's belief that a specific trust factor has the ability to deliver a desired outcome.[22,23] In the TM field, and specifically in the context of improving access to assistive technology, there are three trust factors: medical practitioner, technological reliability and therapeutic solutions.[24]

Medical Practitioner

The focus of the current study is the provision of access to assistive technology solutions via TM. This process usually begins with an initial consultation with a medical practitioner, which is then transitioned to a TM setting. Trust in the practitioner reflects the service user's belief that the professional concerned has the desire and the competence to act in the service user's best interests.[25,26] As the relationship between the practitioner and the service user is key to gaining the service user's confidence in the TM process, trust in the practitioner is critical to ITU.[15] The service user's trust in the practitioner's competence and readiness to act their best interest can help minimize or eliminate doubts concerning the use of impersonal solutions, and increase the willingness to use TM. This is consistent with other studies that have found a positive association between trust in practitioner and ITU in a TM context.[27,28] The study therefore proposes:

Hypothesis 1: Trust in medical practitioner is positively related to ITU.

Technological Reliability

For the purposes of this study, the term "technological reliability" denotes the specific form of technology used to facilitate interaction between the service user (patient) and the service provider (medical institution). This could be, for example, an online video platform, or voice messaging. In alignment with the practitioner trust factor, trust in Technological Reliability is defined as the belief (by the service user) that the technology solution deployed can be relied upon to provide a therapeutic solution (in this case, assistive technology) appropriate to the service user's needs.[29,30] Functionality defines the capability of the TM platform to fulfil its purpose of providing medical care to patients. A service user's impression of a TM solution, has a strong influence on ITU. This impression is formed by a variety of factors, such as image stability and sound quality.[29,30] A favorable impression plays an important role in building trust in the service user, which, in turn, affects ITU e.g.[27,28] Therefore, strong patients' beliefs that a technology will accomplish functionally and reliably through a healthcare provision rise the likelihood of patients' willingness to use TM. The study therefore proposes:

Hypothesis 2: Trust in technological reliability is positively related to ITU.

Therapeutic Solutions

The third trust factor, "Therapeutic Solution", is the ultimate objective of the TM process. Trust in the therapeutic solution derives from the service user's belief in its efficacy and appropriateness, together with trust in the other factors.[16] The associations between these trust factors will be discussed in terms of the trust framework, as described by Stewart.[31] Trust in therapeutic solutions is critical to ITU in a TM context. This is because the Therapeutic Solution represents the service user's medical goal, and is therefore the basic rationale for using TM.[16,28] The logic of this argument implies that a belief in the efficacy and appropriateness will result in positivity towards TM and, consequently, a positive ITU toward the TM strategy. The study therefore proposes:

Hypothesis 3: Trust in therapeutic solutions is positively related to ITU.

Factors of Perceived Risk in TM

The perception of risk is a fundamental and critical component of ITU, and therefore represents a major barrier to adoption.[19] In the context of healthcare, risk can be considered to consist of two basic aspects: (a) level of uncertainty, and (b) perceived severity of consequence.[13,14] It is natural in any context that most individuals will modulate behaviors according to perceived risk, but this is particularly true in the healthcare environment, where such risks can significantly, and negatively, affect present and future health.[27,28] The research model of this study proposes that there are four different risk factors which affect ITU (medical outcomes, personal privacy, time requirement, stress), and the following section looks in more detail at the definition of each factor, how they negatively affect ITU.

Medical Outcomes

In the context of this study, medical outcomes risk refers to the perceived likelihood that the TM process will fail to deliver the desired health benefits to the service user.[32,33] As the TM process is inherently more impersonal than orthodox processes,[27,28] its use can cause service user concerns that diagnosis and subsequent therapies (application of assistive technology) will not be either appropriate or effective.[34–38] This is a key issue, as most individuals place high importance on physical and mental health, so the consequences of therapeutic failure would be perceived as severe.[16] As people tend to reduce risks with severe consequences through the use of avoidance behavior,[32] they are likely to have low ITU. This negative relationship between medical outcome risk and ITU, in a TM context, is supported by research,[27,28] and it has also been shown, by several studies, to be valid in other digital health contexts e.g.[32,37,38] This study therefore proposes:

Hypothesis 4: Medical outcome risk is negatively related to ITU.

Personal Privacy

It is inherent to any healthcare provision process that the service user shares their personal, and often sensitive, information with medical practitioners.[27,28,39] This exposes the service user to the risk of compromised privacy.[27,28,39] This (loss of control of private and sensitive information) can occur in a number of ways, ranging from errors or carelessness to data leaks and hacking.[14] While the level of risk associated with personal privacy varies with the specifics of the situation,[8] it is always viewed as a serious issue in a medical context.[7] However, in a TM context, the perception of risk is exacerbated further, as service users often feel uncomfortable in sharing sensitive information through the mechanism of an impersonal (TM) platform.[27,28,39] Much of the concern in service users stems from the often-severe consequences of information abuse, which can range from social stigma to loss of employment.[34,35] These concerns significantly affect the service user's readiness to engage with TM,[27,28,39] a finding which is reflected in research related to other health provision contexts e.g.[9,11,12] This study therefore proposes:

Hypothesis 5: Personal privacy risk is negatively related to ITU.

Time Requirement

In both principle and practice, the use of TM is a time-efficient process for most service users.[29,30] Many, however, do not (initially) perceive TM in this way, and have concerns that they may need to spend significant time in familiarizing themselves with the TM platform, or that the TM process merely adds complexity and administration requirements to the conventional process of consultation with a medical practitioner.[11,13,14] This apprehension is rooted in the belief that one must overcome a learning curve to become adept at navigating TM systems. Additionally, there is a concern that TM could introduce additional layers of complexity and administrative tasks, potentially complicating what would otherwise be a straightforward consultation with a healthcare professional. As such, while TM is designed to enhance efficiency, its initial perception is marred by the misconception that its integration into routine medical practice might be more time-consuming than beneficial. This study therefore proposes:

Hypothesis 6: Time requirement risk is negatively related to ITU.

Stress

Another important risk factor is stress,[13] which is defined, for the purposes of this paper, as the extent to which a service user experiences emotional anxiety or stress, when engaging with TM.[9,12,13] This stress can manifest in various forms; users may experience frustration if they find the TM platform's interface non-intuitive or challenging to navigate. Such technological barriers can lead to a sense of helplessness, especially when faced with the need for immediate medical assistance or guidance. Furthermore, the impersonal nature of interacting with technology, as opposed to the human warmth felt during face-to-face interactions with medical practitioners, can intensify a patient's perception that their unique health concerns are not being fully understood or addressed. For those with limited digital literacy or no prior exposure to such technology, the transition to TM can be particularly daunting, potentially exacerbating their stress levels.[9,12,13] The apprehension about engaging with a seemingly cold and detached system, coupled with the anxiety of learning new technology, underscores stress as a significant risk factor in the patient's acceptance and effective use of TM services. This study therefore proposes:

Hypothesis 7: Stress risk is negatively related to ITU.

Relation Between ITU and Usage Behavior

There are several models in the literature which explore the factors that influence ITU in technology, such as the now established models described by Davis[40] and Venkatesh et al.[41] Other research, specific to TM, has shown that these models are relevant in the context of TM, and that they (the established models of Davis[40] and Venkatesh et al,[41]) identify the critical factors in ITU. The association between ITU and TM usage behavior has also been the subject of significant research, though these studies have been mainly from the healthcare practitioner perspective and have rarely considered the service user perspective.[42,43] The relationship between ITU and usage behavior is an important consideration. Research across a variety of technology fields and contexts have established that there is a positive association between ITU and behavior – ie that those who demonstrate an ITU a technology is more likely to actually use that technology[40,41] – and this positive association has also been shown to hold true in the arena of healthcare.[44,45] As these findings align well with the generally accepted intention- behavior frameworks of technology acceptance,[40,41] this study proposes that a service user has a greater likelihood of engaging with TM if they express a positive ITU. This study therefore proposes:

Hypothesis 8: ITU is positively associated with usage behavior.

Conceptual Framework

As a result of the theoretical background described above, we hypothesized how perceived risk factors—namely, medical outcomes (H4), personal privacy (H5), time requirement (H6), and stress (H7)—negatively influence the ITU a technology. Conversely, trust factors—such as trust in medical practitioner (H1), trust in technological reliability (H2), and trust in therapeutic solutions (H3)—are posited to exert a positive influence. ITU is posited as a central determinant of use behavior, which is the ultimate outcome of interest. Hypothesis H8 suggests that a stronger ITU will lead to higher actual usage, a relationship that we aim to test empirically using structural equation modelling to understand the concurrent influences of these factors on user behavior.

Research Method

Development of the Survey Instrument

To collect data for this research, we meticulously developed a survey instrument, incorporating elements from questionnaires that have previously demonstrated validity e.g.[23,24,41,46,47] This approach was chosen to ensure that the survey was accurately aligned with the specific goals of our study. The survey was structured into three distinct sections: (1) An introduction outlining the study's objectives and the eligibility criteria for participants, specifically targeting individuals with experience in MT, (2) The collection of data on various metrics associated with our research constructs, with responses measured on a five-point Likert scale, and (3) The acquisition of demographic information from respondents. The-metrics utilized in the questionnaire are detailed in Table 1, providing a comprehensive overview of the constructs under investigation.

To ensure the content validity of the survey items, each was subjected to an independent review by the researchers involved in the study.[48–50] This rigorous process involved detailed discussions on each construct and its associated items, leading to a consensus that ensured the survey's items were both relevant and representative of the constructs being measured. Furthermore, an initial assessment with 43 experts in the field resulted in 39 valuable responses. The insights gained from this feedback led to several refinements in the questionnaire, including:

- The rephrasing of certain items to enhance clarity and understanding.
- The strategic reordering of items to ensure a logical flow and coherence in the survey's structure.
- The addition of explicit instructions for participants on the intricacies of completing the questionnaire accurately.

Table 1 The Constructs, Together with Their Respective Questionnaire Items and Related Factor Loadings

Construct/Factor	Item	Factor Loading
Trust in medical practitioner	I follow my doctor's TM advice due to trust in their expertise.	0.838
	I am comfortable with my medical care being managed through TM.	0.865
	I trust my doctor to effectively diagnose and treat me remotely.	0.871
	I believe my doctor would promptly report any TM treatment errors.	0.941
Trust in technological reliability	The TM platform is extremely reliable.	0.929
	I do not expect to be failed by the TM platform	0.914
	I have full confidence in the TM platform.	0.838
	The TM platform always works as it should for me.	0.913
Trust in therapeutic solutions	I am confident that the TM therapy will be effective for my condition.	0.889
	I expect a clear explanation of how TM therapy will impact my health.	0.901
	The choice of TM therapy will be a collaborative decision between my doctor and me.	0.856
	I anticipate a comprehensive briefing on my TM therapy plan.	0.911
Medical outcome	I have concerns that TM will not produce the results I want.	0.851
	If I used TM, I would worry that it would not perform as expected.	0.891
	The reliability of TM is a significant concern for me.	0.863
Personal privacy	If I used TM, I would have concerns about the privacy of my personal information.	0.803
	I worry about how well the TM platform protects my personal data.	0.884
	I am concerned that TM would misuse my personal data.	0.829
	TM could allow unauthorized third-parties to access and abuse my personal data.	0.884
Time requirement	Using TM may prove time-inefficient.	0.871
	Using TM may mean that I waste time unnecessarily.	0.851
	Using TM may require more time than I can afford.	0.838
Stress	Using an impersonal approach to medicine such as TM makes me feel uncomfortable	0.865
	I find the idea of using TM stressful.	0.786
	I feel anxiety at the thought of using TM.	0.798
ITU	I am intending to use TM for accessing assistive technology.	0.815
	I expect that I will use TM as recommended.	0.786
	My plan is to use TM for gaining access to assistive technology.	0.792

Following the refinement of the English version of the survey, it underwent a translation process into Arabic by a bilingual researcher proficient in both English and Arabic. This was to ensure inclusivity and accessibility for a broader participant base. The back-translation method was employed to validate the accuracy of the translation, a crucial step that underscores the importance of linguistic precision in cross-cultural research.[51]

A pilot study involving a subset of 45 participants from the intended sample population of Saudi residents was then conducted. This preliminary phase was instrumental in testing the survey for clarity, logical sequencing of items, and the elimination of any ambiguous wording.[52] Based on the outcomes of this pilot study, minor adjustments were made to further refine the survey items.

The enhanced version of the survey, enriched by the feedback from the pilot study and the comprehensive evaluation by the research team, was subsequently employed to collect data for the main study. This iterative process of development and refinement ensures that the survey instrument is both robust and sensitive to the nuances of the research objectives, thereby facilitating the collection of high-quality data.

In adopting this meticulous approach, we aimed not only to uphold the academic rigor of our methodology but also to ensure that our instrument was accessible and inclusive, reflecting a commitment to ethical research practices.

Sampling

To collect data, we employed an online survey methodology. This approach was selected due to its broad geographical reach, higher response rates compared-to-traditional methods, cost-effectiveness, and flexibility. Online platforms offer the advantage of easily accommodating larger sample sizes, making them ideal for our study's needs.[53,54]

During the six-month data collection period, we distributed 1200 surveys across a diverse demographic, including various age groups, genders, nationalities, and languages. The questionnaires were distributed through digital survey tools (Google Form), leveraging Email lists, social media platforms, and online community forums. This facilitated our outreach and data collection efforts. We utilized these diverse channels to reach a broad spectrum of participants, aiming for inclusivity and comprehensive representation. Of the received 981 responses, 917 met our eligibility criteria, such as adherence to submission deadlines and completion of all questions, ensuring the integrity and completeness of our dataset. Additionally, all eligible participants were required to have prior experience with telemedicine to provide informed perspectives. Table 2 provides a detailed demographic breakdown of the 917 participants deemed eligible for analysis.

To ensure a comprehensive representation, we meticulously screened respondents based on predefined criteria, aiming to minimize selection bias and enhance the study's validity.[53–55] The screening process was designed to reflect the diverse perspectives and experiences relevant to our research questions.

Our sample size was determined through power analysis, indicating a minimum requirement of 377 participants for statistically meaningful outcomes.[56,57] With 917 valid responses, our study far exceeded this threshold, suggesting a robust sample that enhances the reliability and generalizability of our findings. The power analysis, grounded in statistical theory, confirms that our sample is adequately representative of the larger population, allowing for confident extrapolation of our results.

In conducting this online survey, we encountered and addressed several challenges, including ensuring participant engagement and mitigating the risk of incomplete responses. Strategies such as follow-up reminders and user-friendly survey design were implemented to maximize response rates and data quality.

Nonresponse Bias

To evaluate the risk of non-response bias, we adhered to the methodologies recommended by Armstrong and Overton.[55] By presupposing that the characteristics of the final participants closely mirror those of the individuals who did not respond, we conducted a comparison between the first and last quartiles of survey participants to check for any bias due to nonresponse. The application of the *t*-test revealed no significant differences between these two groups for the main variables of our study ($p > 0.05$). Additionally, a chi-squared test[55,58] was used to compare the gender and age demographics of the two groups, which also indicated no significant differences ($p > 0.05$). Consequently, it appears that non-response bias does not pose a significant issue for this investigation.

Table 2 An Outline of the Demographic Features of the Participants

	Demographic/Experience Category	Participants %
Gender	Male Female	58 42
Education	High school College Degree or Higher Master's Degree PhD Degree	18 39 25 18
Age	18–24 25–49 50+	44 31 25
Nationalities	Saudi Non-Saudi	67 33
Language	Arabic Non-Arabic	71 29

Method of Analysis

The present study utilizes Partial Least Squares Structural Equation Modeling (PLS-SEM) for its analytical framework, motivated by multiple considerations. Primarily, PLS-SEM is acknowledged for its proficiency in facilitating theory development, a fact supported by numerous authoritative references.[59–61] Furthermore, PLS-SEM is preferred for analyzing complex structural models that include many constructs and/or intricate relationships among those constructs. Another key reason for selecting PLS-SEM is its suitability for studies with smaller sample sizes, making it a more appropriate choice than Covariance-Based Structural Equation Modeling (CB-SEM) under such circumstances.

Ethics

All participants on this study were informed, via the early invitation and the survey's web-site, that the study fulfilled with all applicable ethical standards, as approved by the Research Ethics Committee of King Saud University (KSU-HE -12-242). The information emphasized that all data collection and handling would ensure complete anonymity to safeguard privacy, informed participants about their right to opt out at any point, and highlighted that there were no correct or incorrect responses. Additionally, it was underscored that participants would not receive any direct benefits or incentives for taking part.

Results

Testing the Measurement Model

In the present study, we employed Factor Analysis (FA) to reveal underlying factors encapsulated by a series of variables or items, as recommended by.[58,62] Beyond identifying these hidden dimensions, our analysis extended to evaluating the model's fit, and verifying both convergent and discriminant validity to ensure comprehensive assessment. Factor Analysis was chosen due to its robust capacity for uncovering latent constructs that underpin observable variables,[62,63] critical for our research's objectives.

To determine the suitability of our sample for FA, we first employed the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, obtaining a value of 0.832. This value significantly exceeds the commonly recommended threshold of 0.7,[64,65] suggesting our sample size is adequately large and relevant for the analysis. Subsequent application of Bartlett's test of sphericity further supported our methodology; it tested the null hypothesis that the variables are uncorrelated (that the correlation matrix is an identity matrix) and yielded a significant outcome (P-value < 0.05), showing that the variables share sufficient common variance for FA.[58,64] These preliminary tests—the KMO measure and Bartlett's test—collectively affirm the applicability of FA to our dataset, underpinning the robustness of our approach.

In terms of model fit, the derived indices align with the acceptable standards set forth by Hair et al[61] and Hu and Bentler,[66] as evidenced in Table 3 showcasing the structural model's fit. This adherence to recognized benchmarks underscores the robustness of our analytical approach, confirming the validity of our model and the accuracy of our factor analysis. This ensures our findings rest on a solid foundation, reinforcing their reliability and relevance to the underlying constructs of interest.

As illustrated in Table 1, the factor loadings assigned to individual item were significant, extending from 0.786 to 0.941. This range of values highlights the strength of the association between items and their respective factors, underscoring the convergent validity of our analysis. It confirms that each item properly measured its corresponding factor, reinforcing the credibility of our findings. This evidence of convergent validity is essential, as it assures that the constructs identified are indeed reflected by the variables measured, further solidifying the integrity and applicability of our Factor Analysis results.

To assess the internal consistency of our constructs, we applied Cronbach's Alpha (CA), with findings presented in Table 4 showing CA values for each construct in the range of 0.81 to 0.87. Additionally, Composite Reliability (CR) metrics ranged from 0.75 to 0.84, exceeding the advised benchmark of 0.70. These outcomes demonstrate a high degree of internal consistency across constructs, reflecting precise measurement of the targeted latent constructs.[59,61]

Moreover, a test for discriminant validity was conducted to ensure there were clear distinctions between constructs and their measurements, as per the guidelines by Hair et al[59,61] This test involves comparing the square root of the

Table 3 The Model Fit Indices

Fit Measure Category	Fit Measure	Result	Meets Recommended Criteria?
Absolute fit measures	Chi-Square (χ2/DF)	2.59	Yes (<3.0)
	SRMR	0.891	Yes (>0.80)
	GFI	0.961	Yes (>0.90)
	RMSEA	0.039	Yes (<0.05)
Parsimonious fit measures	PGFI	0.641	Yes (<0.05)
	PNFI	0.682	Yes (<0.05)
Incremental fit measures	AGFI	0.922	Yes (>0.90)
	IFI	0.931	Yes (>0.90)
	NFI	0.943	Yes (>0.90)
	CFI	0.951	Yes (>0.90)

Table 4 Results of Correlations, CR, CA and AVE

Construct/Factor	CA	CR	AVE	Correlations							
				1	2	3	4	5	6	7	8
Trust in medical practitioner	0.81	0.84	0.74	0.86							
Trust in technological reliability	0.83	0.82	0.72	0.61	0.85						
Trust in therapeutic solutions	0.82	0.83	0.65	0.68	0.69	0.81					
Medical outcome	0.84	0.79	0.62	0.56	0.64	0.67	0.79				
Personal privacy	0.86	0.78	0.64	0.57	0.68	0.61	0.56	0.80			
Time requirement	0.87	0.81	0.69	0.55	0.66	0.62	0.61	0.53	0.83		
Stress	0.84	0.75	0.72	0.66	0.72	0.49	0.61	0.65	0.55	0.85	
ITU	0.80	0.81	0.74	0.69	0.66	0.54	0.68	0.6	0.66	0.54	0.86

Note: The square root of AVE is emphasized in bold.

Average Variance Extracted (AVE) for each construct against its association coefficients, with the requirement that the square root of the AVE must surpass an association value of 0.50. According to the results displayed in Table 4, our study successfully fulfills these critical conditions, highlighting the adequacy of discriminant validity.

Lastly, the study addressed the issue of multi-collinearity, which occurs when independent variables exhibit a high degree of correlation among themselves. We examined together the Variance Inflation Factor (VIF) and tolerance values to assess this concern. Findings indicated that the VIF value remained below 3, and the tolerance value was higher than 2, aligning with the recommendations of Hair et al[59,67] This adherence to established norms mitigates the impact of multi-collinearity, ensuring the integrity of our analysis.

Considering these comprehensive assessments, the measurement model stands validated and reliable, demonstrating strong model fit, convergent validity, discriminant validity, and controlled multi-collinearity. These results collectively affirm the robustness of our model, validating it as both accurate and dependable for capturing the nuances of the latent constructs under study.

Analysis of Common Method Variance and Bias

Common Method Variance (CMV) is a potential source of methodical error that can occur when collecting data from a single basis. To address this concern in our study, we applied Harman's single factor test to check for CMV, which yielded no evidence of its presence. Additionally, we examined Common Method Bias (CMB), a specific type of CMV that might arise with the use of uniform response scales. For detecting CMB, we utilized the common latent factor method, which also showed no indication of bias. Thus, we can confidently assert that the results of the present study are not compromised by either CMV or CMB, reinforcing the credibility and accuracy of the present findings.

Table 5 The Path Coefficients and *t*-Test Value for the Full Sample

Hypothesis	Standardized Path Coefficient	*t*-Test Value	Support?
Hypothesis 1: Trust in medical practitioner is positively related to ITU.	0.31	5.34***	YES
Hypothesis 2: Trust in technological reliability is positively related to ITU.	0.42	5.21***	YES
Hypothesis 3: Trust in therapeutic solutions is positively related to ITU.	0.33	5.23***	YES
Hypothesis 4: Medical outcome risk is negatively related to ITU.	−0.35	5.27***	YES
Hypothesis 5: Personal privacy risk is negatively related to ITU.	−0.49	5.38***	YES
Hypothesis 6: Time requirement risk is negatively related to ITU.	−0.25	4.11***	YES
Hypothesis 7: Stress risk is negatively related to ITU.	−0.21	4.08***	YES
Hypothesis 8: ITU is positively associated with usage behaviour.	0.45	5.41***	YES

Note: ***0.001 significance.

Findings of the Research Hypotheses

The study employed Structural Equation Modeling (SEM) to assess the measurement model's psychometric properties and to test the research hypotheses. SEM, a robust statistical method, was utilized to explore the relationships among various constructs. The results demonstrated that different trust factors (trust in Practitioners, trust in technological reliability, trust it therapeutic solutions) positively ITU, while perceived risks (medical outcomes, personal privacy, time requirement, stress) were found to negatively influence this intention, explaining 63.7% of the variance observed. This evidence supported hypotheses H1 through H7. Moreover, ITU is positively associated with usage behavior, explaining 50.9% of the variance observed.

The significance of these relationships was confirmed by significant t-values and elucidated through standardized path coefficients listed in Table 5, indicating the strength of each relationship. In summary, the SEM findings robustly validate the theoretical model proposed in our research, highlighting the factors TM.

Discussion

In this study, we aimed to explore the influence of trust and risk on the adoption of TM as a means of accessing assistive technology. Our comprehensive analysis revealed key factors that significantly impact individuals' willingness to embrace TM for healthcare delivery and assistive technology access. These findings underscore the critical roles that trust in TM technology, along with the perceived risks associated with its use, play in adoption decisions.

Specifically, we identified that trust (trust in Practitioners, trust in technological reliability, trust in therapeutic solutions) positively influences users' intentions to adopt TM technology. Trust emerges as a cornerstone, fostering confidence among users in the TM platforms' capability to deliver safe, secure, and effective healthcare solutions.[22,23] Conversely, perceived risks (medical outcomes, personal privacy, time requirement, stress), negatively influences users' intentions to adopt TM technology. These apprehensions highlight the need for stringent measures to safeguard user data and ensure the reliability and quality of TM services.

The present research contributes to the limited body of knowledge on the adoption of TM from the perspectives of trust and risk. While prior studies have extensively explored various facets of TM adoption,[27,28] the nuanced impact of trust and risk factors has received relatively less attention. This oversight is particularly noteworthy given the expanding role of TM in modern healthcare ecosystems, where it promises to enhance accessibility, convenience, and efficiency in accessing healthcare services and assistive technology.

By delineating the influence of trust and risk on TM adoption, the present study provides valuable insights for healthcare providers, policymakers, and technology developers. Addressing these factors effectively can lead to higher adoption/acceptance rates among potential TM users, paving the way for a more inclusive and accessible healthcare system. Ensuring robust security measures, transparent practices, and reliable TM solutions will be key to mitigating risks and building trust among users,[27,28] thereby facilitating the broader adoption of TM as a vital component of healthcare delivery. Additionally, the issue of equity in the use of TM and sustainability must be introduced. The use of TM is still fragmented globally and within each country. Future research should investigate how to ensure equitable access to TM services across different populations and regions. Furthermore, exploring sustainable models for TM integration into healthcare systems is crucial.

The study also addresses the gap between ITU and actual usage behaviour, highlighting the complexities of translating positive attitudes towards TM into consistent use. This gap underscores the need for improved communication about TM's benefits and the availability of assistive technology services, as well as strategies to maintain user engagement over time.

In sum, this study enriches the discourse on TM adoption by emphasizing the critical roles and dissection of trust and risk into subdimensions, as well as the complex interplay between intention and behavior. These insights not only contribute to theoretical advancements in understanding TM adoption, but also offer practical guidance for healthcare providers, policymakers, and technologists aiming to expand the reach and efficacy of TM services (details about contribute below). Future research should also explore how cultural, socioeconomic, and geographical factors influence trust and perceived risks in TM. This will provide a more comprehensive understanding of the barriers and facilitators to TM adoption, contributing to the development of tailored strategies to enhance TM uptake.

Theoretical Implications

This paper creates implications for research into technology adoption in a number of ways. One of these is emphasizing the importance of treating the concept of trust as a multidimensional entity, especially when exploring the willingness of service users to engage with TM. While there are some studies which have taken this approach, such as those by Cao et al[36] and Yang et al,[28] most studies have defined trust as mono-dimensional.[34,35] However, the limited number of studies which have taken the multidimensional approach have found – as has the current study – that trust in technological reliability has a greater impact on the TM adoption mechanism than trust in medical practitioners. This study therefore contributes to the literature by adding to the evidence for this effect. Our findings also add validity to the idea that trust should be considered multidimensional, by showing that each individual trust factor has a different, but significant, impact on ITU.

A similar argument applies to the construct of risk. This study shows that risk should also be treated as consisting of several subdimensions. Although some studies have recognized that risk consists of multiple factors e.g[27,28] none of these studies have examined the separate, independent impact of each factor, and have, instead, treated the effect or risk in a holistic manner. Failure to analyze the impact of individual risk factors, on the other hand, can lead to ambiguity and misleading conclusions.

Another way in which this study contributes to future research on TM adoption is by demonstrating a significant ITU-Behavior gap among service users. While research outside of the specific TM field has shown that ITU does not necessarily translate into actual usage behaviors,[1,30,68] this finding has usually been ignored within the field of TM research, which has tended to concentrate its efforts on the causative factors for ITU only e.g.[31,36] While ITU-focused studies are useful, they do not take account of the fact that other, external, factors could affect usage behavior. The current study shows clearly that, in the TM environment, usage behavior may not follow from ITU.

Practical Implications

Several practical implications result from the findings of this study. One of these is that, if TM is to be widely embraced, it is critical to develop trust in technological reliability among service users, as this can play a major role in forming trust in therapeutic solutions and ITU. Developing this trust will require a multi-pronged approach by individual healthcare providers, as well as governments, to inform and educate the public as the many proven benefits of the technology.

Another practical implication of the study's findings is that service users need to be convinced that the use of TM will provide effective medical outcomes, in terms of access to assistive technology. Again, this will require the promotion of TM, by individual practitioners, organizations and governments, as an effective and reliable route to desirable medical outcomes.

Lastly, service users must believe that the use of TM poses no risk to the desired medical outcome. This can be achieved as part of the promotional strategies designed to increase trust, as described above. Additionally, the need of recognize and address the specific risk concerns of different user groups by tailoring communication strategies can help ensure that risk mitigation messages are culturally sensitive, thereby enhancing their effectiveness. Moreover, establish robust feedback mechanisms that allow users to report issues, express concerns about TM services, and suggest improvements. This not only aids in continuously enhancing the safety and reliability of TM services but also demonstrates a commitment to user-centric care, further reducing perceived risks.

Conclusions

The study's exploration into the adoption of TM elucidates the critical role of multidimensional constructs of trust and perceived risk, underscoring a nuanced understanding necessary for enhancing TM's integration into assistive technology landscapes. By diverging from traditional analyses that conceptualize trust and risk as singular dimensions, this research offers a fresh perspective, revealing the complex interplay of factors influencing TM adoption.

A notable contribution of this research lies in its counterintuitive discovery that trust in technological reliability is more predictive of trust in therapeutic solutions than the traditionally relied-upon trust in medical practitioners. This insight invites healthcare providers and policymakers to reconsider the emphasis placed on technological aspects of TM solutions, advocating for a balanced approach that fosters both technological and practitioner trust to enhance patient receptivity.

Furthermore, the differentiation of perceived risk into distinct dimensions and their varied impacts on TM adoption emphasizes the necessity for a comprehensive risk management strategy. Particularly, the singular significance of medical outcome risks on usage intention highlights a pivotal area for developers and policymakers to address in promoting TM adoption.

The strengths of this study are manifold. It offers a novel perspective by dissecting trust and risk into multi-dimensional constructs, providing a richer understanding of their roles in TM adoption. The unexpected finding regarding the importance of technological trust over practitioner trust further contributes to the discourse, suggesting new focal points for enhancing TM acceptance.

The identified disparity between the ITU of TM and actual usage behaviour unveils a critical research gap, suggesting that factors beyond those measured may influence TM adoption. Future studies are encouraged to delve deeper into psychological, technological, and environmental determinants that bridge this gap, offering a more holistic view of TM adoption dynamics.

Limitations and Future Research

It is important to note that the present research has some limitations. One of these is the study's use of different groups as the basis for comparing the impact of cultural/social factors on the impact of trust and risk on ITU and usage behavior. Although this approach facilitated useful insights, the results cannot be generalized to all socio-cultural factors. Also, the study did not consider the extent to which external, or other, factors, such as the urgency of required therapy, could affect the trust and risk. This could be usefully included in future research.

A second limitation includes the study geographic and demographic scope; the majority of survey participants (75%) were under 49 years old, and thus likely to be digital users with high to very high educational levels. Therefore, the survey did not reach segments of the population with lower educational levels or older populations, who may have a lower level of digitalization but a greater need for care through telemedicine and assistive technology. Future research should expand to diverse populations and settings. Further research should expand to diverse populations and settings. Investigating the underexplored facets of trust and risk, alongside innovative methodologies, could uncover pivotal insights, paving the way for tailored interventions that accelerate TM's widespread acceptance and utilization. This refined understanding and strategic recommendations offer a pathway for harnessing TM's full potential, advocating for a multifaceted approach to fostering widespread adoption and ensuring TM's role as a cornerstone in the future of healthcare delivery.

Thirdly, while the study found a gap between ITU and usage behavior, this gap was not based on independently verified behaviors, which were self-declared by the participant. Although these self-declared behaviors were likely to be accurate in general terms, there was no independent evidence for this assumption. This could be addressed by future (longitudinal) studies. Lastly, this research was focused on a Saudi Arabian context. However, the TM acceptance process may vary with culture, so our findings may not apply to other countries. Future research could examine the extent to which the trust-risk relationships, and their impact on ITU, are a function of cultural context.

Data Sharing Statement

Data are not shared due to privacy and ethical restrictions.

Ethics Statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board (Human and Social Researches) of King Saud University – No. KSU-18-242.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

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Disclosure

The authors report no conflicts of interest in this work.

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