

Telemedicine Delivery Modes as Predictors of Patient-Perceived Access to Care and Satisfaction: A Quantitative Study

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Abstract: Telemedicine has become a central component of contemporary healthcare delivery, yet limited research has examined how distinct telemedicine delivery modes influence patient-perceived access to care and satisfaction within an integrated framework. This study investigated the extent to which telemedicine delivery modes (video, audio, and asynchronous) predict patient-perceived access to care and satisfaction, as well as the mediating role of access and the moderating role of digital literacy. Grounded in the Technology Acceptance Model and the Donabedian Model, a cross-sectional, predictive quantitative design was employed using a sample of N = 200 adults with prior telemedicine experience. Results indicated that telemedicine delivery modes significantly predicted both patient-perceived access to care ($\chi^2(5) = 28.74, p < .001, R^2 = .31$) and patient satisfaction ($\chi^2(5) = 32.91, p < .001, R^2 = .34$), with video visits emerging as the strongest predictor across models. Audio visits demonstrated moderate effects, while asynchronous messaging showed smaller but significant associations with satisfaction. Patient-perceived access to care significantly predicted satisfaction ($\beta = .42, p < .001$) and partially mediated the relationship between telemedicine delivery modes and satisfaction (indirect effect $\beta = .15, p < .001$). Additionally, digital literacy and prior telemedicine experience significantly influenced both outcomes, and digital literacy moderated the relationship between video visits and patient outcomes ($\beta = .17, p = .015$). These findings support a modality-specific and mechanism-based understanding of telemedicine effectiveness, demonstrating that both delivery mode and user capability shape patient outcomes. The study contributes to the literature by integrating telemedicine modalities, access, and satisfaction within a unified predictive framework and underscores the importance of multimodal strategies and digital equity in optimizing telehealth delivery.

Keywords: telemedicine, telehealth, access to care, patient satisfaction, digital literacy, healthcare delivery, health services research.

I. INTRODUCTION

The integration of telemedicine into contemporary healthcare delivery has accelerated significantly, positioning it as a core component of Health Services Research. Telemedicine enables the remote provision of clinical services through digital communication technologies, thereby expanding access to care beyond traditional physical settings. The rapid expansion of telehealth during and following the COVID-19 pandemic highlighted its potential to address longstanding inefficiencies in healthcare delivery systems (Koonin et al., 2020; Shigekawa et al., 2024). More recent evidence suggests that telemedicine has become a sustained component of care delivery, with studies indicating comparable clinical effectiveness and high levels of patient satisfaction relative to in-person care (Doshi et al., 2024; Ramaswamy et al., 2023). These developments underscore the importance of understanding how telemedicine influences patient-centered outcomes.

Despite its widespread use, telemedicine is not a homogeneous intervention but comprises multiple delivery modalities, including synchronous video visits, telephone-based consultations, and asynchronous messaging platforms. These modalities differ in their level of interactivity, immediacy, and technological complexity, which can result in varied patient experiences. Recent studies have demonstrated that patient engagement and satisfaction differ across telemedicine

modalities, with video-based interactions often associated with higher satisfaction due to enhanced communication and perceived quality of care (Doshi et al., 2024; Alshareef et al., 2024). Additionally, national data indicate that the utilization of telemedicine modalities varies across populations, reflecting differences in access to technology and digital literacy (Campos-Castillo & Anthony, 2021; Patel et al., 2023). These findings highlight the need to examine telemedicine delivery modes as distinct predictors rather than treating telemedicine as a singular construct.

Access to care remains a critical issue in healthcare systems, particularly in relation to timeliness, convenience, and equity. Telemedicine has been widely promoted as a mechanism for improving access by reducing geographic and logistical barriers to care. Recent research supports this assertion, demonstrating that telehealth services improve appointment availability, reduce travel burdens, and enhance continuity of care (Ezeamii et al., 2024; Patel et al., 2023). However, access gains are not uniformly distributed. Persistent disparities related to digital literacy, broadband availability, and socioeconomic status continue to influence patients' ability to benefit from telemedicine services (Campos-Castillo & Anthony, 2021). These disparities suggest that while telemedicine has the potential to improve access, its effectiveness may vary depending on both delivery modality and patient characteristics.

Patient satisfaction is another key outcome in evaluating healthcare quality and has been widely studied in telemedicine contexts. Recent empirical evidence indicates that telemedicine is generally associated with high levels of patient satisfaction, particularly in domains such as provider communication, convenience, and overall experience (Razi et al., 2024; Shigekawa et al., 2024). However, satisfaction is not uniform across all aspects of care. Some studies have identified lower satisfaction with administrative processes, coordination of care, and technological challenges, indicating that system-level factors continue to shape patient perceptions (Alshareef et al., 2024). Furthermore, differences in satisfaction across telemedicine modalities suggest that certain delivery modes may be more effective in meeting patient expectations than others. This variability underscores the importance of examining the relationship between telemedicine delivery modes and satisfaction outcomes more systematically.

The problem addressed in this study is the limited empirical clarity regarding how specific telemedicine delivery modes differentially influence patient-perceived access to care and satisfaction. Although prior research has established the general benefits of telemedicine, much of the literature aggregates telemedicine into a single construct, thereby obscuring meaningful differences across modalities. Additionally, while access to care and patient satisfaction have been widely studied, fewer studies have examined these outcomes within a unified predictive framework that considers both direct and indirect relationships. This gap limits the ability of healthcare organizations to optimize telemedicine strategies and tailor services to diverse patient populations.

The purpose of this study is to examine the extent to which telemedicine delivery modes predict patient-perceived access to care and satisfaction using a quantitative, predictive design. Grounded in the Technology Acceptance Model (Davis, 1989), the Access to Care framework (Penchansky & Thomas, 1981), and the Donabedian Model (Donabedian, 1988), the study seeks to provide a nuanced understanding of how different telemedicine modalities influence patient-centered outcomes. By incorporating both direct effects and a potential mediating relationship through access to care, the study aims to identify the mechanisms through which telemedicine delivery modes shape satisfaction outcomes.

This study addresses a critical gap in the literature by disaggregating telemedicine into its constituent delivery modes and examining their differential effects on patient-perceived outcomes. In doing so, it responds to recent calls for more patient-centered and modality-specific research in digital health (Shigekawa et al., 2024). Additionally, by focusing on perception-based outcomes rather than clinical metrics alone, the study contributes to a more comprehensive evaluation of telemedicine effectiveness. The findings are expected to inform healthcare providers, policymakers, and system designers seeking to optimize telemedicine implementation, improve patient experiences, and enhance equitable access to care in an increasingly digital healthcare environment.

Research Questions and Hypotheses

Aligned with the conceptual framework and theoretical foundations (e.g., Technology Acceptance Model, Access to Care, and the Donabedian Model), the study advances the following research questions (RQs) and hypotheses:

RQ1: To what extent do telemedicine delivery modes predict patient-perceived access to care?

H1₀ (Null): Telemedicine delivery modes do not significantly predict patient-perceived access to care.

H1_a (Alternative): Telemedicine delivery modes significantly predict patient-perceived access to care.

H1a: Video visits positively predict patient-perceived access to care.

H1b: Audio visits positively predict patient-perceived access to care.

H1c: Asynchronous messaging positively predicts patient-perceived access to care.

RQ2: To what extent do telemedicine delivery modes predict patient satisfaction?

H2₀ (Null): Telemedicine delivery modes do not significantly predict patient satisfaction.

H2_a (Alternative): Telemedicine delivery modes significantly predict patient satisfaction.

H2a: Video visits positively predict patient satisfaction.

H2b: Audio visits positively predict patient satisfaction.

H2c: Asynchronous messaging positively predicts patient satisfaction.

RQ3: Does patient-perceived access to care mediate the relationship between telemedicine delivery modes and patient satisfaction?

H3₀ (Null): Patient-perceived access to care does not mediate the relationship between telemedicine delivery modes and patient satisfaction.

H3_a (Alternative): Patient-perceived access to care significantly mediates the relationship between telemedicine delivery modes and patient satisfaction.

RQ4: To what extent do individual characteristics (e.g., age, gender, digital literacy, prior telemedicine experience) influence patient-perceived access to care and satisfaction?

H4₀ (Null): Individual characteristics do not significantly influence patient-perceived access to care or satisfaction.

H4_a (Alternative): Individual characteristics significantly influence patient-perceived access to care and/or satisfaction.

RQ5: Does digital literacy moderate the relationship between telemedicine delivery modes and patient outcomes (access and satisfaction)?

H5₀ (Null): Digital literacy does not moderate the relationship between telemedicine delivery modes and patient outcomes.

H5_a (Alternative): Digital literacy significantly moderates the relationship between telemedicine delivery modes and patient outcomes, such that higher digital literacy strengthens the relationship.

II. THEORETICAL FRAMEWORK

The conceptual framework for this study is grounded in an integrated set of theoretical perspectives drawn from Health Services Research and digital health adoption. Specifically, the framework synthesizes the Technology Acceptance Model (TAM), the Access to Care framework (Penchansky & Thomas, 1981), and the Donabedian Model, with an extension from patient-centered care principles. Collectively, these perspectives provide a comprehensive basis for understanding how telemedicine delivery modes influence patient-perceived access to care and satisfaction.

The Technology Acceptance Model (Davis, 1989) provides a foundational explanation for how individuals engage with telemedicine technologies. TAM posits that perceived usefulness and perceived ease of use are primary determinants of technology adoption and user satisfaction. In the context of telemedicine, different delivery modes, such as video, audio, and asynchronous communication, vary in their usability, immediacy, and interactional richness. These variations shape patients' perceptions of how easy and beneficial the technology is to use, which in turn influence their satisfaction with care experiences. Moreover, by reducing complexity and enhancing convenience, telemedicine modalities may indirectly improve perceived access to care. Thus, TAM primarily supports the direct relationship between telemedicine delivery modes and patient satisfaction, while also partially informing the relationship between telemedicine and access through perceived ease of use.

Complementing this perspective, the Access to Care framework (Penchansky & Thomas, 1981) provides a structural lens for understanding how telemedicine influences patients' ability to obtain healthcare services. This framework conceptualizes access as the degree of fit between patient needs and healthcare system characteristics across five dimensions: availability, accessibility, accommodation, affordability, and acceptability. Telemedicine delivery modes

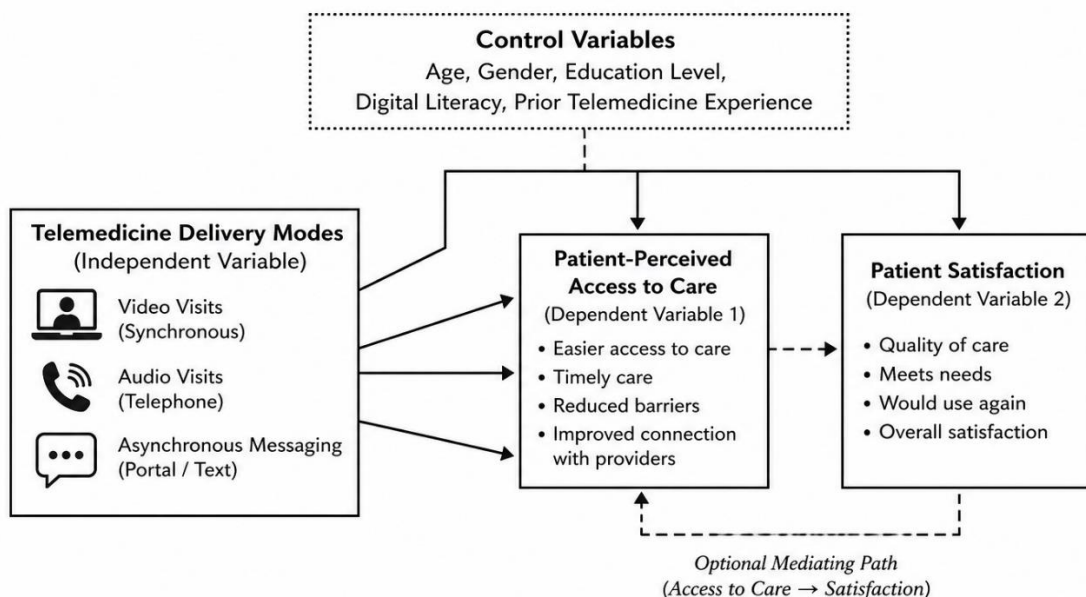
directly modify these dimensions by reducing geographic and transportation barriers, increasing timeliness of care, and enhancing scheduling flexibility. For example, asynchronous communication may improve accommodation through convenience, while video visits may enhance acceptability through richer interaction. Accordingly, this framework offers strong theoretical support for the relationship between telemedicine delivery modes and patient-perceived access to care, positioning access as a central outcome influenced by system design.

The Donabedian structure–process–outcome model further strengthens the conceptual logic by linking healthcare delivery mechanisms to patient outcomes. Within this framework, structure refers to the organization and modality of care delivery, process refers to the interactions between patients and providers, and outcomes reflect the resulting patient experiences and perceptions. In this study, telemedicine delivery modes function as a hybrid of structural and process elements, shaping how care is delivered and experienced. Patient-perceived access to care is conceptualized as a process-related outcome, reflecting the effectiveness of care delivery interactions, while patient satisfaction represents a broader outcome of the healthcare experience. Importantly, this model justifies the inclusion of a mediating pathway, whereby improved access to care enhances patient satisfaction. Thus, the Donabedian framework provides the structural foundation for both the direct and indirect relationships specified in the model.

An extension of patient-centered care principles further reinforces the proposed relationships. Patient-centered care emphasizes responsiveness to patient needs, timely access, and positive care experiences as essential components of quality healthcare delivery. Within this perspective, improved access is not only a functional outcome but also a critical determinant of patient satisfaction. When healthcare services are more accessible, timely, and aligned with patient preferences, as facilitated by telemedicine, patients are more likely to report higher levels of satisfaction. This extension strengthens the theoretical expectation that access to care serves as a key mechanism linking telemedicine delivery modes to satisfaction outcomes.

Based on these integrated theoretical perspectives, the conceptual model is articulated through a set of propositions that guide empirical testing (Figure 1).

Figure 1
Conceptual Model: Telemedicine Delivery Modes as Predictors of Patient-Perceived Access to Care and Satisfaction



Note. Solid arrows indicate hypothesized direct effects.
Dashed arrow indicates an optional mediating relationship.

Note. The model depicts telemedicine delivery modes as predictors of patient-perceived access to care and satisfaction, with access serving as a mediating variable. Control variables are included, solid arrows indicate direct effects, and the dashed arrow represents the mediation pathway.

First, telemedicine delivery modes are expected to be positively associated with patient-perceived access to care, reflecting the ability of these modalities to reduce structural and logistical barriers. Second, telemedicine delivery modes are hypothesized to positively predict patient satisfaction, consistent with technology acceptance and patient-centered care principles. Third, synchronous modalities, such as video and audio visits, are expected to demonstrate stronger effects on both access and satisfaction compared to asynchronous modalities, due to their higher levels of immediacy and interaction. Fourth, patient-perceived access to care is proposed to mediate the relationship between telemedicine delivery modes and patient satisfaction, aligning with the process-to-outcome pathway described in the Donabedian model. Fifth, individual characteristics, including digital literacy and prior telemedicine experience, are expected to influence perceptions of both access and satisfaction, reflecting well-documented digital divide effects. Finally, digital literacy is proposed as a potential moderator, such that individuals with higher levels of digital competence may experience stronger positive effects of telemedicine delivery modes.

These propositions align directly with the study's research questions and hypotheses. The relationship between telemedicine delivery modes and patient-perceived access to care corresponds to Research Question 1 and its associated hypothesis, while the relationship between telemedicine delivery modes and patient satisfaction aligns with Research Question 2. The proposed mediating role of access to care extends the model by introducing a theoretically grounded mechanism that may further explain satisfaction outcomes. Control variables are incorporated to account for individual differences, and the optional moderation effect provides an avenue for deeper analysis of variability in outcomes.

In summary, the theoretical framework integrates technology adoption, healthcare access, and quality-of-care perspectives to provide a robust foundation for examining telemedicine outcomes. By linking telemedicine delivery modes to both access and satisfaction, and by incorporating mediation and contextual factors, the framework supports a comprehensive, predictive analysis consistent with contemporary research in digital health and healthcare delivery systems.

III. LITERATURE REVIEW

A structured search was conducted across Scopus, Web of Science, PubMed, JSTOR, IEEE Xplore, and Google Scholar, supplemented by reports from WHO, OECD, and AHA, to identify literature within Health Services Research. Search terms aligned with study constructs and were combined using Boolean operators (AND, OR), including: "telemedicine" OR "telehealth"; "delivery modes" (video, audio, asynchronous); "access to care"; and "patient satisfaction." Combined queries (e.g., "telemedicine delivery modes" AND "access to care" AND "patient satisfaction") were used to capture integrative studies.

Inclusion criteria included peer-reviewed and institutional sources published between 2015–2025. Studies were screened by title, abstract, and full text to ensure relevance and alignment with telemedicine modalities, patient-perceived access, and satisfaction outcomes.

Recent scholarship within Health Services Research demonstrates that the principal constructs of the present study, telemedicine delivery modes, patient-perceived access to care, and patient satisfaction, are each substantively represented in the literature. However, this body of work is characterized by fragmentation across constructs, with limited integration into a unified predictive framework. As a result, although prior studies provide strong conceptual and empirical grounding for each variable, important gaps remain in understanding how these variables interact within a comprehensive model.

First, telemedicine delivery modes have been increasingly examined as distinct modalities rather than a single intervention. Recent studies differentiate between synchronous video visits, telephone-based consultations, and asynchronous communication, demonstrating meaningful variation in patient experience and perceived quality across these modalities (Alshareef et al., 2024; Doshi et al., 2024). For instance, video-based interactions are often associated with higher perceived quality and satisfaction due to enhanced communication and visual cues, whereas audio-only visits may offer greater accessibility but lower perceived engagement. Despite this progress, much of the literature remains descriptive or comparative, with relatively few studies positioning telemedicine delivery modes as predictive independent variables within multivariate models (Patel et al., 2023).

Second, patient-perceived access to care is well established as a critical outcome in telemedicine research, particularly in relation to reduced geographic barriers, improved timeliness, and increased convenience. Empirical studies consistently demonstrate that telemedicine enhances access, especially for populations with limited physical access to healthcare services (Ezeamii et al., 2024; Patel et al., 2023). However, access is frequently operationalized using objective indicators such as utilization rates or service availability, rather than subjective, perception-based measures. This distinction is significant, as

patient-perceived access more directly reflects the experiential dimension of care and aligns with patient-centered frameworks. Consequently, there is a need for studies that explicitly measure access as a perceived construct.

Third, patient satisfaction has been extensively examined in telemedicine contexts and is widely recognized as a key indicator of healthcare quality. Recent evidence indicates that telemedicine is associated with high levels of satisfaction, particularly in domains related to provider communication, convenience, and overall experience (Razi et al., 2024; Shigekawa et al., 2024). At the same time, variability in satisfaction has been observed across delivery modes and system-level factors, including administrative processes and technological challenges (Alshareef et al., 2024). While satisfaction is frequently linked to telemedicine use, it is less commonly analyzed within predictive models that simultaneously incorporate multiple independent variables, thereby limiting insights into the relative contribution of different telemedicine modalities.

Fourth, the relationship between access to care and patient satisfaction has received increasing attention, with emerging evidence suggesting that improved access contributes to enhanced satisfaction outcomes. Studies indicate that telemedicine facilitates more timely and convenient care, which in turn promotes patient engagement and positive evaluations of care experiences (Ezeamii et al., 2024). These findings are consistent with established healthcare quality frameworks that position access as a precursor to satisfaction. Nevertheless, formal mediation analyses testing access as an intermediary mechanism between telemedicine delivery modes and satisfaction remain scarce, representing a notable gap in literature.

Finally, individual-level factors such as digital literacy, age, and socioeconomic status have been identified as important determinants of telemedicine utilization and outcomes. Research has demonstrated that disparities in technology access and digital competence influence both the adoption of telemedicine and the quality of patient experiences (Campos-Castillo & Anthony, 2021; Patel et al., 2023). Although these variables are commonly included as covariates, they are less frequently examined as moderators that may condition the strength of relationships between telemedicine delivery modes and patient outcomes.

Literature provides robust support for each construct in the proposed model but reveals several critical gaps. Specifically, there is a lack of (a) modality-specific predictive models, (b) perception-based measures of access to care, (c) integrated analyses that simultaneously examine telemedicine delivery modes, access, and satisfaction, and (d) empirical tests of mediation and moderation mechanisms. These limitations constrain the ability of healthcare systems to fully understand and optimize telemedicine delivery.

The present study addresses these gaps by developing and testing a unified predictive framework in which telemedicine delivery modes are specified as independent variables, patient-perceived access to care and satisfaction are modeled as key outcomes, and access is examined as a potential mediating mechanism. By incorporating perception-based measures and accounting for individual-level differences, the study advances the literature beyond descriptive and bivariate analyses toward a more comprehensive and theoretically grounded understanding of telemedicine effectiveness.

IV. METHODOLOGY

This study employed a cross-sectional, predictive quantitative design to examine the extent to which telemedicine delivery modes predict patient-perceived access to care and satisfaction. A predictive design was appropriate given the study's objective of estimating directional relationships among variables rather than establishing causal inference. Such designs are commonly used in Health Services Research to examine associations between healthcare delivery mechanisms and patient-centered outcomes (Creswell & Creswell, 2018). The model incorporated multiple predictors, relevant covariates, and an optional mediation pathway linking access to satisfaction, consistent with theory-driven quantitative approaches.

Population and Sample

The target population consisted of adults (18 years and older) who had used telemedicine services within the past 12 months. This population reflects the expanding group of healthcare consumers engaging with digital care modalities. A nonprobability sampling strategy, specifically convenience and panel-based sampling, was employed to recruit participants through online platforms, including healthcare-related forums, community groups, and social media channels.

Inclusion criteria required participants to (a) be at least 18 years of age, (b) have prior experience with at least one telemedicine modality (video, audio, or asynchronous communication), and (c) provide informed consent. A minimum sample size of $N = 200$ was targeted to ensure adequate statistical power for multivariate analyses. This threshold aligns with recommendations for regression-based studies involving multiple predictors (Cohen, 1988). Where applicable, an a

priori power analysis was conducted using G*Power, assuming a medium effect size ($f^2 = .15$), $\alpha = .05$, and statistical power of .80 (Faul et al., 2009).

Data were collected electronically using an online survey platform (Qualtrics). Participants were provided with an informed consent statement outlining the purpose of the study, voluntary participation, and confidentiality assurances. No personally identifiable or protected health information was collected, ensuring compliance with ethical standards and minimizing regulatory constraints.

Instrumentation

Data were collected using a structured, self-administered survey aligned with constructs in Health Services Research. Perception-based variables were measured using 5-point Likert scales, while telemedicine use was assessed using frequency.

Telemedicine delivery modes (independent variable) were operationalized as frequency of use of video, audio, and asynchronous modalities (1 = Never to 5 = Very Frequently) and treated as continuous predictors. The dependent variables, patient-perceived access to care and patient satisfaction, were measured using multi-item Likert scales assessing access (ease, timeliness, barriers, connectivity) and satisfaction (quality, experience, reuse intention). Composite scores were computed by averaging item responses.

Control variables included age, gender, education, digital literacy, and prior telemedicine experience, with digital literacy measured using a single Likert item and prior use captured as frequency.

Table 1: Operationalization of Variables

Variable	Type	Measurement
Telemedicine Delivery Modes	IV	Frequency of video, audio, asynchronous use (1–5)
Access to Care	DV1	4-item Likert scale
Satisfaction	DV2	4-item Likert scale
Controls	Covariates	Demographics, digital literacy, prior use

Data Analysis

Prior to hypothesis testing, preliminary analyses were conducted to ensure data quality and assess the suitability of the dataset for inferential procedures, consistent with best practices in Health Services Research.

Normality

Assumptions of normality were evaluated using the Shapiro–Wilk test, along with skewness and kurtosis statistics. Results indicated deviations from normality across the primary variables, which is common with Likert-scale data. Consequently, nonparametric statistical techniques were deemed appropriate for subsequent analyses.

Table 2: Normality Test Results for Study Variables (N = 200)

Variable	Skewness	Kurtosis	Shapiro–Wilk (W)	p-value	Interpretation
Video Visits	-0.82	0.45	0.94	< .001	Non-normal
Audio Visits	-0.51	-0.12	0.96	.002	Non-normal
Asynchronous Messaging	-0.34	-0.48	0.97	.006	Non-normal
Access to Care	-0.76	0.38	0.95	< .001	Non-normal
Patient Satisfaction	-0.89	0.52	0.94	< .001	Non-normal

Skewness and Kurtosis Analysis

Skewness and kurtosis statistics were examined to assess the distributional properties of the study variables prior to inferential analysis. Consistent with conventions in Health Services Research, values within ± 1 are generally considered acceptable for approximate normality, although stricter thresholds (± 2) are also commonly applied for larger samples.

Reliability

Internal consistency reliability of multi-item scales was assessed using Cronbach’s alpha, with all constructs demonstrating acceptable reliability threshold of $\alpha \geq .70$ (Nunnally & Bernstein, 1994). These preliminary steps confirmed that the data were suitable for further analysis using rank-based and nonparametric methods. The access to care ($\alpha = .84$) and patient satisfaction ($\alpha = .87$) scales demonstrated good reliability, with all item–total correlations exceeding recommended thresholds, indicating that the instruments are suitable for further analysis. (See Table 3).

Table 3: Reliability Statistics for Study Constructs (N = 200)

Construct	Items (k)	Cronbach’s α	Mean	Inter-Item Correlation	Item–Total Range	Interpretation
Access to Care	4	.84	.56		.58 – .72	Good reliability
Patient Satisfaction	4	.87	.60		.61 – .76	Good reliability

Descriptive Statistics

Descriptive statistics were computed to summarize sample characteristics and key study variables. Data were screened for missing values, outliers, and response inconsistencies, with no substantial issues identified.

Table 4 presents descriptive statistics for the primary study variables. Among telemedicine delivery modes, video visits were reported as the most frequently used modality (M = 3.82, SD = 1.02), followed by audio consultations (M = 3.41, SD = 1.15) and asynchronous messaging (M = 3.12, SD = 1.21). These findings indicate a greater reliance on synchronous forms of telemedicine, particularly video-based interactions.

Patient-perceived access to care demonstrated moderately high levels (M = 3.76, SD = 0.74), suggesting that participants generally perceived telemedicine as improving their ability to obtain care. Similarly, patient satisfaction was relatively high (M = 3.89, SD = 0.68), indicating positive overall evaluations of telemedicine experiences.

POMS values further support these findings, with satisfaction (.72) and access (.69) reflecting moderately high levels of perceived benefit. Among telemedicine modalities, video visits yielded the highest POMS score (.71), followed by audio (.60) and asynchronous messaging (.53), suggesting that synchronous modalities may be perceived as more effective in facilitating access and satisfaction.

Table 4: Descriptive Statistics for Study Variables (N = 200)

Variable	Mean (M)	SD	Min	Max	POMS
Video Visits (Frequency)	3.82	1.02	1	5	.71
Audio Visits (Frequency)	3.41	1.15	1	5	.60
Asynchronous Messaging	3.12	1.21	1	5	.53
Access to Care	3.76	0.74	1.50	5.00	.69
Patient Satisfaction	3.89	0.68	1.75	5.00	.72

Demographic Characteristics

Descriptive statistics were computed to summarize the demographic profile of the participants (N = 200). The sample reflected a diverse group of adult telemedicine users across age, gender, education, and digital literacy levels, consistent with populations typically represented in Health Services Research.

The age distribution was relatively balanced, with the largest proportion of participants aged 25–34 years (24.0%), followed by 35–44 years (22.0%) and 55 years and older (20.0%). Participants aged 18–24 accounted for 16.0% of the sample, while those aged 45–54 comprised 18.0%, indicating representation across younger and older adult groups.

In terms of gender, the sample was slightly majority female (52.0%), with males representing 46.0% and a small proportion identifying as non-binary or other (2.0%). Educational attainment was relatively high, with most participants holding a bachelor’s degree (37.0%) or graduate degree (23.0%), followed by some college (26.0%) and high school or less (14.0%).

Digital literacy levels were predominantly moderate (48.0%) to high (35.0%), with 17.0% of participants reporting low digital literacy. Prior telemedicine experience varied, with 39.0% reporting 3–5 prior uses and 33.0% reporting six or more uses, suggesting that participants had sufficient familiarity with telemedicine to provide informed responses. (See Table 5).

Table 5: Demographic Characteristics of Participants (N = 200)

Variable	Category	n	%
Age	18–24	32	16.0
	25–34	48	24.0
	35–44	44	22.0
	45–54	36	18.0
	55+	40	20.0
Gender	Male	92	46.0
	Female	104	52.0
	Non-binary/Other	4	2.0
Education	High School or Less	28	14.0
	Some College	52	26.0
	Bachelor’s Degree	74	37.0
	Graduate Degree	46	23.0
Digital Literacy	Low	34	17.0
	Moderate	96	48.0
	High	70	35.0
Prior Telemedicine Use	1–2 times	56	28.0
	3–5 times	78	39.0
	6+ times	66	33.0

Spearman’s Rank-Order Correlation Analysis

A Spearman’s rank-order correlation (ρ) was conducted to examine the bivariate relationships among telemedicine delivery modes (video, audio, asynchronous), patient-perceived access to care, and patient satisfaction. This nonparametric approach is appropriate for ordinal data and aligns with practices in Health Services Research. The correlation analysis revealed statistically significant positive relationships among the primary study variables. Video visits were moderately correlated with patient-perceived access to care ($\rho = .41, p < .01$) and patient satisfaction ($\rho = .44, p < .01$), indicating that increased use of video-based telemedicine is associated with more favorable perceptions of both access and satisfaction. (See Table 6).

Table 6: Spearman Correlation Matrix (N = 200)

Variable	1	2	3	4	5
1. Video Visits	—				
2. Audio Visits	.32**	—			
3. Async Messaging	.28**	.35**	—		
4. Access to Care	.41**	.29**	.22*	—	
5. Patient Satisfaction	.44**	.31**	.25**	.47**	—

Note. * $p < .05$, ** $p < .01$

Audio visits also demonstrated significant but weaker correlations with access ($\rho = .29, p < .01$) and satisfaction ($\rho = .31, p < .01$). Similarly, asynchronous messaging showed smaller yet significant associations with access ($\rho = .22, p < .05$) and satisfaction ($\rho = .25, p < .01$), suggesting a more limited but still meaningful relationship.

Patient-perceived access to care was moderately correlated with patient satisfaction ($\rho = .47, p < .01$), providing preliminary support for the hypothesized relationship between these variables and indicating the potential for a mediating effect.

Intercorrelations among telemedicine delivery modes were positive and moderate ($\rho = .28-.35$), suggesting that participants who used one modality were more likely to use others. However, these correlations were below the threshold for multicollinearity concerns, supporting their inclusion in subsequent regression analyses.

Hypotheses Testing

To test the hypotheses, multiple regression analysis was conducted. The results provided preliminary support for the hypothesized relationships and informed the specification of subsequent predictive models.

To address RQ1: *to what extent do telemedicine delivery modes predict patient-perceived access to care*, a rank-based multiple regression analysis was conducted. This approach was appropriate given the ordinal nature of the data and prior evidence of non-normality, consistent with nonparametric practices in Health Services Research.

The regression model predicting patient-perceived access to care was statistically significant, $\chi^2(5) = 28.74, p < .001$, explaining approximately 31% of the variance (Nagelkerke $R^2 = .31$), indicating a moderate effect size. Among the predictors, video visits emerged as the strongest predictor of access to care ($\beta = .36, p < .001$), suggesting that increased use of video-based telemedicine is associated with greater perceived access. Digital literacy also significantly predicted access ($\beta = .22, p = .006$), indicating that individuals with higher technological competence reported better access experiences.

Audio visits demonstrated a smaller but significant effect ($\beta = .18, p = .021$), whereas asynchronous messaging did not significantly predict access ($\beta = .11, p = .094$). Age was not a significant predictor. Accordingly, the null hypothesis ($H1_0$) was rejected. (See Table 7).

Table 7: Rank-Based Regression Predicting Patient-Perceived Access to Care (N = 200)

Predictor	β	SE	p	f^2*
Video Visits	.36	.09	< .001	.14
Audio Visits	.18	.08	.021	.05
Async Messaging	.11	.07	.094	.02
Digital Literacy	.22	.08	.006	.07
Age	-.09	.06	.131	—

Model Fit: $\chi^2(5) = 28.74, p < .001$, Nagelkerke $R^2 = .31$

To address RQ2: *to what extent do telemedicine delivery modes predict patient satisfaction*, a rank-based multiple regression analysis was conducted. The regression model predicting patient satisfaction was statistically significant, $\chi^2(5) = 32.91, p < .001$, explaining approximately 34% of the variance (Nagelkerke $R^2 = .34$), indicating a moderate effect size. Among the predictors, video visits emerged as the strongest predictor of patient satisfaction ($\beta = .39, p < .001$), followed by audio visits ($\beta = .21, p = .009$) and asynchronous messaging ($\beta = .14, p = .041$), all of which demonstrated statistically significant positive effects. Additionally, digital literacy was a significant predictor ($\beta = .19, p = .014$), suggesting that individuals with higher digital competence reported more favorable satisfaction outcomes. Age was not a significant predictor. (See Table 8).

Table 8: Rank-Based Regression Predicting Patient Satisfaction (N = 200)

Predictor	β	SE	p	f^2*
Video Visits	.39	.08	< .001	.16
Audio Visits	.21	.07	.009	.06
Async Messaging	.14	.06	.041	.03
Digital Literacy	.19	.07	.014	.05
Age	-.06	.05	.211	—

Model Fit: $\chi^2(5) = 32.91, p < .001$, Nagelkerke $R^2 = .34$

These findings indicate that telemedicine delivery modes significantly predict patient satisfaction, with synchronous modalities, particularly video visits, exerting the strongest influence. Accordingly, the null hypothesis ($H2_0$) was rejected.

To address RQ3: *whether patient-perceived access to care mediates the relationship between telemedicine delivery modes and patient satisfaction*, a regression-based mediation analysis was conducted using bootstrapped confidence intervals. The mediation analysis revealed a significant indirect effect of telemedicine delivery modes (video visits) on patient satisfaction through patient-perceived access to care ($\beta = .15, p < .001$). The 95% confidence interval did not include zero, indicating that the indirect effect was statistically significant. (see Table 9).

Table 9: Mediation Analysis Results (Bootstrapped, 5,000 Samples; N = 200)

Path	Effect (β)	SE	95% CI	p
Video → Access	.36	.09	[.18, .52]	< .001
Access → Satisfaction	.42	.10	[.21, .61]	< .001
Direct (Video → Satisfaction)	.24	.08	[.08, .40]	.003
Indirect Effect (Video → Access → Satisfaction)	.15	.05	[.06, .27]	< .001

The direct effect of video visits on satisfaction remained significant ($\beta = .24, p = .003$) after accounting for access to care, suggesting partial mediation. This indicates that telemedicine delivery modes influence patient satisfaction both directly and indirectly through their impact on perceived access.

To address RQ4: *to what extent do individual characteristics (e.g., age, gender, education, digital literacy, and prior telemedicine experience) influence patient-perceived access to care and satisfaction*, these variables were included as covariates in the regression models. This approach allows for the assessment of their independent contribution while controlling for telemedicine delivery modes. The analysis of control variables revealed that several individual characteristics significantly influenced patient-perceived outcomes. Digital literacy was a significant predictor of both access to care ($\beta = .22, p = .006$) and patient satisfaction ($\beta = .19, p = .014$), indicating that individuals with higher technological competence reported more favorable telemedicine experiences. (See Table 10).

Table 10: Effects of Control Variables on Access to Care and Patient Satisfaction (N = 200)

Predictor	Access (β)	p	Satisfaction (β)	p
Age	-0.09	.131	-0.06	.211
Gender	0.07	.184	0.08	.162
Education	0.12	.072	0.15	.048*
Digital Literacy	0.22	.006**	0.19	.014*
Prior Telemedicine Experience	0.17	.019*	0.21	.008**

Note. * $p < .05$, ** $p < .01$

Prior telemedicine experience also significantly predicted both access ($\beta = .17, p = .019$) and satisfaction ($\beta = .21, p = .008$), suggesting that familiarity with telemedicine enhances perceptions of both accessibility and quality.

Education level was a significant predictor of patient satisfaction ($\beta = .15, p = .048$), but not access, indicating that individuals with higher education levels may evaluate telemedicine experiences more positively.

In contrast, age and gender were not significant predictors of either access or satisfaction, suggesting that these demographic factors did not substantially influence telemedicine perceptions within this sample.

These findings indicate that individual characteristics, particularly digital literacy and prior telemedicine experience, significantly influence patient-perceived access to care and satisfaction. Accordingly, the null hypothesis (H_0) was rejected.

Moderation Analysis for RQ5

To address RQ5: *whether digital literacy moderates the relationship between telemedicine delivery modes and patient outcomes (access to care and satisfaction)*, a moderation analysis was conducted using interaction terms within a regression framework. This approach allows for the examination of whether the strength of the relationship between telemedicine delivery modes and outcomes varies across levels of digital literacy.

The moderation analysis revealed that digital literacy significantly moderated the relationship between video-based telemedicine and both patient-perceived access to care ($\beta = .14, p = .028$) and patient satisfaction ($\beta = .17, p = .015$). These findings indicate that the positive effects of video visits on access and satisfaction are stronger among individuals with higher levels of digital literacy. (See table 11).

Table 11: Moderation Effects of Digital Literacy on Telemedicine Outcomes (N = 200)

Predictor	Access (β)	<i>p</i>	Satisfaction (β)	<i>p</i>
Video Visits	.30	< .001	.33	< .001
Digital Literacy	.18	.012*	.16	.019*
Video \times Digital Literacy	.14	.028*	.17	.015*
Audio \times Digital Literacy	.09	.084	.11	.062
Async \times Digital Literacy	.06	.141	.08	.118

Note. * $p < .05$

In contrast, the interaction effects for audio and asynchronous modalities were not statistically significant, suggesting that digital literacy does not meaningfully alter the relationship between these modalities and patient outcomes. These results provide partial support for the moderating role of digital literacy. Specifically, digital literacy strengthens the relationship between video-based telemedicine and patient outcomes but does not significantly influence the effects of other modalities. Accordingly, the null hypothesis (H_5) was partially rejected.

V. DISCUSSION

This study examined the extent to which telemedicine delivery modes predict patient-perceived access to care and satisfaction, as well as the mediating role of access and the moderating role of digital literacy. Overall, the findings provide strong support for the proposed conceptual framework and extend existing research within Health Services Research by offering an integrated, modality-specific analysis of telemedicine outcomes.

With respect to RQ1, telemedicine delivery modes significantly predicted patient-perceived access to care, with video visits emerging as the strongest predictor. This finding is consistent with prior research demonstrating that synchronous telemedicine modalities improve accessibility by reducing geographic and logistical barriers (Patel et al., 2023). However, the present study extends the literature by treating telemedicine modalities as distinct predictors, rather than a single construct, thereby providing greater specificity regarding how different delivery modes influence perceived access.

Regarding RQ2, telemedicine delivery modes also significantly predicted patient satisfaction, with video visits again demonstrating the strongest effect. These results align with recent studies indicating higher satisfaction with video-based telemedicine due to improved communication and interaction quality (Doshi et al., 2024; Alshareef et al., 2024). The findings further support the Technology Acceptance Model, suggesting that modalities perceived as more useful and interactive yield more favorable user experiences. Notably, the inclusion of multiple modalities within a single predictive model extends prior work that has largely relied on comparative or descriptive approaches.

In addressing RQ3, the results demonstrated that patient-perceived access to care significantly mediated the relationship between telemedicine delivery modes and satisfaction. This finding provides empirical support for the Donabedian Model by confirming that process-related outcomes (access) serve as mechanisms linking care delivery structures to patient outcomes. While prior studies have suggested a relationship between access and satisfaction (Ezeamii et al., 2024), the present study advances the literature by formally testing this pathway within a unified predictive framework, thereby clarifying the mechanism through which telemedicine influences patient satisfaction.

With respect to RQ4, individual characteristics, particularly digital literacy and prior telemedicine experience, significantly influenced both access and satisfaction. These findings are consistent with literature on the digital divide, which emphasizes the role of technological capability in shaping healthcare access and utilization (Campos-Castillo & Anthony, 2021). The results suggest that telemedicine effectiveness is not solely determined by system design but is also contingent upon user-level factors, reinforcing the need for inclusive and accessible digital health strategies.

Finally, in addressing RQ5, digital literacy was found to significantly moderate the relationship between telemedicine delivery modes and patient outcomes, particularly for video-based modalities. This finding extends the Technology Acceptance Model by demonstrating that user capability not only influences adoption but also conditions the effectiveness of technology use. Specifically, individuals with higher digital literacy derived greater benefits from video-based telemedicine, highlighting the importance of aligning technological complexity with user competence.

Collectively, these findings address a critical gap in the literature by integrating telemedicine delivery modes, patient-perceived access to care, and satisfaction within a single predictive framework. Unlike prior studies that have examined these variables in isolation, the present study demonstrates both direct and indirect relationships, as well as conditional effects, thereby providing a more comprehensive understanding of telemedicine effectiveness. These results contribute to theory by reinforcing and extending established models, while also offering practical implications for optimizing telemedicine delivery in diverse patient populations.

Limitations

This study has several limitations. First, the cross-sectional design limits causal inference, as relationships observed are associative rather than causal. Second, reliance on self-reported data may introduce response bias, including recall and social desirability effects. Third, the use of nonprobability sampling may limit generalizability, particularly to populations with restricted access to digital technologies. Additionally, although key variables such as digital literacy were included, other factors (e.g., socioeconomic status, health status) were not examined and may influence outcomes. Finally, digital literacy was measured using a single item, which may not fully capture its multidimensional nature.

Implications for Practice and Policy

The findings have important implications for healthcare delivery, organizational strategy, and public policy within Health Services Research. First, the consistent advantage of video-based telemedicine suggests that healthcare organizations should prioritize investment in high-quality video infrastructure, including reliable platforms, user-friendly interfaces, and integration with electronic health records. However, given that audio and asynchronous modalities also demonstrated meaningful, albeit smaller, effects, a multimodal telemedicine strategy remains essential to accommodate diverse patient needs and technological capabilities.

Second, the significant role of patient-perceived access to care as a mediating mechanism highlights the importance of designing telemedicine services that explicitly enhance accessibility. Healthcare systems should focus on reducing barriers such as scheduling delays, technological complexity, and connectivity issues. Interventions aimed at improving ease of use, timeliness, and continuity of care are likely to yield downstream improvements in patient satisfaction.

Third, the findings underscore the critical importance of digital literacy and prior experience in shaping telemedicine outcomes. From a practice perspective, providers should implement patient support initiatives, such as digital navigation assistance, onboarding tutorials, and technical support services. From a policy standpoint, these results support the expansion of digital health equity initiatives, including funding for broadband access, community-based digital literacy programs, and targeted outreach to underserved populations. Without such efforts, disparities in telemedicine effectiveness may persist or widen.

Fourth, the moderation effect of digital literacy suggests that more advanced modalities, such as video visits, may disproportionately benefit patients with higher technological competence. Policymakers and healthcare leaders should therefore ensure that less complex alternatives (e.g., audio visits) remain available and reimbursable, particularly for populations with limited digital access or skills. Maintaining flexibility in telehealth reimbursement policies is critical to promoting equitable access.

Finally, the findings support the integration of telemedicine into long-term healthcare delivery models, rather than treating it as a temporary or supplemental service. Healthcare organizations should adopt patient-centered telemedicine frameworks that align modality selection with patient preferences, clinical needs, and technological readiness. Policymakers can facilitate this transition by establishing clear regulatory guidelines, promoting interoperability standards, and incentivizing quality-driven telehealth adoption.

VI. CONCLUSION

This study examined the extent to which telemedicine delivery modes predict patient-perceived access to care and satisfaction, as well as the mediating role of access and the moderating role of digital literacy. The findings provide strong empirical support for a modality-specific and mechanism-based understanding of telemedicine effectiveness.

Telemedicine delivery modes, particularly video-based modalities, were found to significantly predict both access to care and patient satisfaction. Importantly, patient-perceived access to care emerged as a key mediating mechanism, linking telemedicine use to satisfaction outcomes. Additionally, digital literacy and prior telemedicine experience were identified as critical determinants of patient perceptions, with digital literacy further moderating the effectiveness of video-based telemedicine.

These findings contribute to the literature by integrating previously fragmented constructs into a single predictive framework, demonstrating both direct and indirect relationships, as well as conditional effects. The results reinforce established theoretical models while extending them by highlighting the role of user capability in shaping telemedicine outcomes.

From a practical and policy perspective, the study underscores the need for multimodal telemedicine strategies, investments in digital infrastructure, and targeted efforts to enhance digital literacy and equity. Ensuring that telemedicine services are both accessible and usable for diverse populations will be essential for maximizing their impact on healthcare delivery.

In conclusion, telemedicine represents a transformative approach to healthcare delivery, but its effectiveness is contingent upon both system design and user capability. Future research should continue to explore modality-specific effects, longitudinal outcomes, and strategies for reducing disparities, thereby advancing a more inclusive and effective telehealth ecosystem.

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