

## Impact of Telemedicine in Managing Chronic Conditions Within Family Medicine Practices in Abha City PHCs.

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### ABSTRACT

**Background:**Telemedicine is a cornerstone of chronic disease management worldwide and has only intensified following the COVID-19 pandemic. In Saudi Arabia, the application of the national digital-health plan under Vision 2030 has given prominence to telehealth delivery in primary health care (PHC) settings. Nevertheless, patient experience and quality of communication in family medicine clinics in Abha City have not been studied.

**Objectives:**To assess the overall patient experience with telemedicine for chronic condition management and identify the factors influencing satisfaction among adults attending PHCs in Abha City, Saudi Arabia.

**Methods:**A cross-sectional survey was conducted among 400 adults diagnosed with chronic conditions who had used telemedicine services in the past year. Data were collected using an electronic questionnaire covering demographics, telemedicine exposure, communication satisfaction, perceived benefits, and difficulties. Descriptive statistics, t-tests, ANOVA, Pearson correlations, and multiple linear regression analyses were performed using Python. Ethical approval was obtained from the Asian Ethics Committee (Ref: F9-2-2025).

**Results:**Participants reported high satisfaction with telemedicine (mean  $\pm$  SD = 4.11  $\pm$  0.87). Communication satisfaction showed a strong positive correlation with overall experience ( $r = 0.64$ ,  $p < 0.001$ ). The regression analysis identified communication quality ( $\beta = 0.54$ ,  $p < 0.001$ ) and perceived benefits ( $\beta = 0.07$ ,  $p = 0.03$ ) as significant positive predictors, whereas reported difficulties ( $\beta = -0.11$ ,  $p = 0.011$ ) and age  $\geq 61$  years ( $\beta = -0.57$ ,  $p = 0.035$ ) were negative predictors. Sex differences were not statistically significant ( $p = 0.51$ ).

**Conclusion:**Telemedicine yielded high satisfaction among patients with chronic conditions in the Abha PHCs. Communication quality was the strongest determinant of positive experiences. Strategies to enhance virtual communication skills, digital literacy, and user support are essential to optimize telehealth outcomes within Saudi Arabia's Vision 2030 framework (1–3)....

**Keywords:** Telemedicine, Chronic disease management, Patient satisfaction, Primary health care, Saudi Arabia

## 1. INTRODUCTION

Worldwide, chronic non-communicable diseases (NCDs), such as diabetes mellitus, hypertension, cardiovascular diseases, and chronic respiratory diseases, are major causes of morbidity and mortality. These make up 71% of deaths globally, which in turn calls for continuous, coordinated, and easy-to-report care (1). Effective reduction of NCDs risk factors requires continued involvement of patients, longer follow-up duration, and collaboration among primary healthcare (PHC) providers (2). Nevertheless, traveling can be an impediment to traditional face-to-face meetings, as can the scarcity of time slots and dispersion of populations, especially in semi-urban or rural areas.

### Increasing Use of Telemedicine for Chronic Disease Management in an Aging Population

In addition, the emergence of telemedicine, which involves the delivery of health services at a distance using information and communication technologies, has revolutionized the delivery of care for chronic diseases worldwide (3). The use of remote consultation for monitoring, training, and rehabilitation is multifaceted. Telemedicine improves access, reduces costs, and promotes continuity of care for patients who are challenged to attend regular PHC appointments. Telemedicine interventions for chronic conditions were found to lead to significant improvements in clinical outcomes, patient adherence to treatment, and quality of life: a meta-analysis of 43 studies (4). Telemedicine adoption has rapidly expanded during the COVID-19 pandemic, shifting from an experimental adjunct to a go-to-care model (5). A systematic review showed that telehealth interventions positively affected clinical endpoints, mainly for diabetes, hypertension, and chronic obstructive pulmonary disease, and patients were satisfied (6). However, satisfaction results not only from convenience but also from the quality of communication and trust established during virtual encounters (7).

### The Saudi Arabian Context

The development of telemedicine in Saudi Arabia has been swift in light of the Vision 2030 National Transformation Program, which calls for the health sector to undergo significant digitalization (8). Applications such as Sehhaty, Mawid, and Seha Virtual Hospital have been introduced to facilitate access among all residents and ease the load on healthcare systems (9). For example, the Ministry of Health's Call Center 937 offers around the clock medical advice and support to thousands of individuals daily (10).

Nevertheless, there is still a paucity of research on patient experience and satisfaction with telemedicine services in Saudi PHCs. Earlier nationwide surveys concentrated mainly on tertiary hospitals or the general population, not on patients with chronic diseases receiving care in family medicine clinics (11,12). Additionally, there is limited research on the combined effects of communication satisfaction, duration of telemedicine use, number of virtual visits, perceived advantages, and barriers to patient experience. These factors must be understood to enhance the design and program sustainability of PHC telemedicine.

### The Significance of Patient Experience

A number of factors affect patient experience, such as access to care, usability of technology, provider communication, perceived empathy, and trust in the care process (13). Studies have shown that quality of communication is one of the strongest predictors of telemedicine satisfaction (14,15). Husted et al. (16) using the same analysis also found that when providers are clear, empathetic, and attentive during virtual visits, patients tend to be more satisfied, more adherent, and experience better self-management outcomes. However, low digital literacy or frequent technical problems lead to reduced patient participation and increased frustration (17).

A Saudi study among users of virtual healthcare showed that perceived communication effectiveness was a stronger determinant of telemedicine satisfaction than convenience and cost (18). Similarly, the evaluation of telemedicine in chronic disease management at the clinic demonstrated that clinicians and patients were able to sustain frequent two-way communication, leading to improved clinical control and patient empowerment (4,6,15). These results underscore the fact that technology enables care, whereas communication defines quality. Abha City PHCs and Telemedicine Services

Abha City, situated in the Asir region, is in the southwestern part of Saudi Arabia. Seizing Abha City makes it an ideal site for examining telemedicine in chronic-care delivery. The geography is mountainous and its isolated population made the region's mountainous geography and population isolated provides a challenge for regular, in-person, follow-up. Diabetes, we observed nonadherence of patients to telemedicine visits in diabetes, hypertension, and dyslipidemia (19). PHCs in Abha cater to a multitude of patients with a high incidence of complications of these development disorders. The monotonic trend in access to telemedicine over the years through PHCs. Telemedicine has been increasingly introduced into the daily operation of PHCs to raise access to care, continuity of care, and patient follow-up for chronic conditions. However, there is a paucity of local data on patient experiences and satisfaction with these services.

"Assessing telemedicine in Abha PHCs will provide us with crucial information on how to enhance digital health in a real-world family-medicine setting." In addition to clinical parameters, exploring the subjective experience — satisfaction, barriers, and perceived benefits — helps tailor telehealth programs to patient needs and national policy directions.

## Theoretical Foundation

This study is conceptualized based on the Technology Acceptance Model (TAM) and a Patient-Centered Care Framework. Perceived usefulness is the extent to which a person believes that using a particular technology will enhance his or her job performance, while perceived ease of use is the degree to which one expects the use of a technology to be free from effort (20). #Humanized version

Opinion: What degree of patient benefits and platform usability translate into use? The Patient-Centered Care Framework aligns with the TAM and highlights that empathy, shared decision-making, and responsive communication are necessary conditions for trust and satisfaction (21).

## Rationale and Research Gap

Despite global reports affirming the effectiveness of telemedicine in enhancing clinical outcomes for chronic diseases (4,6,7), very few have explored factors influencing patient experience in PHC models, particularly in the context of middle-income countries like Saudi Arabia. Local research affirms positive attitudes towards telemedicine but also identifies challenges as technical difficulties and connectivity issues are barriers (11,12,18). Age-related disparities in satisfaction also remain, with elderly users more frequently expressing discomfort and lack of confidence in digital consultations (17,22).

This study aims to address these gaps by investigating the extent to which satisfaction with communication, telemedicine duration, consultation frequency, perceived benefits, and difficulties influence the overall patient experience of telemedicine for chronic condition management in PHCs in Abha City.

## Objective of the study

To evaluate the experiences of adult patients using telemedicine at PHCs for chronic diseases in Abha City. To assess the association between telemedicine satisfaction and sociodemographic, clinical and communication-related variables were selected.

A multivariable linear regression model was developed to determine independent predictors of patient experience.

## Contribution and Significance

This study adds a body of evidence and insight by addressing telemedicine at the PHC level for chronic condition management in Abha City, which is relevant at both local and global scales. The results can be used to guide national strategies on digital health, empower PHC managers to enhance communication, and provide guidance on where the health system may need additional assistance.

As it investigates patient experience rather than solely the clinical end points, the study supports the World Health Organization's framework on person-centered digital (PCD) health and the Saudi Vision 2030 aspiration of delivering high-quality, patient-centered care in all regions (8,9,21).

## 2. METHODS

### 2.1 Study Design and Population

A community-based cross-sectional study was conducted to evaluate the use of telemedicine and its satisfaction among adult patients with chronic diseases attending primary healthcare centers in Abha City. The study included 400 participants, all of whom had been provided telemedicine services by their PHC for at least one month. This sample size provided strong statistical power to detect clinically meaningful associations within multiple demographic subgroups and variables of interest.

### 2.2 Ethical Approval

This study was approved by the ethical committee of the institution (approval number F9-2-2025) and conducted in accordance with the Declaration of Helsinki and the International Committee on Harmonization Good Practice Recommendations and applicable Saudi Arabian regulations for research involving human subjects in healthcare.

### 2.3 Data Collection and Variables

Methods of data collection: The survey was administered through a structured questionnaire that included the following survey components:

**Demographic Features:** Age (grouped as follows:  $\leq 30$ , 31-40, 41-50, 51-60, 61+) - sex (male/female)

**Telemedicine Exposure Variables (Days):** Length of telemedicine use (classified as  $< 1$  month, 1-3 months, 3-6 months, 6-12 months,  $> 1$  year) - Rate of telemedicine visits (classified as less than every three months, every three months, every month, every week)

**Clinical Variables:** - Duration of chronic illness (classified as  $< 1$  year, 1-3 years, 4-5 years,  $> 5$  years) - Total number of telemedicine-related problems (continuous variable, with a maximum of six), total number of telemedicine-related benefits

(continuous variable, with a maximum of six)

**Outcomes:** Telemedicine overall experience satisfaction (5-point Likert scale, 1-5) - Provider-patient communication quality (5-point Likert scale, 1-5)

### 2.4 Statistical Analysis

Basic statistics (mean, standard deviation, quartile, and range) were calculated for all the continuous variables. Correlation analyses were performed using Pearson’s correlation coefficients to assess the associations between the outcome and predictor variables. Bivariate tests of group differences, including independent sample t-tests (for gender differences) and one-way analysis of variance (ANOVA) (for age group differences) were employed. We developed a multivariable linear regression model to determine the predictors of overall satisfaction with the telemedicine experience, adjusting for potential confounders. The following variables were entered into the regression model as predictors: age, disease duration, telemedicine frequency, gender, quality of communication, reported difficulties, and reported benefits.

## 3. RESULTS

### 3.1 Descriptive Statistics

The study population (N=400) demonstrated the following characteristics:

Variable	Count	Mean	SD	Min	25th %	Median	75th %	Max
Overall Experience Score	400	4.11	0.87	1	4	4	5	5
Communication Quality Score	400	4.10	0.85	1	4	4	5	5
Age (Ordinal)	400	1.59	0.97	0	1	2	2	4
Disease Duration (Ordinal)	400	1.80	0.88	0	1	2	2	3
Telemedicine Duration (Ordinal)	400	2.09	1.11	0	1	2	3	4
Telemedicine Frequency (Ordinal)	399	1.57	0.70	0	1	2	2	3
Reported Difficulties (Count)	400	1.59	0.87	1	1	1	2	6
Reported Benefits (Count)	400	2.51	1.05	1	2	2	3	6
Male Gender	400	0.53	0.50	0	0	1	1	1

#### Key Observations:

Patient satisfaction with the overall telemedicine experience was very high (M=4.11 out of 5, SD=0.87), and respondents were generally satisfied with their telemedicine visits. The perceived quality of communication was 4.10 (SD=0.85), indicating that patients positively perceived the quality of provider-patient communication during the telemedicine visit. The gender distribution of the sample was approximately equal (53% male), and participants tended to report more benefits of telemedicine (M = 2.51) than barriers (M = 1.59). The duration of disease and telemedicine exposure were highly variable in the sample, reflecting diverse chronic disease management and telemedicine use patterns.

### 3.2 Correlation Analysis

Pearson correlation coefficients were calculated to examine the relationships between all study variables. The correlation matrix reveals several important associations.

Variable Pair	Correlation Coefficient
Overall Experience & Communication Quality	0.66
Overall Experience & Benefits Count	0.33
Overall Experience & Difficulties Count	-0.29
Overall Experience & Age	-0.19
Overall Experience & Disease Duration	0.19
Overall Experience & Telemedicine Duration	0.21
Communication Quality & Benefits Count	0.39
Communication Quality & Difficulties Count	-0.32
Communication Quality & Age	-0.22
Telemedicine Duration & Disease Duration	0.45
Telemedicine Frequency & Disease Duration	-0.36

### Clinical Interpretation:

The largest observed association was for overall experience satisfaction and communication quality ( $r=0.66$ ), which suggests that patients' satisfaction with telemedicine is highly dependent on their perception of communication quality with healthcare providers. This emphasizes the need for provider education on communication methodology effectively utilized, not in-person visits.

There were positive correlations between overall experience and disease duration ( $r=0.19$ ) and telemedicine duration ( $r=0.21$ ), indicating that patients with long-standing chronic conditions had more telemedicine visits for a somewhat higher satisfaction. This might be an adaptation to telemedicine tools/systems or the selection of more motivated patients for long-term telemedicine.

In contrast, weak negative correlations emerged with age ( $r=-0.19$ ) and the number of reported issues ( $r=-0.29$ ) (Figure 1), suggesting that older patients reported somewhat lower satisfaction levels, and that those with more issues using telemedicine platforms were less satisfied overall. These relationships are significant, and have the potential to provide a foundation for tailored support approaches.

The significant positive correlation between disease duration and telemedicine duration ( $r = 0.45$ ) indicates that patients with long-standing chronic conditions have been using telemedicine for longer periods, a trend expected in the primary care management of well-established chronic diseases.

### 3.3 Bivariate Statistical Tests

Two primary bivariate analyses were run to test for differences between demographic groups included in the study were as follows:

**Independent t-test (Female vs Male):** - Test Statistic:  $t = -0.67$  - p-value: 0.51 - Interpretation: Overall telemedicine experience scores were not statistically significantly different between males and females ( $p>0.05$ )

**One-Way ANOVA (Differences among Ages):** - Test Statistic:  $F = 6.47$ , p-value:  $<0.001$  ( $4.70 \times 10^{-5}$ ), Interpretation: There are statistically significant differences in telemedicine overall experience scores among age groups ( $p<0.05$ ), and further post-hoc analyses will be needed to identify which groups are different from each other.

The ANOVA result is of particular interest, as it shows that age (and not gender or group) had a significant effect on telemedicine satisfaction, suggesting age-specific implementation considerations and possibly specific assistance for senior participants.

### 3.4 Multivariable Linear Regression Analysis

A comprehensive linear regression model was developed to identify independent predictors of overall telemedicine experience satisfaction, while controlling for demographic and clinical confounders. The results are presented in the following table:

Predictor	Coefficient	95% CI Lower	95% CI Upper	p-value	Interpretation
Intercept	1.44	0.88	1.99	<0.001	Baseline satisfaction level
Age 31-40 (vs. ≤30)	0.055	-0.155	0.265	0.608	Not significantly different
Age 41-50 (vs. ≤30)	-0.092	-0.289	0.105	0.359	Not significantly different
Age 51-60 (vs. ≤30)	-0.188	-0.441	0.065	0.145	Not significantly different
Age 61+ (vs. ≤30)	-0.569	-1.099	-0.039	<b>0.035</b>	<b>Significantly lower satisfaction</b>
Disease Duration 1-3 years (vs. <1 year)	0.013	-0.308	0.335	0.935	Not significantly different
Disease Duration 4-5 years (vs. <1 year)	0.230	-0.107	0.566	0.181	Not significantly different
Disease Duration >5 years (vs. <1 year)	0.352	0.0004	0.704	<b>0.050</b>	<b>Marginally significantly higher satisfaction</b>
TM Duration 1-3 months (vs. <1 month)	-0.072	-0.348	0.203	0.606	Not significantly different
TM Duration 3-6 months (vs. <1 month)	-0.031	-0.301	0.239	0.822	Not significantly different
TM Duration 6-12 months (vs. <1 month)	-0.014	-0.310	0.282	0.927	Not significantly different
TM Duration >1 year (vs. <1 month)	0.221	-0.103	0.545	0.181	Not significantly different
TM Frequency Quarterly (vs. Less frequent)	0.346	-0.010	0.702	0.057	Marginally significant

Predictor	Coefficient	95% CI Lower	95% CI Upper	p-value	Interpretation
TM Frequency Monthly (vs. Less frequent)	0.341	-0.023	0.705	0.067	Marginally significant
TM Frequency Weekly (vs. Less frequent)	0.146	-0.288	0.580	0.509	Not significantly different
Male Gender	0.005	-0.125	0.136	0.938	Not significantly different
Communication Quality Score	0.542	0.448	0.636	<0.001	<b>Strongest predictor of satisfaction</b>
Reported Difficulties Count	-0.109	-0.193	-0.025	<b>0.011</b>	<b>Inversely associated with satisfaction</b>
Reported Benefits Count	0.075	0.007	0.143	<b>0.030</b>	<b>Positively associated with satisfaction</b>

#### Model Interpretation:

Linear regression analyses revealed several meaningful predictors of telemedicine satisfaction, both from statistical and clinical perspectives.

**Primary result:** Communication quality was the most powerful independent predictor of global satisfaction with the telemedicine experience (coefficient=0.542,  $p<0.001$ ). Every time the communication quality value increased by one unit, the overall satisfaction increased by approximately 0.54, which is a large effect compared with the 5-point scale. This finding further validates the compression of provider-patient interaction as crucial for telemedicine success.

**Age effect:** Patients aged 61 years and older were significantly less satisfied than the reference group (patients  $\leq 30$  years) by 0.569 points (95% CI: -1.099 to -0.039,  $p=0.035$ ). This age-related disparity highlights the need for specific interventions to enhance telemedicine's access and utility among older adults.

**Disease Duration Effect:** Individuals with chronic disease for  $>5$  years indicated slightly greater satisfaction than those with a disease duration  $<1$  year (coefficient=0.352,  $p=0.050$ ). This indicates that patients with chronic illnesses who have lived longer with their disease may be more accustomed to long-term medical care and, therefore, more willing to engage in telemedicine. Telemedicine frequency effect: Satisfaction was slightly higher in those receiving more frequent telemedicine visits (quarterly,  $p=0.057$ ; monthly,  $p=0.067$ ; frequencies were close to significance). However, once-weekly visits did not lead to a significant increase in satisfaction compared with less frequent interactions.

**Benefits and challenges:** Satisfaction with telemedicine's perceived benefits was positive (coefficient = 0.075,  $p = 0.030$ ) and that with reported challenges was inversely related to satisfaction (coefficient = -0.109,  $p = 0.011$ ). The results of this study underscore the importance of enhancing perceived benefits and reducing operational difficulty in improving patient satisfaction.

**Non-Significant Predictors:** Gender did not significantly predict telemedicine satisfaction ( $p = 0.938$ ), and telemedicine duration was not an independent predictor of satisfaction after controlling for other variables.

#### 4. DISCUSSION

This study revealed that telemedicine patients with chronic condition management services in Abha City PHCs were highly satisfied (mean =  $4.11 \pm 0.87$ ), and quality of communication was the most influential factor that positively affected communication quality. These findings emphasize that in addition to access to technology, in teleconsultations, the perceived quality of interpersonal relationships continues to be the main factor of telemedicine satisfaction. This is consistent

with international publications reporting that good provider–patient communication is a strong predictor of perceived telehealth success and is positively related to trust, adherence, and follow-up compliance (1–3).

The moderately strong positive association between communication satisfaction and overall satisfaction ( $r = 0.64$ ,  $p < 0.001$ ) is not unexpected and supports previous meta-analyses reporting that user engagement and two-way communication improve self-management and treatment compliance (2, 3). In contrast, those who indicated that they had more problems with teleconsultations were less satisfied, highlighting the significance of usability, digital literacy, and dependable connectivity. These findings are consistent with those of other Saudi and international studies that identify technical problems and the absence of training as frequent hindrances to the optimal use of telehealth services (4, 5).

No significant differences were observed between sexes ( $p = 0.51$ ) indicated that telemedicine provisions were equally accepted among male and female patients. Nevertheless, age-related differences remained, and older patients ( $\geq 61$  years) were less satisfied ( $\beta = -0.57$ ,  $p = 0.035$ ). This supports previous reports that older individuals have more difficulty adjusting to digital health applications due to a lack of technical knowledge and physical limitations (6, 7). A few reviews have reported that customized telemedicine onboarding programs, user-friendly interfaces, and involvement of family members and caregivers can significantly enhance engagement with telemedicine among elderly individuals (8, 9).

The results of the present study also showed that greater perceived benefit from telemedicine was positively associated with satisfaction ( $\beta = 0.07$ ,  $p = 0.03$ ), and that more reported problems were negatively associated with satisfaction ( $\beta = -0.11$ ,  $p = 0.011$ ). This is consistent with behavioral models of technology acceptance technology use models and the Unified Theory of Use and Acceptance of Technology, where both perceived usefulness and perceived ease of use influence users' attitude towards digital care (10).

From a policy perspective, these findings reinforce the conceptual framework that has established Saudi Arabia's National Digital Health Strategy Vision 2030, which includes telehealth as a significant component of the strategy to focus on improving chronic disease outcomes and reducing the burden on the healthcare system (11). Patient satisfaction was steadily high among patients in Abha PHCs, indicating that national-level investments in digital infrastructure, which include the Sehhaty, Mawid, and 937 call center platforms, resulted in positive patient outcomes (12). Nevertheless, the continued barriers related to digital literacy and age disparity demonstrated that structural-level strategies for implementation need to extend beyond technology provision and should also consider training, accessibility, and communication standardization.

Similarly, studies in other GCC countries and Western health systems identified the same determinant factors of telehealth satisfaction: convenience, clear communication, and trust in telehealth providers (13, 14). However, the novelty of this study lies in the scope of PHC-based chronic disease management in Saudi Arabia. Most Saudi studies have combined data from hospital environments or specialized teleconsultation platforms (15, 16). Focusing exclusively on patients with PHC, this study provides local evidence for enhancing telemedicine services at the point of care.

**Interpretation and implications.** The findings indicate that telemedicine is not just a substitute for in-person visits, but also a unique model that needs to be designed to maintain human connections. The patient's understanding and satisfaction may also be improved by introducing structured communication, visual materials, and summaries after consultation. Ongoing professional development of PHC physicians in telecommunication skills, including tone of voice, empathy, and reinforcing information, may contribute to maintaining quality virtual visits (3, 8, 13).

**Limitations.** The cross-sectional design of the study impedes causal inference, and self-report data introduces the possibility of recall or social desirability bias. The study was constrained to one city, and tertiary hospitals in other Saudi regions may have had different results. However, the outcomes were limited to perceived experience, and clinical outcomes such as blood pressure or HbA1c were not measured. However, mixed-method or longitudinal studies may validate quantitative satisfaction instruments using qualitative interviews and clinical information to yield a more comprehensive assessment of the effectiveness of telemedicine.

**Perspective for the future: Practical Implications.** Based on this evidence, policymakers should encourage user-centered telemedicine design and uniform communication training in PHC systems. Future studies could also investigate the impact of different consultation intervals (weekly, monthly, or quarterly) on satisfaction and disease control. In addition, programs on digital health literacy for the elderly population could be incorporated into chronic care pathways that could facilitate Saudi Arabia's vision for a digitally empowered nation.

In this study, we show that telemedicine is consistent with recent worldwide trends of enhanced patient experience, when communication is prioritized and usability issues are ameliorated. This is it! This underlines the idea that technology facilitates care, whereas communication defines the quality of care.

## 5. CONCLUSIONS

This is the first systematic review to analyze the effect of telemedicine on family medicine practice in patients with chronic diseases in Abha City, Saudi Arabia. The quality of communication was by far the strongest predictor of patient satisfaction and was much stronger than any of the background variables or outcome variables. The finding of age-based inequities

highlights the importance of designing implementation strategies to facilitate equal access opportunities and satisfy CDM services among all age cohorts.

The ratio of benefits to barriers and the high satisfaction scores suggest that telemedicine should be integrated into geriatric clinics for primary care, at least for utilization guidelines. These results are challenging and align with Saudi Arabia's Vision 2030 digital health transformation agenda and illustrate pragmatic pointers to optimize telemedicine services. Future implementation should focus on provider training in engaging remote patients effectively, consider age-stratified models of care, systematically addressing patient-reported challenges, and track outcomes, especially regarding equity in vulnerable patients.

Telemedicine is a revolutionary technology in improving access to primary care services and convenience for patients, and our study shows that with proper attention to quality of communication and patient-centered design, it is possible to realize high levels of satisfaction and substantial healthcare value even in the management of chronic disease. Ongoing investigations of long-term health outcomes, cost-effectiveness, and implementation in a broader range of healthcare settings will be critical to fully define the role of telemedicine in the transformation of the healthcare system in Saudi Arabia.

## 7. Appendices

### Appendix A: Descriptive Statistics (Complete)

Variable	Count	Mean	Standard Deviation	Minimum	25th Percentile	Median	75th Percentile	Maximum
Overall Experience Score	400	4.1075	0.8677	1	4	4	5	5
Communication Quality Score	400	4.1000	0.8496	1	4	4	5	5
Age (Ordinal)	400	1.59	0.9666	0	1	2	2	4
Disease Duration (Ordinal)	400	1.80	0.8757	0	1	2	2	3
Telemedicine Duration (Ordinal)	400	2.0875	1.1149	0	1	2	3	4
Telemedicine Frequency (Ordinal)	399	1.5664	0.6981	0	1	2	2	3
Reported Difficulties (Count)	400	1.585	0.8658	1	1	1	2	6

Variable	Count	Mean	Standard Deviation	Minimum	25th Percentile	Median	75th Percentile	Maximum
Reported Benefits (Count)	400	2.505	1.0453	1	2	2	3	6
Male Gender	400	0.53	0.4997	0	0	1	1	1

Appendix B: Correlation Matrix (Complete)

	Overall Experience	Communication Quality	Age	Disease Duration	Telemedicine Duration	Telemedicine Frequency	Difficulties	Benefits
Overall Experience	1.000	0.660	-0.186	0.187	0.212	-0.016	-0.286	0.329
Communication Quality	0.660	1.000	-0.222	0.088	0.161	0.080	-0.320	0.391
Age	-0.186	-0.222	1.000	0.315	0.122	-0.127	0.170	-0.098
Disease Duration	0.187	0.088	0.315	1.000	0.454	-0.363	0.148	0.093
Telemedicine Duration	0.212	0.161	0.122	0.454	1.000	-0.345	0.015	0.124
Telemedicine Frequency	-0.016	0.080	-0.127	-0.363	-0.345	1.000	-0.044	0.018
Difficulties	-0.286	-0.320	0.170	0.148	0.015	-0.044	1.000	0.095
Benefits	0.329	0.391	-0.098	0.093	0.124	0.018	0.095	1.000

Appendix C: Bivariate Statistical Tests (Complete)

Test	Statistic	p-value	Interpretation
Independent t-test (Gender)	-0.666	0.506	No significant difference in telemedicine satisfaction between males and females
One-Way ANOVA	6.475	<0.001	Significant differences in telemedicine satisfaction among age groups

Test	Statistic	p-value	Interpretation
(Age Groups)			

Appendix D: Linear Regression Model Details

**Model Specification:** Multiple linear regression with overall telemedicine experience satisfaction as the dependent variable

**Predictor Variables:** - Age category (categorical: reference group ≤30 years), disease duration category (categorical: reference group <1 year), telemedicine duration category (categorical: reference group <1 month), telemedicine frequency category (categorical: reference group less than quarterly), gender (binary: male=1, female=0), communication quality score (continuous), reported difficulties count (continuous), reported benefits count (continuous)

**Model Fit Statistics:** Full regression results are presented in the Results section (Table: Multivariable Linear Regression Analysis)

**Sample Size:** n=400 for all regression models.

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