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IoB-TMAF: Internet of Body-based Telemedicine Adoption Framework

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***Abstract*—Saudi healthcare organizations are increasingly using Telemedicine (TM) services to reduce expenses and improve the effectiveness of healthcare delivered. Population aging and the growth of the costs of chronic diseases management has an urgent problem that requires the use of technical solutions that contribute to expanding and improving healthcare services and addressing these issues. Consequently, the growing investments in developing TM products and services have made user acceptance of technology crucial in ensuring effective use. The purpose of this study is to explore the factors influencing Saudi patients and healthcare providers to adopt Internet of Body (IoB) technologies to support diagnosis in TM settings. The Technology Acceptance Model (TAM) is employed in this study as the foundational theoretical framework, extending it with additional constructs to fit the context. The IoB-TMAF model identifies factors influencing the adoption intentions of patients and providers for IoB-based TM system. The influencing factors stem from users' individual contexts (social influence, self-efficacy, attitude, and perceived trust), technological contexts (perceived usefulness, perceived ease of use, task fit, reliability, perceived cost, and perceived privacy control), organizational contexts (facilitating conditions), and health contexts (perceived health risk). This study adds to the existing literature by introducing a comprehensive model to explore the motivational factors driving the effective adoption of IoB-based TM in the Kingdom of Saudi Arabia (KSA). Thus, formulating a strategy for the proper execution aligned with the viewpoints of its users.**

***Index Terms*—telemedicine, Technology Acceptance Model, adoption of telemedicine, IoB, TAM.**

I. Introduction

THE information revolution has seen significant advancements in telecommunication services within the health sector, transforming how healthcare is delivered, managed, and experienced. A notable example of this shift can be clearly seen in the case of Telemedicine (TM), which delivers remote clinical services over Information and Communication Technologies (ICT) channels, such as consultation, medical diagnostic, and monitoring. The global TM market is projected to reach around $300 billion by 2030 [1], driven by factors like the COVID-19 pandemic, workforce shortages, and the increasing prevalence of chronic diseases [1], [2], [3].

The benefits of TM have been revealed by many scientists in their literature. It promotes equitable access to quality care regardless of location or physical limitations. According to studies [4] and [5], TM is a prominent solution for bridging geographical and social barriers to healthcare by reaching rural and underserved communities, people with disabilities, the elderly, and beyond. Moreover, research has shown that TM plays a vital role in improving healthcare outcomes [6], expanding access to specialized consultations [7], and reducing travel time and expenses for patients [8]. Therefore, TM becomes a powerful tool in ensuring healthcare accessibility, affordability, and quality, which gives it a significant role to play in any healthcare system.

The potential of TM is further revolutionized by the Internet of Things (IoT) technologies. Studies have shown IoT significantly enhances TM by increasing usability, acceptance, and adoption [2], [9], [10]. This interest has led to the emergence of the Internet of Body (IoB) in 2016, which integrates the human body into interconnected systems to collect health data [11]. The IoB includes a range of different technologies like wearable, embedded medical devices, and sensors that collect health data. This innovative approach promises to personalize and enhance healthcare services further.

Given TM's significant potential, both developed and developing countries are heavily investing in remote healthcare services. TM is integral to healthcare systems in countries like the USA, UK, Canada, and the EU, where infrastructure and policies support its implementation [12], [13]. Meanwhile, developing countries, particularly in the Middle East, are building the necessary infrastructure, training healthcare professionals, and creating policies to expand TM services [13], [8].

Furthermore, the author of [13] highlighted compelling reasons for healthcare organizations in developing countries to implement TM systems. Adopting TM is critical to address the growing challenges posed by aging populations while reducing costs and maintaining high-quality healthcare delivery. Moreover, the World Health Organization (WHO) noted that technological advancements and the widespread availability of affordable internet and smart devices have paved the way for these countries to integrate TM into their healthcare systems [14]. This has enabled healthcare organizations to offer innovative and efficient healthcare services by expanding TM's scope to include web-based applications such as email, video conferencing, and sharing medical imagery with professionals [13]. Given the multifaceted benefits of TM at various levels, it is imperative to capitalize on its potential by addressing digital divides and employing best practices to ensure successful adoption and utilization of this technology for equitable access to high-quality healthcare.

Despite TM's promise, the degree of success in TM applications varies between developed and developing countries. It has been reported that several TM pilot projects have been terminated due to the many challenges they encountered [15], [16], [17]. Additionally, studies have indicated that TM has not been fully integrated into the healthcare system to provide routine services as intended [18], [19]. There might be some factors that may contribute to this, such as legal and regulatory barriers, data privacy concerns, technological limitations, lack of physical assessments, incompatibility with medical workflows, or a lack of perceived utility for current solutions [20]. Moreover, a growing body of research has shown that individuals' intentions and perspectives toward adopting and accepting a novel system are strongly influenced by users' behaviour and their culture [15], [9], [21], [22], [23]. Therefore, user acceptance is becoming an essential factor in determining the success of IT implementation or the introduction of new systems.

While the existing literature on TM adoption is extensive, there remains a notable gap regarding the intention to use IoB as a supporting tool for diagnosis in the TM context. Additionally, to date, the factors influencing its acceptance by healthcare providers and patients in the Kingdom of Saudi Arabia (KSA) are not fully identified and understood [9]. Therefore, the current study aims to fill the gap by investigating the factors that shape the acceptance of IoB-based TM among Saudi healthcare providers and patients. To achieve this, the Technology Acceptance Model (TAM) is adapted and extended to fit the context of IoB-based TM. Understanding the factors that drive the acceptance of IoB-based TM is crucial for its successful implementation and integration into healthcare systems. The findings will provide insights into improving healthcare delivery, particularly in regions like the KSA where TM can address significant healthcare challenges.

The following sections will discuss the theoretical foundation of the study, develop the IoB-TMAF theoretical framework, and detail its constructs. The final section will conclude the discussion, outline future research directions, and propose a methodology for examining the IoB-TMAF model.

II. Theoretical Foundation

Examination of the literature uncovers a range of theoretical models that provide insight on understanding users' intentions and motivations to adopt ICT [21]. Some examples of these models are Diffusion of Innovations Theory (DOI) [22], Theory of Reasoned Action (TRA) [23], Theory of Planned Behaviour (TPB) [24], TAM and its extensions [25], [26], Unified Theory of Acceptance and Use of Technology (UTAUT) [27], and Health Belief Model (HBM) [28]. These models present various factors that impact the behaviour of end users in adopting IT. The significance of addressing the adoption of IoB technology in TM services, and the development of a new framework for investigating influential factors, becomes evident through a systematic review of the current literature [9]. The results of this review have indicated that two models, TAM and UTAUT, are the most common models employed to understand the factors influencing the adoption of TM among healthcare providers and patients across diverse countries and TM settings [9]. Furthermore, most studies included in the review introduce additional contextual factors and integrate them with the base models, such as TAM and UTAUT. Despite their widespread applications for examining the adoption of IT projects in the healthcare sector, a single theory or model may not consistently provide a sufficient explanation for the phenomena being investigated. Therefore, it is necessary to adopt a multifaceted approach to studying adoption. This can be achieved by using more than one model or theory and extending them by integrating additional contextual factors [29]. Such integration is essential for a better understanding of user technology acceptance, considering the intricacies of the IoB-based TM context from various viewpoints. Incorporating these factors allows for a more comprehensive and holistic understanding of user technology acceptance, which can differ based on the specific field context [30].

III. Proposed Adoption Model: IoB-TMAF

In the context of this study, the proposed model IoB-TMAF is developed based on a synthesis of systematic reviews on TM adoption literature conducted earlier [9]. This comprehensive model combines various well-established factors, offering a robust framework for studying the adoption of IoB-based TM, by providing valuable insights into different users' behaviour and intentions in this context. The TAM model is employed as the basis for the model, with its original four factors, namely Perceived Usefulness (PU), Perceived Ease of Use (PEoU), Attitude (ATT), and Behavioural Intention (BI). In addition, the model includes two factors from the UTAUT model (Social Influence (SI), and Facilitating Condition (FC)), one factor from HBM (Perceived Health Risk (PHR)), and other external variables, including Self-Efficacy (SE), Perceived Privacy Control (PPC), Perceived Cost (PC), Perceived Trust (PT), Task Fit (TF), and Reliability (R). The selected factors represent the most relevant and frequently identified predictors for this study's context, which examines individuals' intentions to adopt IoB-based TM [9]. These factors were chosen for their direct applicability to the study's goals. Furthermore, it is worth noting that TAM is frequently cited as the prevailing model for understanding acceptance in the healthcare domain due to its simplicity, flexibility, and ability to provide adequate explanatory power [31], [32].

In our proposed model, we estimated the effect sizes of these several predictors on IoB-based TM adoption intention. These estimates are derived from previous similar studies, converted to a common metric Cohen's f^2, and then averaged across all studies to provide a comprehensive understanding of their impact. The f^2 values were interpreted according to Cohen's (1988) guidelines, where $0.02 \leq f^2 < 0.15$ represents a small effect, $0.15 \leq f^2 < 0.35$ represents a medium effect, and $f^2 \geq 0.35$ represents a large effect.

As shown in Table I, PU demonstrated the largest effect size (f^2=0.782), followed by PEoU (f^2=0.529) and ATT (f^2=0.418). These variables exhibited large effects on IoB-based TM adoption. TF also showed a large effect (f^2=0.390). Several variables demonstrated medium effects, including SI, SE, PT, FC, and PHR. R showed a small effect, while PPC and PC exhibited very small effects.

These findings suggest that interventions or strategies focusing on improving users' attitudes, perceived usefulness, and perceived ease of use may have the most substantial impact on IoB-based TM adoption. However, the influence of other factors should not be discounted, as even small effects can be meaningful in this context.

Fig. 1 shows the IoB-TMAF proposed model for the investigation. Based on the meta-analysis, the predictors of adopting IoB-based TM were categorized and organized into four main groups: individual context, technological context, health context, and organizational context. The following sections illustrate the interconnections between ideas and concepts related to the research problem and provide a detailed description of each category along with its respective factors.

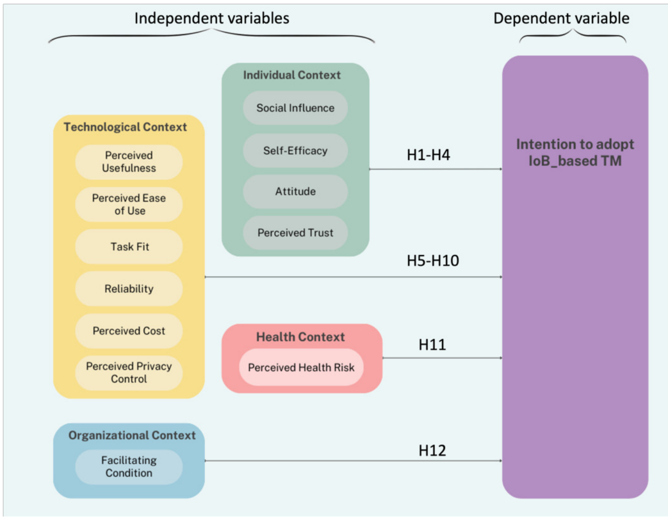

Fig. 1. IoB-TMAF Proposed Model.

A. Individual Context

Individual factors play a significant role in shaping a user's decision either to adopt or decline the usage of the technology [17]. Individual factors refer to those aspects that stem from the individual themselves and influence their interaction with the system [44]. The individual context includes beliefs, thoughts, attitudes, and trust, which result from information and experiences, influencing decisions and shaping how individuals interpret various aspects. The review by [20] reported that individual resistance is considered one of the main barriers to TM implementation in Middle East countries. Examples of barriers related to individuals include a lack of awareness, knowledge, culture, trust, and motivation to use the technology [20]. Some researchers state that identifying and addressing potential barriers related to the individual context can facilitate a smoother transition to new technology and mitigate resistance [16], [20], [17]. Therefore, there is a need to consider the individual context to examine the key factors that determine the success of IoB-based TM adoption, providing more user-centered and adaptive technological solutions. The factors related to the individual context under investigation include attitude, social influence, self-efficacy, and trust beliefs, which are detailed below.

1) Social Influence (SI): Numerous studies have highlighted the complicated role of SI in shaping the acceptance of emerging technologies [30], [45], [46]. SI, a key construct in the UTAUT model, is defined as "the degree to which an individual perceives that important other (e.g., family and friends) believe they should use the new system" [27]. In this study, SI refers to the extent to which an individual believes that their decision regarding the adoption of IoB devices in TM for diagnosis is influenced by the recommendations of others. Empirical evidence demonstrates that SI positively impacts an individual's intention to adopt various types of health information technology, including mobile health services [47], wearable health devices [30], [47], and TM [30], [33], [48], [34].

Building on these findings, this study assumes that SI plays a pivotal role in supporting individuals' confidence to embrace IoB-based TM and enriches their remote healthcare experience. Previous research underscores SI's significant impact on the adoption of TM by both healthcare providers [48], [34] and patients [30], [33]. A recent study by [49] supports the common observation that IoT consumers frequently seek advice from family members, peers, and colleagues uncertain about a product. Moreover, SI is driven by the influence of highly educated and successful individuals who share their experiences and motivating their social circles over time [33]. Therefore, the following hypothesis is proposed:

H1: Social Influence is significantly influencing user intention to adopt **IoB-based Telemedicine.**

2) Self-Efficacy (SE): SE significantly influences individuals' attitudes in adopting and effectively utilizing new technological advancements, including various domains such as healthcare and technology-mediated applications. SE refers to an "individual's belief or judgment regarding their capability to use a technology to accomplish a particular job or task" [50]. The concept of SE is like Perceived Behavioural Control in the Cognitive Theory of the TPB [50], and Computer Self-Efficacy

TABLE I
ESTIMATE THE EFFECT SIZES OF PREDICTORS ON IOB-TMAF ADOPTION

Predictor variable	Estimated Effect Size f^2	Description	Source
SI	0.192	Medium effect	[33], [34], [35], [30], [36], [37], [38], [39], [40], [41]
SE	0.110	Medium effect	[33], [41], [17], [42], [36]
ATT	0.418	Large effect	[17], [32], [42], [35], [34], [39]
PT	0.116	Medium effect	[43], [42], [40], [37], [39]
PU	0.782	Large effect	[33], [32], [34], [41], [35], [30], [36], [37], [38], [39], [40]
PEoU	0.529	Large effect	[33], [32], [34], [41], [30], [36], [37], [38], [40], [17], [40]
TF	0.390	Large effect	[33], [39], [38]
R	0.087	Small effect	[39], [36]
PPC	0.033	Small effect	[39], [37]
PC	0.018	Small effect	[39], [30]
FC	0.185	Medium effect	[33], [30], [39], [34], [35], [17], [37], [38], [40]
PHR	0.171	Medium effect	[43], [36], [42], [30]

in the extended TAM [51]. It serves as internal control over the belief that an individual can carry out a specific behaviour [51] and as predictive in decision-making regarding technology use [52].

Prior research provides experimental evidence supporting the significant influence of SE on the intention to use new technology [33], [51], [53]. In IoB-based TM, SE represents an individual's belief in the set of skills they possess to use IoB devices in a TM setting. The literature in health information technology has shown a significant impact of SE on the adoption of TM applications for patients [47], [33], [54] and healthcare providers [17], [34]. Users with lower levels of SE are uncertain and less comfortable when using technology [50]. In a study conducted by [33], it was observed that patients who possessed a high sense of SE demonstrated a favorable intention toward the adoption of TM. This finding underscores the significant role that confidence in one's ability to perform specific tasks or actions in influencing individuals' receptiveness to technological innovations in healthcare.

Similarly, another study by [17] revealed that healthcare providers exhibited a greater willingness to adopt TM when they perceived themselves as competent and capable of effectively using the various devices and tools associated with TM services. This connection between SE and the willingness of healthcare professionals to engage with technology suggests that SE is a pivotal factor not only in the patient's acceptance of technology but also in the readiness of healthcare providers to integrate technological solutions into their practice. These findings collectively highlight the critical role of SE in shaping the adoption and effective utilization of technology within the healthcare industry. Therefore, the following hypothesis is proposed:

H2: Self-Efficacy is significantly influencing user intention to adopt **IoB-based Telemedicine.**

3) Attitude (ATT): In the realm of technology adoption, each user brings a unique perspective and attitude toward a specific item, a notion emphasized by the TAM model [17]. TAM highlights that the construct of ATT shapes the individuals' intention to engage in certain behaviours related to technology [23]. ATT is defined as "the degree of evaluative effect that an individual associates with using the target system in their job" [52]. The role of ATT stands out as a key predictor of behavioural intention in numerous studies [23], [55]. Interestingly, within the healthcare domain, ATT's significance diverges. While some studies suggest it may not significantly contribute to the intention to adopt technology [56], others identify it as a variable influencing the behavioural intentions of healthcare providers and patients, particularly in the context of technology acceptance such as TM [17], [47], [57]. This discrepancy underscores the complex link between individuals' sentiments regarding technology and their inclination to consider its use [23].

However, when a positive attitude toward technology is present, it can have significant benefits for both healthcare providers and patients. Researchers believe that the positive ATT of healthcare providers towards technology not only fosters increased commitment and enthusiasm for its adoption in their medical practice but also plays a significant role in improving patient care quality [32], [17]. This positive outlook among healthcare professionals encourages them to explore and implement cutting-edge technologies, which can lead to more efficient diagnoses, treatment options, and overall healthcare delivery [58].

Similarly, patients who have a favorable perception of the technology used in their healthcare experience greater confidence and trust in their medical providers [47]. This trust in the healthcare system's technological capabilities can result in higher patient satisfaction and better engagement in their own care [59]. Moreover, authors in [60] reported that when patients feel comfortable and empowered by the technology integrated into their healthcare journey, they are more likely to actively participate in managing their health and adhering to treatment plans, ultimately contributing to better health outcomes. Therefore, the following hypothesis is proposed:

H3: Attitude is significantly influencing user intention to adopt **IoB-based Telemedicine.**

4) Perceived Trust (PT): Trust holds the power to shape a user's intentions and attitudes toward an innovative IT system [47]. This influence becomes even more crucial in healthcare, where an increasing number of services are being provided through technologies that need users' involvement, participation, and trust [47]. PT is defined as "faith in the adoption of a new technology that end-users place in it with regards to the services this technology can provide" [43]. In the context of this study, PT, is defined as the degree of confidence and reliance that end-users place in the providers, IoB, and the TM system as a whole [47].

Several studies highlight the importance of trust in this context. Scholars argue that trust is a main precursor influencing the adoption of e-health [61]. It represents the most significant factor in fostering a successful healthcare relationship in remote doctor-patient communication [47]. Moreover, as the healthcare sector continues to integrate cutting-edge technologies, such as IoB, trust assumes an even more pivotal role [62]. A study by [63] emphasized the importance of trust for the IoT, as IoB falls under the IoT umbrella. The authors highlighted two key aspects: firstly, the interaction and trust among various IoT elements, including body-connected devices, and secondly, the trust of users in adopting and using these technologies [40], [63].

In addition to facilitating technology adoption, establishing trust is critical for the successful implementation of eHealth services. Studies have shown that an atmosphere of trust can enhance the efficacy of technology adoption [61], [40]. Conversely, a lack of trust in healthcare technology may adversely impact patients' health outcomes [47]. Similarly, distrust of IT has been identified as a key factor leading to the avoidance of using technology as a resource for health-related purposes [64]. Therefore, the impact of trust on user perceptions and behaviours towards IT systems, particularly in the healthcare sector, underscores its indispensable role in shaping the success of technological integration. Therefore, the following hypothesis is proposed:

H4: Perceived Trust is significantly influencing user intention to adopt **IoB-based Telemedicine.**

B. Technological Context

To build a successful ICT system, it is essential to not only establish the appropriate technological infrastructure but also develop a comprehensive understanding of user perceptions and behaviours from a technological perspective [65]. The technological concept encompasses the technological elements and strategic considerations involved in designing, implementing, establishing communication infrastructure, and utilizing related technologies to facilitate the acceptance of the new system- in our context, the provision of remote healthcare [9]. This includes, for example, system characteristics, system quality, complexity, security and privacy, information accuracy, cost, and job reflection [10].

Building on the insights of [65], [25], it is evident that explaining the technological aspects of an ICT system is pivotal in gaining user acceptance. The TAM model serves as a valuable guide, emphasizing that users' acceptance is influenced by the perceived ease of use and perceived usefulness of the new system [65]. To comprehend the adoption of a system, specifically the IoB-based TM in this study, it is imperative to identify key technological factors impacting users. The factors related to the technological context under investigation include perceived usefulness, perceived ease of use, task fit, reliability, perceived cost, and perceived privacy control.

1) Perceived Usefulness (PU): PU represents one of the core constructs of the TAM model [65]. It is defined as "the extent to which a person believes that using the system will enhance his or her job performance" [26]. In the context of IoB-based TM, PU can be viewed as the extent to which healthcare providers believe that using this technology will enhance their performance and productivity to provide effective and high-quality care to patients. For patients, it can be viewed as their belief that using this technology will improve their health management and overall healthcare experience. According to [66], IoB technology has the potential to transform healthcare by enabling continuous tracking of patients' vital signs and health information in real-time. This shift towards continuous remote patient monitoring can provide healthcare providers with the timely, accurate insights needed to make prompt diagnoses and treatment decisions.

Previous research has consistently identified PU as a key driver in the adoption of technology among healthcare providers [17], [56], [67] and patients [68]. The belief that integrating IoB into TM practices will enhance diagnostic capabilities serves as a crucial determinant for its acceptance. The study by [69] underscores that consumer adoption of healthcare wearable devices is significantly influenced by the perception that these devices enhance healthcare effectiveness, emphasizing the pivotal role of user beliefs in shaping technology adoption. Authors of [31] further expand the scope of PU in the healthcare domain, transcending individual productivity to encompass broader aspects such as increased efficiency, elevated quality and safety standards, enhanced workflow support, patient empowerment, and other utility measures specific to healthcare [70], [31].

Conversely, the absence of PU in information technology can pose a substantial barrier to adoption. As elucidated by [70] in their review, PU is not merely a singular barrier but a linchpin, constituting 15% of the various barriers encountered in the adoption of electronic health records in the KSA [49], [70]. Thus, understanding PU in the IoB-based TM context becomes important for fostering widespread adoption and ensuring successful implementation in healthcare settings in the KSA. Therefore, the following hypothesis is proposed:

H5: Perceived Usefulness is significantly influencing user intention to adopt **IoB-based Telemedicine.**

2) Perceived Ease of Use (PEoU): In the TAM model [65], PEoU stands as one of the core constructs. It is defined as "the extent to which a person believes that using the system will be free of effort" [26]. In the context of this study, it refers to the user's perception of the ease of using IoB-based TM. The degree of ease associated with using technology is found to positively affect the acceptance behaviour [65], [27]. This indicates that the smoother and more straightforward the user perceives the system, the more likely they are to embrace and adopt it. This positive relationship between PEoU and user acceptance underscores the importance of designing and implementing technology in a manner that minimizes cognitive load and operational complexities for the end user [65].

Providing support for these ideas, numerous studies have confirmed that PEoU significantly influences the adoption of technologies in the healthcare domain [21]. Authors of [47], [67] emphasized the paramount importance of user-friendliness and accessible technical support in telehealth systems. Additionally, [17] reported that healthcare provider providers exhibit a greater willingness to adopt and incorporate technology into their practices when they find it to be user-friendly and require minimal cognitive effort, given their complex working environment and busy schedules. This aligns with the broader literature on technology adoption, emphasizing that usability and ease of use are key determinants influencing users' willingness to engage with and embrace novel technological solutions [27], [51].

However, the complexity of technology, particularly in the healthcare domain, gives rise to resistance and rejection to adopt innovations [20], [70]. With specific reference to Saudi healthcare services, an identified challenge emerges in the form of a perceived lack of ease of use, which accounts for approximately 15% of the obstacles hindering the widespread adoption of electronic health records [70]. This implies the importance of this factor to facilitate the seamless integration of advanced technological solutions, such as IoB-based TM, in Saudi healthcare practices. Therefore, the following hypothesis is proposed:

H6: Perceived Ease of Use is significantly influencing user intention to adopt **IoB-based Telemedicine.**

3) Task Fit (TF): In the realm of ICT systems, ensuring that the applications, and services align with the users' needs and objectives is critical. This involves conducting comprehensive needs assessments, understanding user requirements, and customizing the technological solutions to address specific challenges and goals [71]. TF is defined as "an individual's perception regarding the degree to which the target system is applicable to his or her job" [26]. In other words, it reflects how essential the IoB-based TM system's capability is to support a specific set of tasks related to diagnosis within that job. The TF concept is like the Job Relevance in the extended TAM [26], and Task-Technology Fit [72], which have empirically confirmed positive roles in healthcare acceptance of technology [33], [54].

Moreover, TF serves as a judgment that influences the individual's intention toward adopting technology [26]. According to the extended TAM model, individuals employ a mental representation to evaluate the alignment between significant work objectives and the outcomes of engaging with a system [26]. This serves as the foundation for making judgments regarding the perceived usefulness of that system [26]. Similarly, earlier studies in human-computer interaction and psychology have highlighted that users' specific knowledge, shaped by mental representations of their job situations, can function as a foundation for identifying tasks compatible with a given system [26], [73], [74].

In the context of TM, as reported by several studies, the lack of physical examination in TM is considered one of the main barriers in the field [35], [75], [76]. If the IoB provides this potential, healthcare providers and organizations are more likely to perceive the usefulness of the systems, as they are compatible with work needs and values. With IoB technologies, healthcare providers can remotely access real-time physiological data, allowing for a more accurate and dynamic evaluation of patients [58]. This capability not only addresses the current barrier of limited physical examination in TM but also opens new avenues for proactive and personalized healthcare. Therefore, the following hypothesis is proposed:

H7: Task Fit is significantly influencing user intention to adopt **IoB-based Telemedicine.**

4) Reliability (R): The significance of R in system development becomes evident when assessing user adoption and utilization, emphasizing its pivotal role as a crucial quality factor [77]. Various studies delve into the R within user acceptance models, each identifying distinct dimensions based on the context and specific study objectives [78]. Common elements include system reliability, output quality, data accuracy, error handling, system availability, and response time. Previous research has highlighted that both system quality and information quality not only serve as key predictors for the adoption of IT but also exert a significant impact on user satisfaction [79].

Moving to the healthcare domain, [36] identified the health information technology (HIT) reliability, incorporating the quality of output and demonstrability of results. Output quality refers to "the degree to which an individual believes that the system performs his or her job tasks well" [25], [26], while result demonstrability refers to "the degree to which an individual believes that the results of using a system are tangible, observable, and communicable" [25], [26]. These concepts were derived from the extended TAM model, which posits that PU is shaped by both output quality and result demonstrability. Consequently, individuals assess the system's effectiveness and accuracy in task execution, forming more favorable perceptions of a system's usefulness when the correlation between usage and positive outcomes is easily observable [26].

In the context of this study, R is crucial to ensure that users trust and rely on the IoB devices for monitoring and assessing their health [66]. Several dimensions or factors contribute to the R of IoB-based TM systems in the context of user acceptance models. R, in this study, will be examined to measure contextual aspects, including output quality, data accuracy, and demonstrability of results, aligning with previous studies in this domain [69]. Data accuracy refers to the individual's perception of the accuracy of the information presented or processed by the system. Therefore, examining the R within user acceptance models, encompassing dimensions such as output quality, data accuracy, and demonstrability of results, underscores its indispensable role in fostering user trust, satisfaction, and reliance on IoB devices for health assessment in the TM practice. Therefore, the following hypothesis is proposed:

H8: Reliability is significantly influencing user intention to adopt **IoB-based Telemedicine.**

5) Perceived Cost (PC): Perceived cost is like the price value in the extended UTAUT model. It is defined as "the consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them" [80]. Another study defined perceived cost as “concerns on the costs consumed in buying, using, and repairing the component of a particular system or service” [81]. Based on the study's context, it refers to the concerns about the cost, including various elements such as expenses related to data service operators (mobile Internet), device acquisition costs, and applicable service charges [30]. This multifaceted understanding of cost is crucial in evaluating the overall considerations that users weigh when adopting new technologies.

A body of prior research has consistently highlighted cost as a significant barrier to the utilization and acceptance of IoT products and services [30], [82]. Authors of [81] found that the cost is a significant determinant of the intention to adopt IoT technology within smart home environments. This suggests that understanding and managing the financial implications associated with adopting IoT technologies is essential for successful implementation and user acceptance. Similarly, [83] delved into the healthcare sector, emphasizing the relevance of the cost factor in doctors' intentions to use IoT healthcare devices, particularly during the challenging times of the COVID-19 pandemic. This underscores the importance of cost consideration as a hindering factor in the adoption process, influencing users' intentions as it is perceived as a hindrance in various contexts [81]. This highlights the role of the cost factor as a critical determinant in the acceptance and adoption of IoB technologies in a TM setting.

If users find IoB-based TM devices at an affordable cost, they are more likely to have a positive intention to adopt and accept them. Earlier studies have indicated that TM serves as a cost-effective means of accessing healthcare services remotely [84]. Consequently, researchers deduce that PC plays a significant role as a determinant of the behavioural intention to utilize the technology. The accessibility and convenience offered by TM have proven instrumental in overcoming geographical barriers and improving healthcare outcomes [15]. Therefore, the following hypothesis is proposed:

H9: Perceived Cost is significantly influencing user intention to adopt **IoB-based Telemedicine.**

6) Perceived Privacy Control (PPC): In the realm of healthcare services, individuals' receptiveness to innovative technologies is significantly influenced by the concern about privacy [67]. The critical examination of privacy and data security issues remains pivotal in shaping their willingness to share information [85]. PPC is defined as “an individual's perception that healthcare providers have control over the amount of information to be shared and disclosed with others” [85]. To ensure accurate diagnoses and effective treatment, patients are required to disclose their information to healthcare providers [68]. Nevertheless, the fear of social discrimination arises when it comes to sharing sensitive details like psychological and mental health issues, as well as conditions such as HIV, leading patients to hesitate in disclosing such information [68].

Given the sensitivity of personal health information for individuals, it becomes imperative to consider the impacts of data security factor when assessing an individual's acceptance of IoB-based TM devices [69]. Adoption of healthcare technology occurs when an individual perceives the benefits to outweigh the potential privacy risks, as indicated by [86]. Conversely, if this balance tips in favour of privacy risk, the technology is likely to be rejected [69], [86].

Regarding the adoption of TM in Saudi healthcare services, prior studies revealed that 90% of doctors expressed concerns regarding the privacy of patients [49], [86]. Interestingly, doctors are perceived to harbour the highest level of privacy concern, surpassing even that of the patients themselves [49]. This heightened level of concern among doctors may be attributed to their front-line role, which fosters an increased sense of responsibility for the protection of patient information.

Moreover, [67] revealed in their study that ensuring privacy in technological infrastructure requires a careful balance between confidentiality and practicality, as neglecting the latter can unintentionally hinder ease of use. This is particularly crucial in healthcare, where designing rational digital permissions is essential to safeguarding patient information while enabling efficient access for healthcare providers. Therefore, the following hypothesis is proposed:

H10: Perceived Privacy Control is significantly influencing user intention to adopt **IoB-based Telemedicine.**

C. Health Context

The impact of health considerations on individuals' perspectives, attitudes, and behaviours regarding the adoption of new healthcare technologies is significantly important [87]. Well-known factors include health interests, perceived health risks, perceived severity, perceived vulnerability, and health beliefs [28]. Understanding and addressing these considerations can help ensure that technologies are designed, implemented, and promoted to effectively meet user needs and concerns. Neglecting this could limit adoption or lead to suboptimal utilization. As healthcare technology evolves, understanding the complex interaction between health factors and technological advancements shapes how people perceive, embrace, or resist integration, influencing innovation and implementation [88], [87]. Notably for TM, studies show patients are more impacted by health factors than providers, indicating the significant role of patients' psychological and emotional considerations like concerns over remote consultation efficacy or misdiagnosis risk. Reviews highlight perceived health risk as pivotal in influencing technology acceptance in healthcare, underscoring its importance for frameworks like IoB-TMAF [9], [10].

Perceived Health Risk (PHR): The significance of risk as a pivotal determinant of human behaviour cannot be overlooked.

Perceived risk refers to an individual's assessment of the risk when deciding to engage in a particular action or activity [30]. The effects of risk and uncertainty are unavoidable in the realms of health and information communication technologies. The HBM theorizes that a person's health-related beliefs influence their health behaviours based on perceived susceptibility, perceived severity, perceived benefits of action, perceived barriers to action, and self-efficacy [28]. Additionally, the study [37] has classified perceived barriers in healthcare into seven groups, namely, time, financial, performance, privacy, physiological, social, and overall risk.

Building on that, this research study defines PHR for patients in terms of susceptibility, severity, and performance risk. The other factors were omitted either as they are described in the framework as separate factors or are based on the organizational level, which is out of the scope of this study. Performance Risk refers to the probabilistic perception that a TM system may harm patients by failing to provide adequate information about their health status due to the lack of physical examination [37]. Perceived Susceptibility refers to "an individual's belief about their likelihood of getting a health condition or problem" [28]. Perceived Severity is defined as "an individual's belief about the seriousness of a health condition or its potential consequences" [28]. Therefore, integrating the IoB with TM may shape individuals' beliefs and intentions by reducing these kinds of risks and enhancing their interest in health to engage in such practices.

According to the HBM, an individual's likelihood of engaging in health-related behaviours depends on their perceived susceptibility to and severity of a health threat [28]. When people believe they are more vulnerable to a condition or that it would have very serious personal consequences, they become more motivated to act to prevent its onset [89]. Applying this model to the adoption of online health services, research shows that higher perceived susceptibility to and severity of health threats are associated with stronger intentions to use these technologies as part of one's health management, as observed in the study by [53]. Essentially, the more an online health information seeker believes they are at risk for and could be seriously impacted by a health issue if they do not act, the more likely they are to adopt available online health services to empower their health decisions and behaviours.

Furthermore, research shows that when people perceive a health threat to be more severe or likely, they are more likely to adopt new health technologies to reduce and mitigate that threat [53], [36]. These studies found a positive relationship between an individual's risk assessment of a health issue and their intention to adopt health-related technology. Thus, understanding and addressing the multifaceted dimensions of perceived risk, including perceived threat, and performance aspects, is crucial for shaping individuals' beliefs and intentions, and fostering greater interest and engagement in health-related technologies. Therefore, the following hypothesis is proposed:

H11: Perceived Health Risk is significantly influencing user intention to adopt **IoB-based Telemedicine.**

D. Organizational Context

The organizational context plays a crucial role in explaining user acceptance of new technology. It refers to the various internal elements within an organization that influence the user's intention regarding the extent to which new technologies are embraced, implemented, and integrated into their operations [9]. These factors encompass a wide range of aspects related to the organization's culture, top management support, resources availability, and the alignment with existing system [20]. The literature review has clearly demonstrated that the control of the external factors, i.e., the support and resources accessible to the individual to enable them to engage in the behaviour, are the major influencers for adopting new technologies [33], [52]. The increased likelihood of investing in new technology is underscored by [17], who highlight that organizations with greater top management support and superior IT capabilities are more likely to adopt such advancements. Further, in terms of IoB-based TM, a recent review identified that the FC is the most significant factor under organizational context, influencing the adoption of the system for both patients and providers [9]. Thus, the factor related to the organizational context under investigation include FC represented in resources and management supports.

Facilitating Condition (FC): FC plays a paramount role in shaping the environment for technological adoption within an organization. These conditions encompass a set of elements ranging from adequate financial resources to the provision of skilled manpower, training courses, and technical infrastructure [46]. FC, one of the core constructs in the UTAUT model, is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system" [27]. Within the scope of this study, FC refers to an individual's perception of possessing the requisite knowledge, resources, and support for engaging in the IoB-based TM system.

The tendency to adopt technology in the TM is significantly influenced by sufficient technical infrastructure and organizational support [33]. As highlighted by [35], who found that healthcare providers are more motivated to engage in teleneurology when supported by robust infrastructure and organizational backing. These positive effects tend to amplify over time due to the availability of continuous assistance and guidance, underscoring the critical role of robust infrastructure and resources in sustaining technological integration [17], [35]. Additionally, top management support is crucial, as leadership commitment to innovation fosters an organizational culture open to change and experimentation, enhancing the acceptance of new technology [17]. Studies show that top management's commitment positively impacts the reception of new systems, promoting beliefs in their usefulness and ease of use, thereby facilitating widespread acceptance and successful integration within the organization [17]. Therefore, the following hypothesis is proposed:

H12: Facilitating Condition is significantly influencing user intention to adopt **IoB-based Telemedicine.**

IV. Conclusion and Future Work

This study aimed to investigate the core factors influencing the acceptance of adopting IoB-based TM among Saudi patients and healthcare providers. The proposed IoB-TMAF framework, grounded in the TAM, was developed to identify the key factors influencing the acceptance of this system by its primary users. These factors are derived from a variety of contexts including individual, technology, organization, and health.

The proposed model emerged as an important finding from the systematic review and the initial year of thesis work. It is expected to serve as a valuable resource for the Saudi Ministry of Health (MOH), healthcare policymakers, and practitioners by providing critical factors for the successful utilization of IoB-based TM in supporting diagnosis from the perspective of end-users, including providers and patients. Consequently, this is anticipated to improve the quality and efficiency of health services.

While this study lays a foundational framework, it is limited by its theoretical nature at this stage. The next steps involve empirical validation which is crucial for confirming the framework's applicability in real-world settings. Future research will involve a comprehensive study to gather data and analyze the model's performance and validity using a mixed method. This will include two sequential phases: a qualitative data collection phase involving semi-structured interviews with a small sample of twelve healthcare providers and patients, and a quantitative data collection phase through an electronic survey targeting at least 450 participants. The qualitative phase aims to explore the proposed model and other construct-based theories of behaviour by identifying users' feelings and perceptions regarding the implementation of IoB-based TM, allowing for potential refinements to the model. In the quantitative phase, the hypotheses will be tested, the proposed model will be empirically examined using Structural Equation Modeling (SEM), and the estimated effect size will be validated and refined.

By continuing this research, we aim to provide robust, empirically validated insights into the factors influencing the acceptance of IoB-based TM. This research has the potential to significantly enhance the quality and efficiency of healthcare services in Saudi Arabia by providing a model that is responsive to the needs and perspectives of both healthcare providers and patients.

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