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# Towards Sustainably Driven Telemedicine: Understanding the Determinants Affecting Elderly's Behavioral Intentions and Usage Behavior

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## ABSTRACT

*Background*: The sustainability aspect of telemedicine remains unclear in the extant literature. Despite the significant advancements in telemedicine, the behavioral intention and the actual usage of sustainably driven telemedicine (SDT) among the elderly have yet to be examined. This research aims to address these gaps through the theoretical lens of the extended unified theory of acceptance and use of technology (UTAUT).

*Methods*: A self-administered survey was used to collect data from 340 valid respondents. The data were analyzed using the partial least squares (PLS) method based on structural equation modeling (SEM).

*Results*: The result revealed that performance expectancy, effort expectancy, facilitating conditions, and social influence substantially influenced the elderly's behavioral intentions, while environmental concern and trust were insignificant. Moreover, gender significantly moderated the associations between performance expectancy, trust, and behavioral intentions.

*Conclusions*: The insights from this study can help telemedicine service providers, planners, government agencies, and policymakers develop and implement sustainable marketing strategies effectively. Additionally, this research contributes to the extant literature by unveiling the key constructs influencing the adoption of SDT.

**KEYWORDS:** telemedicine; elderly people; behavioral intentions; usage behavior; Bangladesh; UTAUT; PLS



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## ABBREVIATIONS

ICTs, information communication technologies; UN, United Nations; SDGs, sustainable development goals; IS, information systems; TAM, technology acceptance model; UTAUT, the unified theory of acceptance and use of technology; PLS, partial least squares; SEM, structural equation modeling

## INTRODUCTION

Telemedicine has transformed the landscape of medical services, serving as an alternative for effectively managing diseases and expanding the quality of life globally [1,2]. Marginalized groups in remote areas, in particular, have greatly benefited from telemedicine [3]. It involves the remote medical practice using advanced information communication technologies (ICTs) to deliver health care services [4]. Telemedicine reduces costs, improves quality, and increases access to healthcare for rural patients [5]. By offering a diverse range of clinical support and medical advice, telemedicine promotes healthier lifestyles and overall well-being for patients [1,6].

Research shows that telemedicine was less prevalent before the COVID-19 pandemic, particularly in developing countries [7]. Traditional infrastructure, insufficient technology, and lack of psychological readiness were the primary barriers to its large-scale adoption [7]. However, the pandemic demonstrated telemedicine's effectiveness and potential impact in managing COVID-19, shifting global perceptions [8,9], and offering comfort, safety, and flexibility for timely consultations from home.

The question of how telemedicine contributes to environmental sustainability remains unresolved in the extant literature. Recently, there has been growing attention on patient adoption and post-adoption behaviors related to telemedicine [10–13]. For instance, Adenuga, Iahad [10] examined the factors influencing telemedicine adoption among clinicians in Nigeria, finding that Nigerian clinicians see telemedicine as a shared responsibility requiring adequate support. Exploring the factors affecting telemedicine adoption, Thabet, Albashtawi [11] identified that performance expectancy, hedonic motivation, perceived security, and user satisfaction strongly trigger telemedicine adoption. Diverse aspects of telemedicine have also been explored in the extant literature, such as post-pandemic health management [9], telemedicine and AI integration [14], and managing diabetes in pregnancy [15].

However, current research falls short in addressing the sustainability aspects of telemedicine [16]. Only a few recent studies have investigated the relationship between telemedicine and sustainability [7,16,17]. For example, Chauhan, Jakhar [7] examined sustainable healthcare operations during a pandemic. Rana, Tandon [17] investigated how medical service quality, system quality, and information quality of telemedicine promote sustainable development in India. These studies reveal a notable gap in

the literature, underscoring the need for more thorough research on how telemedicine can align with and advance sustainability. Nassi, Riza [16] argued that telemedicine can boost the accomplishment of the United Nations (UN)s' Sustainable Development Goals (SDGs), a blueprint to achieve a better and more sustainable future for all. In particular, it can play a crucial role in achieving SDG #3 (Good Health and Well-being) and SDG #13 (Climate Action).

Linking telemedicine with the promotion of the SDGs is crucial to highlight the connection between human health and the environment, in which we live. Research indicates that healthcare is one of the most energy-intensive sectors, consuming huge natural resources and putting pressure on the environment [16,18]. Its negative environmental impacts are multifaceted, including air and water pollution, water scarcity, and harmful gas emissions [19]. Consequently, sustainability in healthcare has become a pressing issue, with telemedicine emerging as a promising tool in combating environmental degradation [16]. Given these perspectives, the current study seeks to uncover the drivers behind elderly individuals' behavioral intentions and actual use of SDT, particularly within the context of developing countries.

Research indicates a sharp rise in the elderly population worldwide, with developing nations expected to host 80% of elderly, accounting for 20% of the total population by 2050 [20]. Globally, elderly people are more vulnerable to chronic illnesses, physical impairments, and mental difficulties than other age groups. A study by Khanam, Streatfield [21] found that 60% of elderly had more than one chronic disease, and 80% had at least one chronic disease. Managing their care is challenging, as elderly people with numerous chronic diseases often require consultations with healthcare specialists. Physical visits with doctors subsequently become difficult for them (due to cost, health, time, and environmental issues).

From a sustainability perspective, little is known about whether elderly people's behavioral intentions and actual use of telemedicine are dragged by environmental factors. With the lens of the unified theory of acceptance and use of technology (UTAUT) with two extended constructs (environmental concern and trust), this research unveils what factors trigger elderly people's adoption and post-adoption behaviors in a developing country (Bangladesh). Factors influencing the elderly's intentions and behavior towards sustainably driven telemedicine (SDT) can also be related to the economic aspects of machine learning algorithms for various contexts, such as COVID-19 prediction, detection, and diagnosis, impacting hospital management and influencing pandemic awareness, anxiety, and fear of contagion [22,23]. Notably, this study is the first to empirically assess the drivers of SDT adoption in the healthcare sector.

The remaining part of the study is organized as follows: a review of the related studies in part 2 (RELATED STUDIES); literature review with

the theoretical framework and hypotheses development presented in part 3 (LITERATURE REVIEW); methodological part is presented in section 4 (METHODOLOGY); findings and analysis are presented in section 5 (FINDINGS AND ANALYSIS); theoretical and practical contributions are presented in section 6 (DISCUSSIONS); and lastly conclusions, limitations followed by recommendations are offered in section 7 (CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH DIRECTIONS).

## RELATED STUDIES

Scholars and practitioners globally have paid sharp attention to investigating and clarifying customer intention and acceptance of telemedicine. Notably, Kuen, Schürmann [24] addressed the effects of trust transfer and associated risks involved in the adoption of telemedicine. Highlighting telemedicine adoption in an emerging economy, Hossain, Amin [25] examined the moderating effects of patient engagement, satisfaction, and individual innovativeness. Lu, Wei [26] investigated users' telemedicine adoption behaviors within the context of promoting greener healthcare practices. The adoption of eHealth and mHealth in Bangladesh has been addressed in the extant literature, including Khatun, Heywood [27] on community readiness in local areas, Rahman and Hoque [1] on telemedicine adoption in rural areas of Bangladesh, Ahmed, Bloom [28] on eHealth and mHealth initiatives, Hossain, Yokota [29] on portable health clinics in Bangladesh, Andaleeb [30] on health information seeking behavior, Quaosar, Hoque [20] and Hoque and Sorwar [31] focused on factors affecting the adoption intention of mHealth services among the elderly people etc. In these studies, diverse theoretical models were underpinned to determine the influential factors of telemedicine adoption. We used the extended UTAUT, deemed crucial for many studies in health information technology [1,31]. As seen in Table 1, several studies have primarily focused on the technology acceptance model (TAM) and UTAUT in telemedicine/eHealth/mHealth adoption research. These studies mainly shed lights on the numerous factors influencing healthcare technology adoption rather than underpinning the sustainability context of telemedicine in developing country aspects.

Therefore, very limited research has been observed investigating the adoption of telemedicine, particularly in SDT, among elderly people in developing countries. So, it is relevant and essential to assess the factors influencing the adoption and use of SDT among elderly people in Bangladesh.

**Table 1.** Telemedicine/eHealth/mHealth adoption research summary in developed and developing countries.

| Authors | Theory/Model | Key Factors Affecting Adoption | Focusing on Sustainability |
|---|---|---|---|
| Lu, Wei [26] | TAM-Extended | Perceived usefulness, trust, social influence, economic benefits, and perceived severity. | ✓ |
| Hoque, Bao [32] | TAM-Extended | Trust, perceived usefulness, privacy, perceived ease of use, and gender. | × |
| Thabet, Albashtawi [11] | UTAUT-Extended and IS Success Model | Performance expectancy, hedonic motivation, perceived security, and user satisfaction. | × |
| Rahman and Hoque [1] | TAM-Extended | Technology anxiety, perceived usefulness, satisfaction, resistance to change, and social influence. | × |
| Upadhyay, Kamble [33] | UMEGA-Extended | Performance expectancy, perceived severity, effort expectancy, and perceived risk. | × |
| Alaboudi, Atkins [34] | UTAUT, TOE & ETSSM | Financial support, conformity with principal vision, mission, needs, reimbursement and limitations of the HCF. | × |
| Cimperman, Makovec Brenčič [35] | UTAUT-Extended | Performance expectancy, perceived security, computer anxiety, facilitating conditions, social influence, and effort expectancy. | × |
| Hoque and Sorwar [31] | UTAUT-Extended | Technology anxiety, social influence, effort expectancy, performance expectancy and resistance to change. | × |
| Hossain, Yokota [29] | TAM | Social reference, age, gender, and education. | × |
| Rho, Choi [36] | TAM | Self-efficacy, perceived usefulness, perceived ease of use, and perceived incentives. | × |
| Adenuga, Iahad [10] | UTAUT-Extended | Facilitating conditions, performance expectancy, reinforcement, and effort expectancy. | × |

Note: TAM: Technology Acceptance Model; TOE: Technology-Organisation-Environment; ETSSM: Evaluating Telemedicine Systems Success Model; UTAUT: Unified Theory of Acceptance and Use of Technology.

## LITERATURE REVIEW

### Sustainably Driven Telemedicine

According to Nassi, Riza [16], the term “sustainability” in telemedicine encompasses environmental conservation and the longevity of the

telemedicine projects. Building on Nassi, Riza [16], we focused on the environmental aspects of telemedicine to examine how individuals incorporate SDT into their adoption behavior. Research has shown that healthcare is one of the leading energy-consuming industries, affecting social and environmental factors like housing, air and water quality, and food security [16,19]. The French healthcare sector emits over 46 million tons of $CO_2$, nearly 8% of the country's total, while the UK's National Health Service (NHS) contributes 18 million tons, about a quarter of public sector emissions [37]. The global medical waste management market is expected to grow from USD 6.8 billion in 2020 to USD 9 billion by 2025 [38]. Eckelman and Sherman [19] demonstrated that its negative impacts are attributed to air and water pollution, causing detrimental effects on ecological balance. In contrast, to illustrate how telemedicine promotes the environment, Nassi, Riza [16] distinguished between face-to-face telemedicine services (physical visits) and distant telemedicine services (virtual visits and telephone consultations). Replacing physical visits with virtual or telephone consultations may subside transportations that cause carbon emissions. Sun, Chrysikou [18] emphasized the importance of electronic medical documentation, such as electronic health records and prescriptions. Maintaining digital records reduces paper and material use while allowing medical professionals to work remotely, cutting fuel consumption. Evidence shows telemedicine has a more positive environmental impact than traditional healthcare [39]. Hence, it is essential to accelerate the broader adoption of telemedicine because it is a crucial step towards sustainable medicine and climate resilience, aligning with SDG #13. However, limited studies have concentrated on the environmental aspects of telemedicine in the extant literature [18,39]. Importantly, SDT adoption is still nascent in the extant literature [26], which motivates the current study to delve into the domain.

**Conceptual Framework and Hypothesis Development**

Information systems (IS) based research has explored for a long time how and why people adopt new information technologies [40]. In recent years, several well-established theories and models have been applied to clarify the relationship between user beliefs, attitudes, and behavioral intentions in the telemedicine context, including TAM [41], IS success model [11], TOE, ETSSM [34], and UTAUT [10].

The UTAUT paradigm is a prominent theory that predicts users' technology adoption behavior [42]. Its simplicity, parsimony and robustness make it one of the most commonly used models [43]. Past research has confirmed that the UTAUT model is acceptable in telemedicine services [44–46]. Regardless of the facts, surprisingly, no extant research has addressed what environmental aspects of SDT impact users' adoption behavior by underpinning UTAUT. It would be insightful to employ UTAUT with the extended constructs (environmental concern and trust) in a relatively new research domain. In addition, applying the

model in the context of public health in Bangladesh can deepen understanding of the robustness of the model in explaining SDT acceptance and usage. Figure 1 presents the proposed model of the study.

To measure users' behavioral intentions and subsequent usage behavior, we incorporated performance expectancy, effort expectancy, social influence, facilitating conditions, environmental concern, and trust, with gender as a moderating factor for several key reasons. Although the original constructs of the UTAUT model (performance expectancy, effort expectancy, social influence, and facilitating conditions) have been widely applied in technology adoption studies, their impact on users' behavioral intentions within the context of SDT remains unexplored. Furthermore, including environmental concern and trust, along with the moderating role of gender, represents a novel contribution in a relatively underexplored context. To the best of our knowledge, integrating these constructs within the context of SDT is a novel contribution to this specific area of research, offering a robust framework for analyzing telemedicine adoption.

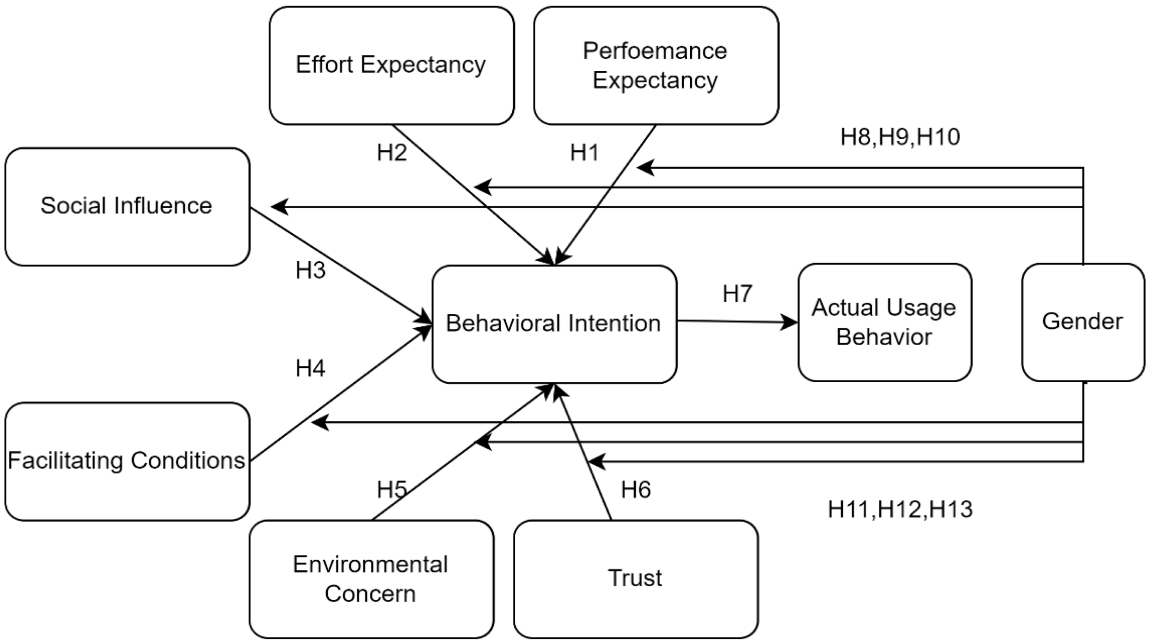


**Figure 1.** Proposed research model.

### Performance Expectancy (PE)

PE is defined as the extent to which a person perceives that using the system will help to accelerate job performance [47]. The perception of technology has strong explanatory power regarding elderly users' behavioral intentions [48]. Owusu Kwateng, Darko-Larbi [49] opined that users adopt a system if they believe it will improve their performance. Therefore, the elderly feel that personalized health concerns can be resolved with eHealth services [50]. Hoque and Sorwar [31] also revealed that PE is a major predictor of mHealth acceptance by the elderly. They

found users' PE is significantly connected with their acceptance of behavior. Similarly, we can assume PE would significantly impact the behavioral intentions of Bangladeshi people to adopt SDT. Thus, it was hypothesized that:

H1: Performance expectancy positively influences elderly's behavioral intention to use SDT.

**Effort Expectancy (EE)**

EE is implied as the magnitude of ease related to the usage of the system [47]. The ease of using that technology strongly influences the adoption behavior of the elderly [51,52]. Hossain, Amin [25] argued that a straightforward, flexible, and user-friendly technology can quickly attract users and enhance the engagement of telemedicine services. In a similar context, Cimperman, Makovec Brenčič [35] concluded that EE significantly influences users' acceptance of telehealth services. If it is relatively easy for the elderly to use telemedicine, the usage rate is expected to rise accordingly [41]. Thus, it was hypothesized that:

H2: Effort expectancy positively influences the elderly's behavioral intention to use SDT.

**Social Influence (SI)**

SI is known as the degree to which an individual perceives the importance of others to believe that the new system should be used [47]. SI plays a significant role when considering technology acceptance by the end users [51]. Previous studies have shown a positive association between SI and telemedicine adoption [52]. Pan and Jordan-Marsh [53] revealed that SI was an important determinant of technology usage intention among the elderly people. It is unclear whether SI can be influential in the context of SDT. Therefore, we postulated the following hypothesis;

H3. Social influence positively influences elderly people's behavioral intention to use SDT.

**Facilitating Conditions (FC)**

FC is characterized as how much an individual trusts that a specialized and structural foundation exists to upkeep the utilization of the system [47]. For older users, facilitators such as accessibility and availability of technical assistance considerably enhance BI in ICT usage [45]. Age-related specifications, like screen size, color scheme, and symbol usage, significantly impact how much older people want to use the programs [54]. It was shown that FC had a direct positive impact on BI using telemedicine [52]. So, the study hypothesized that:

H4: Facilitating conditions positively influence elderly people's behavioral intention to use SDT.

### Environmental Concern (EC)

EC plays a crucial role in shaping pro-environmental behavior. This impacts individuals' awareness and actions regarding environmental issues (e.g., global warming and pollution) [55]. Studies have shown that people with high environmental concerns are more likely to prioritize sustainable materials while making purchase or adoption decisions. For example, Lee [56] highlighted that EC significantly impacts consumers' sustainable behaviors. Maichum, Parichatnon [57] found that Thai consumers' EC substantially influences their attitudes and purchase intentions towards environmentally friendly products. Overall, the depth of EC is a strong determinant of sustainable consumer practices [57]. Based on these insights, we posit that the elderly's EC may significantly impact their behavioral intentions to use SDT services. Thus, the study proposed that:

H5: Environmental concern positively influences elderly's behavioral intention to use SDT.

### Trust (TR)

TR is indicated as willing to depend on a trusted exchange partner [58]. Trust plays a major role in patients' intention to reveal their health status and medical data in healthcare systems [59]. The future success of telemedicine services depends entirely on the trust of the individuals who use them [60]. In the context of SDT, individuals believe that the technologies they use are environmentally friendly. In effect, van Velsen, Hermens [61] advised incorporating trust in the realm of telemedicine service acceptance to enhance the superiority of services among the elderly. Therefore, the study proposed the hypothesis:

H6: Trust positively influences elderly's behavioral intention to use SDT services.

### Behavioral Intention to Actual Usage Behavior (AUB)

The operationalization of BI is the degree to which an individual believes they are willing to adopt IS [62]. BI is the predictor of accepting technology in health [45], and it is the degree of users' behavioral intention to adopt telemedicine services [63]. Previous researchers revealed that BI influences users' usage behavior (AUB) when using health technology. Therefore, this study hypothesized the following:

H7: Behavioral intention positively influences elderly's actual use of behavior of SDT.

### Moderating Effects of Gender

Research shows gender perceptions and relative differences between men and women regarding their beliefs and values in their workplace [64]. Gender differences in adopting new technology are also important [65]. For example, living alone was associated significantly with symptoms of

depression and suicide in elderly men but not in elderly women [66]. Gender was found to have moderating effects on technology usage intention by Sieverding and Koch [67], who researched the role of gender and its many elements surrounding the attitude toward technology acceptance. Additionally, Anderson [68] found that women have a less positive attitude toward technology acceptance, which could ultimately impact the adoption of new technologies. According to Rothschild [69], social influence and performance expectations are moderated by gender. Zhang, Guo [70] addressed gender as an mHealth adoption moderator and uncovered that men have a greater intention to adopt than women. There appear to be considerable gender disparities in receiving informal home care for older adults in developed countries [71].

It is therefore believed that, in the context of SDT, gender will have a significant moderating effect on the use of telemedicine services, particularly in developing nations whose social structure is predominately male. So, in the context of Bangladesh, this research addressed the influence of gender on SDT adoption, and the following hypotheses were developed:

H8: Gender positively affects the relationship between performance expectancy and behavioral intention.

H9: Gender positively affects the relationship between effort expectancy and behavioral intention.

H10: Gender positively affects the relationship between social influence and behavioral intention.

H11: Gender positively affects the relationship between facilitating conditions and behavioral intention.

H12: Gender positively affects the relationship between environmental concern and behavioral intention.

H13: Gender positively affects the relationship between trust and behavioral intention.

## METHODOLOGY

### The Study's Context

Bangladesh has one of Southeast Asia's emerging mobile and telecommunications industries. However, the historical backdrop of telemedicine services in Bangladesh traces back to 1999, when not many private organizations began services that were highly inadequate opportunities. In 2011, telemedicine services were formally inaugurated at eight hospitals as a part of the National Digital Innovation Fair. Furthermore, in 2012, 10 telemedicine centers were opened in various hospitals [72]. A total of 26 initiatives have been taken in Bangladesh by public and private organizations with direct or indirect associations with eHealth and mHealth services. Additionally, the government launched an enhanced telemedicine service nationwide from 42 hospital-based clinics. Hence, the Bangladesh Government is making significant policy

formulation efforts to build vast ICT infrastructures for telemedicine services [1]. For example, one of the most well-known telemedicine projects, Access to Information (A2I), has clinicians providing value-added medical advice. People can take up various services such as medical advice, doctor appointments, obtaining the results of medical tests, and obtaining personal health information via telemedicine services. Compared to the developed countries, the intention to adopt telemedicine among elderly people is still significantly low in Bangladesh. Despite the numerous telemedicine ventures by government and non-government agencies for managing healthcare, many ventures have been halted, highlighting how SDT can foster environmental conservation along with other utilitarian benefits. These raise questions regarding the factors that influence the intention to adopt SDT.

**Measures**

To guarantee the legitimacy of all measures, the measurement items for latent constructs were derived from the prior studies and modified according to the SDT adoption behavior. The items for performance expectancy, effort expectancy, social influence, and facilitating conditions were derived from the UTAUT model developed by Venkatesh, Morris [47]. On the other hand, environmental concern was adopted from Kilbourne and Pickett [73], and trust was derived from Gefen, Karahanna [74], whereas behavioral intention and actual usage behavior were adapted from Venkatesh, Morris [47]. A well-structured questionnaire was developed with the consent of two industry experts and one professor. The questionnaire includes two parts. Part A contains the construct items that measured different facets of SDT related to antecedents of behavioral intents of elderly people to use, and part B contains the respondents' demographic profile.

**Sampling and Data Collection**

This study employed a positivist methodology based on the recommendation of Lee [75]. The method is deemed suitable for exploring the elderly's behavioral intentions and actual use of SDT services. A survey of elderly people was conducted in various areas in the southern part of Bangladesh. Due to lacking a list of telemedicine end-users, we selected the convenience sampling method for its cost-effectiveness and common use in IS research [76].

Initially, we developed an English questionnaire, which was later translated into Bengali by a skilled professional translator to capture respondents' opinions accurately. A standard 5-point Likert scale, ranging from strongly agree (5) to strongly disagree (1), was utilized to gather cognitive information. Then, a pilot study with 20 elderly people was carried out to assess the questionnaire's effectiveness and appropriateness. Based on the pilot study's findings, we made the necessary modifications.

At the final data collection stage, a well-trained team of four interviewers was recruited. They conducted face-to-face interviews to recruit potential participants, as postal, Internet, and telephone systems might be unreliable in Bangladesh. No gifts or incentives were offered to avoid response bias. Data collection took place from January 2, 2024, to March 15, 2024. Approximately 380 questionnaires were distributed, with 350 returned, resulting in a 92 percent response rate. Out of the 350, 10 were incomplete and excluded from the analysis, leaving 340 valid respondents for the study.

In order to ensure ethical standards, we provided approval forms and information sheets to all the respondents explaining the study's objective, functions, features, and brief notes about SDT. We ensured confidentiality and anonymity.

## FINDINGS AND ANALYSIS

The demographic characteristics of the respondents are presented in Table 2. Most participants (80% of the total population) were aged 50 years and above. The significant descriptive statistics indicated that most participants were male (54%) with SSC level or below education level (73.50%). About 56% of the respondents also have less than 4 years of telemedicine services experience. On the other hand, among respondents, 67% of them have 1 to 5 years of ICT usage experience, and 27% have more than 5 years of ICT usage experience.

**Table 2.** Demographics profiles of the participants.

| Variables | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 184 | 54 |
| Female | 156 | 46 |
| **Level of Education** | | |
| SSC/Below SSC | 250 | 73.50 |
| HSC | 60 | 17.60 |
| Bachelor and above | 30 | 8.90 |
| **Telemedicine Usage Experiences** | | |
| 1 to 3 years | 190 | 56 |
| 4 to 6 years | 80 | 23 |
| 7 to 9 years | 50 | 15 |
| More than 10 years | 20 | 6 |
| **ICT Usage Experiences** | | |
| 1 to 5 years | 230 | 68 |
| 6 to 10 years or more | 110 | 32 |

### Measurement Model: Validity and Reliability Test

With the measurement model, we evaluated each construct's convergent, discriminant, and internal reliability [77]. The *p*-value of 0.00 for Bartlett's test and the KMO measure of 0.878 indicates that our data was appropriate for factor analysis. The measurement model's goodness of fit was acceptable, as evidenced by its CMIN/DF of 1.792, RMSEA of 0.040, and values of above 0.9 for the NFI, GFI, and CFI (0.938, 0.914, and 0.979, respectively). The internal consistency, reliability, and convergent validity analyses were performed using a confirmatory factor analysis (CFA).

According to Schmelkin [78], CFA is a frequently used technique to verify if a latent concept is unidimensional. Table 3 shows that each item was loaded independently of the other factors and that no issues with factor analysis were discovered. The item loadings of all manifest variables on their corresponding latent variables, which are greater than their loadings with all other latent variables, further support the discriminant validity of the model.

The loadings of the items, average variance extracted (AVE), composite reliability (CR), and Cronbach's alpha ($\alpha$) were satisfactory. To satisfy the convergent validity requirement, the AVE value and related item loadings must be greater than 0.5 [79]. The CR and $\alpha$ values for all constructs exceed 0.70 and 0.80, respectively, above the suggested threshold of 0.7. According to the data shown in Table 3, the AVE values for all constructions exceed 0.52. However, the square roots of the AVE for each construct (see Table 4) were considerably greater than the inter-correlations across the latent constructs [79]. To satisfy discriminant validity criteria, the diagonal elements must be larger than the entries in corresponding correlations between the constructs [80]. Thus, all components in our study model demonstrate the ability to differentiate from one another, and the model itself is statistically valid.

**Table 3.** Item loadings with AVE, CR, and $\alpha$ values.

| Constructs | Items | Loadings | AVE | CR | $\alpha$ |
|---|---|---|---|---|---|
| AUB | AUB1 | 0.8966 | 0.7814 | 0.9346 | 0.9066 |
| | AUB2 | 0.8621 | | | |
| | AUB3 | 0.8734 | | | |
| | AUB4 | 0.9031 | | | |
| BI | BI1 | 0.9067 | 0.7914 | 0.9192 | 0.8680 |
| | BI2 | 0.8677 | | | |
| | BI3 | 0.8939 | | | |
| EE | EE1 | 0.8603 | 0.6934 | 0.9004 | 0.8525 |
| | EE2 | 0.8178 | | | |
| | EE3 | 0.8116 | | | |
| | EE4 | 0.8403 | | | |

**Table 3.** *Cont*.

| Constructs | Items | Loadings | AVE | CR | $\alpha$ |
|---|---|---|---|---|---|
| FC | FC1 | 0.8922 | 0.7663 | 0.9291 | 0.8984 |
| | FC2 | 0.8634 | | | |
| | FC3 | 0.8841 | | | |
| | FC4 | 0.8613 | | | |
| PE | PE1 | 0.8574 | 0.6933 | 0.9003 | 0.8527 |
| | PE2 | 0.8566 | | | |
| | PE3 | 0.8122 | | | |
| | PE4 | 0.8028 | | | |
| SI | SI1 | 0.8484 | 0.6985 | 0.9026 | 0.8563 |
| | SI2 | 0.8414 | | | |
| | SI3 | 0.8223 | | | |
| | SI4 | 0.8307 | | | |
| EC | EC1 | 0.8583 | 0.6370 | 0.8737 | 0.8509 |
| | EC2 | 0.8993 | | | |
| | EC3 | 0.7631 | | | |
| | EC4 | 0.6481 | | | |
| TR | TR1 | 0.7351 | 0.6768 | 0.8927 | 0.8483 |
| | TR2 | 0.7714 | | | |
| | TR3 | 0.8927 | | | |
| | TR4 | 0.8803 | | | |

**Table 4.** Discriminant validity test (Fornell-Larcker criterion).

| Constructs | AUB | BI | EE | FC | PE | SI | EC | TR |
|---|---|---|---|---|---|---|---|---|
| AUB | **0.8839** | | | | | | | |
| BI | 0.8100 | **0.8896** | | | | | | |
| EE | 0.5388 | 0.5590 | **0.8327** | | | | | |
| FC | 0.3493 | 0.4122 | 0.3838 | **0.8754** | | | | |
| PE | 0.5480 | 0.6193 | 0.5849 | 0.4321 | **0.8326** | | | |
| SI | 0.4187 | 0.4693 | 0.6772 | 0.3449 | 0.4150 | **0.8357** | | |
| EC | −0.0041 | −0.0386 | −0.0183 | −0.0001 | −0.0058 | −0.0014 | **0.7981** | |
| TR | 0.1247 | 0.1256 | 0.1694 | 0.1373 | 0.2741 | 0.1784 | 0.0556 | **0.8226** |

### Structural Model: Hypothesis Testing

Once the measurement model's validity, reliability, and fit indices were satisfactory, the structural model and hypotheses were evaluated with a confidence level set at $p \leq 0.05$. The study used the partial least squares

structural equation modeling (PLS-SEM) technique. The bootstrap approach evaluated the associations between dependent and independent variables. This included assessing the path coefficient ($\beta$) and $t$-statistics. As shown in Table 5, there are significant relationships between PE and BI ($t$ = 4.8979, $\beta$ = 0.4182, $p$ < 0.05), EE and BI ($t$ = 2.3245, $\beta$ = 0.1817, $p$ < 0.05), SI and BI ($t$ = 2.1193, $\beta$ = 0.1415, $p$ < 0.05), FC and BI ($t$ = 2.2333, $\beta$ = 0.1212, $p$ < 0.05), and BI and AUB ($t$ = 43.1285, $\beta$ = 0.8868, $p$ < 0.05). Therefore, H1, H2, H3, and H4 were corroborated. However, the relationships between EC and BI ($t$ = 0.5152, $\beta$ = −0.0293, $p$ > 0.05) and TR and BI ($t$ = 1.476, $\beta$ = −0.0601, $p$ > 0.05) were not statistically significant and did not provide evidence for supporting H5 and H6 in the present investigation. Furthermore, the $R^2$ values for BI (0.47) and AUB (0.78) exceed the required thresholds.

**Table 5.** Results of the structural model.

| Hypothesis | Path | $\beta$ | $t$-Statistics | $p$-Value | Comments |
|---|---|---|---|---|---|
| H7 | BI -> AUB | 0.8868 | 43.1285 | 0.001 | Accepted |
| H2 | EE -> BI | 0.1817 | 2.3245 | 0.05 | Accepted |
| H4 | FC -> BI | 0.1212 | 2.2333 | 0.05 | Accepted |
| H1 | PE -> BI | 0.4182 | 4.8979 | 0.01 | Accepted |
| H3 | SI -> BI | 0.1415 | 2.1193 | 0.05 | Accepted |
| H5 | EC -> BI | −0.0293 | 0.5152 | 0.60 | Rejected |
| H6 | TR -> BI | −0.0601 | 1.4760 | 0.141 | Rejected |

In Table 6, the moderating effect of gender is presented. The table shows that in terms of PE and BI, $t$-value (1.526 versus 3.316), $p$ < 0.05). Females had a greater impact of PE on BI. On the other hand, in the case of TR and BI, $t$-value (0.042 versus 3.253), $p$ < 0.05). Although, TR had no significant impact on BI. But, the relationship between TR and BI is moderated by gender. Therefore, two hypotheses were supported.

**Table 6.** Moderating effect of gender.

| For Male | | | For Female | | Moderated/Not Moderated |
|---|---|---|---|---|---|
| Relationship | $\beta$-Value | $t$-Statistics | $\beta$-Value | $t$-Statistics | |
| BI -> AUB | 0.185 | 1.940 | 0.188 | 1.723 | Not Moderated |
| EE -> BI | 0.149 | 2.245 | 0.219 | 3.074 | Not Moderated |
| FC -> BI | 0.490 | 4.865 | 0.287 | 3.483 | Not Moderated |
| PE -> BI | 0.142 | 1.526 | 0.296 | 3.316 | Moderated |
| SI -> BI | −0.142 | 2.402 | −0.170 | 2.074 | Not Moderated |
| EC -> BI | −0.118 | 1.945 | −0.051 | 0.464 | Not Moderated |
| TR -> BI | −0.003 | 0.042 | −0.242 | 3.253 | Moderated |

## DISCUSSIONS

This research examined the main influential factors accountable for SDT adoption among elderly people. Since telemedicine services in developing countries have not been as successful as expected, the research results are consistent with the outcomes of the literature on applying the UTAUT model to eHealth/mHealth adoption [31,81]. These studies support the empirical findings regarding PE, SI, EE, FC, and BI in SDT adoption intention and usage. As shown in the results section, PE was observed to be among the most substantial factors, followed by EE predicting behavioral intentions, which was supported by Lee and Han [12]. In other words, clients who adopt telemedicine services widely are more likely to see such cutting-edge channels as more resourceful, productive, and supportive in their everyday lives [82].

Moreover, users are very concerned about the ease of use of existing SDT services. Indeed, SI plays a significant role in predicting behavioral intention. Alternatively, Bangladeshi users are more likely to depend on suggestions from their social system to use telemedicine services. On the other hand, FC positively impacts behavioral intention towards SDT services, which is consistent with [83]. Patients who used SDT services also paid specific attention to FC. The accurate use of telemedicine requires significant funds, and customers cannot use this service without the availability of such resources. This, in turn, makes the role of FC more important for telemedicine users.

This study identified that TR did not have a significant role in BI's use of SDT. This finding is inconsistent with [84]. Additionally, ICT usage by women is highly influenced by men [28]. Although TR had no significant impact on BI, the gender moderates TR and BI. This study indicates that females depend more on trust when selecting technology for healthcare services. In addition, the association between PE and BI is also moderated by gender, supported by Rho, Kim [41].

This study demonstrated that EC is negatively associated with BI in adopting SDT services. This finding is aligned with Jia, Nadeem [85] and contrasts with Islam and Tsuji [86], Guo, Sun [87] & Hoque and Sorwar [31]. The results may reflect that most older adults in Bangladesh do not consider the environmental aspects of telemedicine. Still, most older adults depend on conventional health services [88]. On the other hand, due to telemedicine's user-friendly nature, elderly people are not afraid of using these services in Bangladesh. As a result, they are likely to use the service, accelerating the adoption rates. Carlsson [89] confirmed that the elderly's BI adopts the more telemedicine, the more technology is used. Ifinedo [46] also stated that there is a technology adoption connection between user BI and AUB. The study found that TR and BI have an insignificant co-relationship. Surprisingly, these findings may be unexpected but could reflect the status of Bangladesh's healthcare services. However, a moderating effect of gender exists between TR and BI. Females are more dependent on trust than males. So, telemedicine authorities must

focus on building trust among female users to increase the acceptance of SDT services in Bangladesh.

### Theoretical and Managerial Implications

This research contributes to informing the research body about telemedicine services design and growth to maximize its adoption rate in developing nations. By including two fresh constructs (trust and environmental concern) alongside the constructs of UTAUT and by suggesting innovative causal routes between the key antecedents of behavioral intentions, this research extends beyond what is recommended in the UTAUT model [47]. In the current literature, these extra-important determinants of SDT adoption were ignored. In addition, the researchers described how gender differences affect behavior, revealing that gender moderates the strengths of the relationship between PE and TR on BI. This research adds to the literature on IT adoption behavior in developing nations and accounts for factors particular to this setting.

From a methodological perspective, this research offers significant insights into the factors influencing the adoption of SDT. A conceptual approach is absent in technology acceptance modeling as studies focus on a particular technology or service. This research is, therefore, one of the leading studies to extend the UTAUT model by examining innovative technology (telemedicine services), and new users (elderly people) and exploring a new context (i.e., Bangladesh). The amalgamation of these two extra variables with the UTAUT model is remarkable in the literature, and no such mix has been made in the context of a developing nation.

The empirical results may provide strategies for implementing IT in healthcare services in Bangladesh. Considering the large investment in global digital health systems, ensuring people genuinely embrace this system is paramount. Adopting SDT services is vital for patients, healthcare organizations, physicians, nurses, etc. Because patients can improve their health status by using telemedicine technology, healthcare organizations can develop telemedicine systems as an additional source of revenue in the healthcare industry. Therefore, the important managerial implications presented in this paper are identifying the factors that may help healthcare providers offer better and more competitive services to their patients through SDT. The findings of this study might also be used to help the government, telemedicine service providers, planners, health IT managers, clinicians, and other healthcare institutions to inspire patients to adopt SDT as a means of treatment, monitoring, and consultation, which can help to lessen the burden of diseases with fewer doctors and could also improve the quality of life and environment.

Moreover, developing countries can adopt SDT that account for diverse technological and healthcare access challenges. Healthcare practitioners should focus on scalable solutions, such as using mHealth platforms, low-bandwidth technologies, and training programs for healthcare workers.

In addition, they should prioritize infrastructure assessments, local partnerships, and adaptable technologies like SMS or app-based consultations, ensuring cost-effective and culturally appropriate telemedicine practices. By leveraging existing resources and integrating advanced tools, SDT can expand healthcare access and improve patient outcomes in resource-limited settings.

## CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH DIRECTIONS

The number of healthcare institutions is insufficient in developing countries; therefore, the elderly people are mostly deprived of proper healthcare services. Healthcare support through SDT can benefit elderly people worldwide, particularly in developing countries. A dearth of communication, education, and health awareness in developing countries creates additional challenges and higher costs. SDT provides a perspective on overcoming the challenges in healthcare provision and promoting environmental conservation. In this study, the researchers proposed and empirically tested a conceptual model that identifies various factors shaping individuals' intention to use SDT services in Bangladesh. It was found that while PE, EE, SI, and FC positively influence individuals' technology use intention, TR and EC were insignificant. Additionally, it was found that PE, BI, TR, and BI were moderated by gender. This study is a milestone for developing countries to examine the factors influencing the adoption of SDT services in Bangladesh.

Despite the implications of the study, there are likewise a few confinements. Firstly, this research was directed at selected elderly respondents from southernpart of Bangladesh. Henceforth, the outcomes may not give a genuine impression of the attitudes of the entire population towards the intention to use SDT services. Since consumer buyer behavior differs from an individual in one region to an individual in another area, the kinds of predictors might vary depending on the nature of the telemedicine services. It is therefore necessary to explore extra influential variables in future studies. Secondly, the model developed in this research can be connected to other developing nations with a less progressed structure for telemedicine than anticipated dimension. Finally, the model proposed in this research may also be linked to adopting different eHealth services such as mHealth, electronic health records, telecare, telehealth, and video conferencing. With the living vision of digital Bangladesh, an intelligent advance forward for the administration is turned into the steward of telemedicine and bolsters the connection between innovation and health in this nation.

## DATA AVAILABILITY

The study's dataset is available from the authors upon reasonable request.

## AUTHORS' CONTRIBUTIONS

MAK designed and investigated the study; IZ, MAK, MSR, and AAM collected and analyzed the data; MAK and MSR wrote the paper with input from all authors.

## CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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